ASIAN WATER DEVELOPMENT OUTLOOK 2025

THE INDEX OF WATER SECURITY FOR ASIA AND THE PACIFIC

ASIAN DEVELOPMENT BANK

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ADB placed its regular assistance to Afghanistan on hold effective 15 August 2021.
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Village woman collecting drinking water from an Arsenic Free Tubewell, Narail (Photo by ADB).

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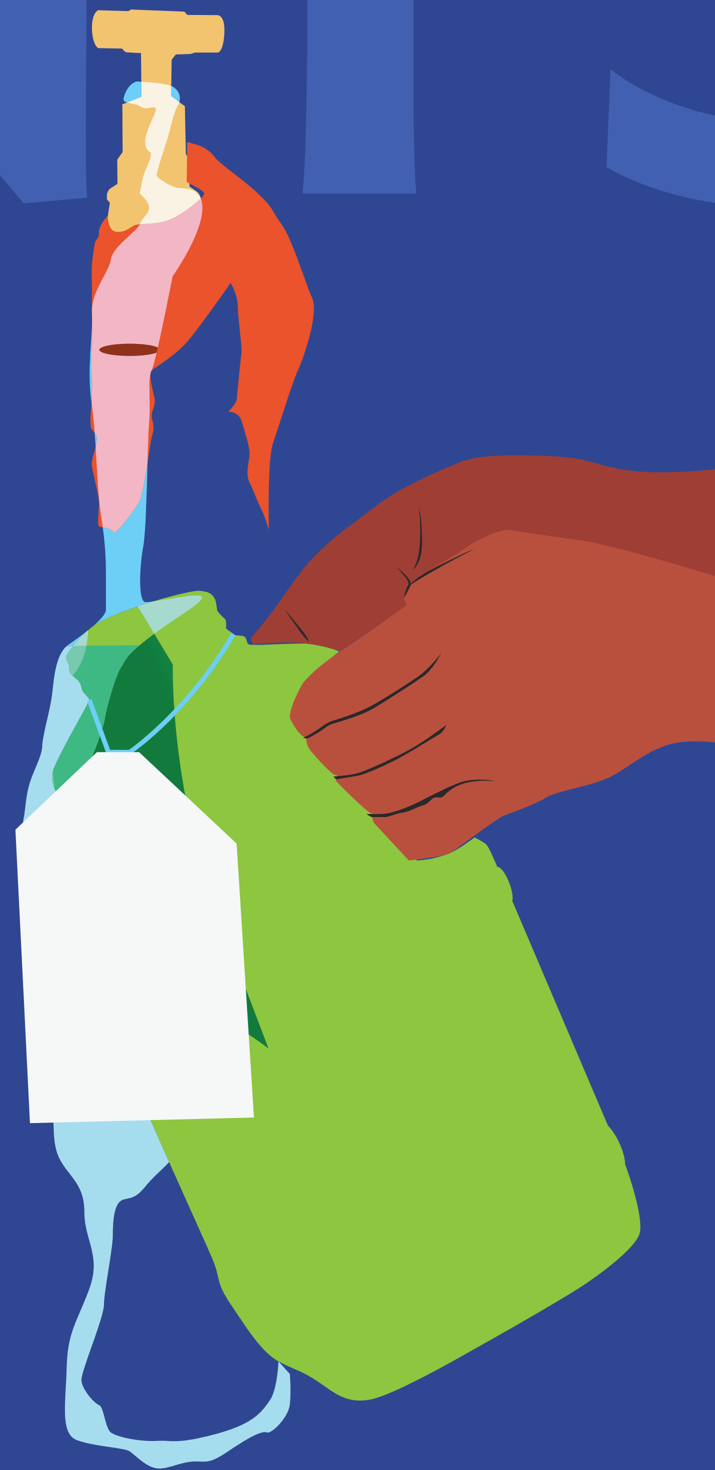

Tables, Figures, and Boxes

Tables

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Abbreviations

ADB	Asian Development Bank
APEC	Asia-Pacific Economic Cooperation
AWDO	Asian Water Development Outlook
BMDA	Barind Multipurpose Development Authority
BWDB	Bangladesh Water Development Board
CASCI	Catchment and Aquatic System Condition Index
COP	Conference of the Parties, Under the UN Framework Convention on Climate Change
CPS	Country Partnership Strategy
DALY	Disability-Adjusted Life Years
DMC	Developing Member Country
DRI	Disaster Resilience Index
DRR	Disaster Risk Reduction
EGI	Environmental Governance Index
EPI	Environmental Performance Index
Eta	Evapotranspiration (actual)
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	Food and Agriculture Organization Statistical Database
GBD	Global Burden of Disease
GDP	Gross Domestic Product
GLAAS	Global Analysis and Assessment of Sanitation and Drinking Water
GLOF	Glacial Lake Outburst Flood
GWP	Global Water Partnership
HDI	Human Development Index
HKH	Hindu Kush Himalaya
ICHARM	International Centre for Water Hazard and Risk Management
IRSA	Indus River System Authority
IWC	International Water Centre
IWISE	Individual Water Insecurity Experiences
IWRM	Integrated Water Resources Management
KD	Key Dimension
MDB	Multilateral Development Bank
MDG	Millennium Development Goal

MW	Megawatt
NAP	National Adaptation Plan
NDC	Nationally Determined Contribution
NDMA	National Disaster Management Authority
NTT	Nusa Tenggara Timur (East Nusa Tenggara, Indonesia)
NWP	National Water Policy
NWS	National Water Security
NWSI	National Water Security Index
OECD	Organisation for Economic Co-Operation and Development
PCR-GLOBWB	Pcraster Global Water Balance – A Global Hydrological Model
PCRWR	Pakistan Council of Research In Water Resources
PRC	People's Republic of China
SDG 6.4.2	Sustainable Development Goal Indicator 6.4.2 on Water Stress
SDG	Sustainable Development Goal
SIDS	Small Island Developing States
SPC	South Pacific Commission (now the Pacific Community)
SPI	Standardized Precipitation Index
SSEBop Eta	Simplified Surface Energy Balance Operational Actual Evapotranspiration
UK	United Kingdom
UN	United Nations
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
WASH	Water, Sanitation, and Hygiene
WECS	Water and Energy Commission Secretariat
WSSTFC	Water Supply and Sanitation Tariff Fixation Commission

Glossary

Term	Definition
Access to Services	The proportion of the population with access to safe and reliable water supply, improved sanitation, and basic hygiene services.
Adaptation Gaps	Shortcomings in policies, finance, or institutions that prevent effective climate adaptation and disaster preparedness.
Aquastat	FAO's global water information system providing data on water resources, uses, and agricultural practices.
Back casting	A method that re-estimates past data using updated methodologies to ensure consistency over time in trend analysis.
Basic Water Supply	Refers to access to improved sources of drinking water (e.g., piped supply, protected wells, boreholes) that are available within a reasonable distance and provide safe water for daily needs.
Capacity (Institutional/Community)	The ability of governments and communities to plan, finance, and implement disaster risk reduction and climate adaptation measures. A key sub-indicator for KD5.
CASCI (Catchment and Aquatic System Condition Index)	An index measuring the ecological condition of fresh water systems, capturing pressures such as hydrological alteration, pollution, and habitat loss.
Climate Hazards	Weather- and climate-related events such as floods, droughts, storms, and sea-level rise that impact water security and human well-being.
Climate Resilience (of WASH)	The ability of rural WASH systems to withstand and adapt to climate-related stresses, such as droughts, floods, and water scarcity, often assessed through National Adaptation Plans (NAPs).
Climate Resilience of Rural WASH	Existence and integration of rural WASH measures within a country's National Adaptation Plan (NAP) or equivalent climate policy frameworks; scored based on evidence of rural WASH inclusion in adaptation policies and plans.
Disaster Risk Reduction (DRR)	A systematic approach to identifying, assessing, and reducing disaster risks, focusing on prevention and preparedness rather than response.
Early-Warning Systems	Mechanisms to detect, forecast, and communicate hazard information to enable timely action and reduce disaster losses.
Economic Resilience	The capacity of an economy to withstand and recover from water-related shocks while maintaining stability and growth.
Energy Security	Reliable access to affordable energy sources; in KD2, this includes the role of water in energy generation and access.
ETa (Actual Evapotranspiration)	The total amount of water that is transferred from land to the atmosphere by evaporation and plant transpiration.
EGI (Environmental Governance Index)	An index assessing the effectiveness of national policies, regulations, and institutions in managing and protecting fresh water ecosystems.
FAOSTAT	Statistical database maintained by the Food and Agriculture Organization (FAO), providing food and agriculture data for over 245 countries and territories.
FCCB (Forests, Climate Change, and Biodiversity Programme)	An EU-funded program referenced in KD4, supporting environmental protection and climate resilience.

Term	Definition
Floods	Overflow of water onto normally dry land, caused by intense rainfall, river overflow, storm surges, or dam failure. A core hazard tracked in KD5.
Freshwater Systems	Rivers, lakes, wetlands, and aquifers that provide ecological services, water supply, and habitat for biodiversity.
GDP (Gross Domestic Product)	The total market value of all final goods and services produced within a country in a specific time period.
Glacial Lake Outburst Floods (GLOFs)	Sudden releases of water from glacial lakes, triggered by ice or moraine dam failure. Increasingly common in the Hindu Kush Himalaya due to glacier retreat.
Governance Frameworks	National or local laws, policies, and institutional arrangements that regulate water management and ecosystem protection.
Green Infrastructure	Urban water management approaches that use natural systems (wetlands, permeable pavements, urban forests) to manage stormwater and reduce flooding.
Groundwater Depletion	The long-term decline of groundwater levels due to excessive extraction beyond natural recharge rates.
Hazard Exposure	The degree to which populations and assets are at risk from floods, storms, droughts, and other hazards.
Health Outcomes (Diarrheal Disease Burden)	Number of deaths and Disability-Adjusted Life Years (DALYs) lost due to diarrheal diseases attributable to unsafe water, sanitation, and hygiene in rural populations.
Hindu Kush Himalaya (HKH)	Mountain range spanning multiple Asian countries, where glacier retreat poses significant long-term risks for water and disaster security.
Hygiene Facilities	The availability of basic handwashing facilities with soap and water at home, considered essential for reducing disease transmission.
Hydrological Alteration	Modification of natural water flows caused by dams, diversions, withdrawals, or climate variability.
Industrial Security	Assesses water use and productivity in industrial sectors. Includes indicators for industrial output per water unit, self-sufficiency, and industrial output per capita.
Integrated Urban Water Management (IUWM)	An approach that coordinates the management of water supply, sanitation, stormwater, and wastewater in urban areas to maximize efficiency, sustainability, and resilience.
Improved Sanitation	Sanitation facilities that hygienically separate human excreta from human contact, such as flush/pour-flush toilets connected to sewer systems or septic tanks, and ventilated improved pit latrines.
KD1: Rural Household Water Security	Rural household use of accessible, reliable, and safe water, sanitation, and hygiene (WASH) services, which contribute to reducing the burden from diarrheal diseases, where services are supported to adapt to future climate. It is measured by a composite score out of 20.
KD2: Economic Water Security	The assurance of adequate and reliable water to sustain economic growth and reduce vulnerability to water-related disruptions. It is measured by a composite score out of 20.
KD3: Urban Water Security	The extent to which countries are providing safely managed and inclusive water and sanitation services and drainage for their urban communities, while maintaining environmental water security. It is measured by a composite score out of 20.
KD4: Environmental Water Security	The environmental water security indicator assesses the health of rivers, wetlands, and groundwater systems and measures progress on restoring aquatic ecosystems to health on a national and regional scale. It is measured by a composite score out of 20.

Term	Definition
KD5: Water-Related Disaster Security	The extent to which populations are protected from water-related disasters, reflecting their ability to withstand, manage, and recover from water-related risks, including floods, drought, and storms. It is measured by a composite score out of 20.
Nutrient Security	Adequacy of national per capita food supply in terms of dietary energy, protein, and micronutrients.
ND (No Data)	Denotes countries or years where reliable data is unavailable for a particular indicator or sub-indicator.
National Adaptation Plans (NAPs)	Formal adaptation strategies submitted under the UNFCCC, indicating how countries plan to manage long-term climate risks. Used as a KD5 indicator of institutional preparedness.
Per Capita Investment	Investment in infrastructure or services calculated on a per person basis, often used in comparing national capacities.
PCR-GLOBWB	A global hydrological model used to simulate water availability, demand, and drought indices at high spatial resolution.
PLOS (Public Library of Science)	A peer-reviewed open-access scientific publisher cited in KD4 references.
REACH	Research Program on Improving Water Security for the Poor
Remote Sensing	The use of satellite-derived data to measure variables such as evapotranspiration or cropland area, especially where on-the-ground data is lacking.
Riparian Vegetation	Plant life along riverbanks that stabilizes soil, filters pollutants, and provides habitat for aquatic and terrestrial species.
River Connectivity	The natural linkages within and between rivers, floodplains, and wetlands that support ecological processes and biodiversity.
Safely Managed Services	An SDG 6.1/6.2 indicator referring to water and sanitation services that are improved, located on premises, available when needed, and free from contamination.
Sea-Level Rise	Gradual increase in global sea levels due to climate change, threatening coastal and low-lying areas with flooding, erosion, and salinization.
Self-Sufficiency	The extent to which a country meets its own demand in food, energy, or industrial goods without relying excessively on imports.
Service Quality	Goes beyond infrastructure coverage to include safety, reliability, affordability, and sustained functionality of WASH services.
Small Island Developing States (SIDS)	A group of countries facing unique development challenges due to their size, isolation, and exposure to climate risks.
Social Cohesion	The level of trust, cooperation, and inclusion within communities that enhances disaster preparedness and response. A critical factor influencing KD5 outcomes.
SSEBop ETa	Simplified Surface Energy Balance Operational Actual Evapotranspiration. A remote sensing model used to estimate agricultural water use.
SDG 6.4.2	A global indicator under the UN Sustainable Development Goals measuring water stress levels by comparing withdrawals to available resources.
Storage Capacity	The ability of a country to store water (e.g., dams, reservoirs) to mitigate seasonal and drought-related variability.
Storms (Cyclones, Typhoons, Hurricanes)	Severe tropical weather systems producing strong winds, rainfall, and storm surges, affecting millions across Asia and the Pacific.

Term	Definition
UNOPS (United Nations Office for Project Services)	A UN agency supporting infrastructure, environmental, and development projects.
Urban Resilience	The ability of urban water systems (supply, sanitation, drainage) to withstand and recover from shocks such as droughts, floods, pollution events, or infrastructure failures.
Water, Sanitation, and Hygiene (WASH)	A collective term referring to the provision of safe water supply, adequate sanitation facilities, and hygiene practices such as handwashing with soap.
Wastewater Treatment	Percentage of wastewater collected through sewer networks that is safely treated before discharge.
Water–Energy Nexus	The interdependence between water and energy systems, where water is needed for energy production and energy is needed for water treatment and distribution.
Water Productivity	Economic output or energy/crop production per unit of water used.
Water Quality	Refers to the safety of drinking water in terms of compliance with microbial and chemical standards (e.g., free from fecal coliforms, arsenic, fluoride).
Water Service Reliability	The extent to which water supply is continuous, safe, and sufficient to meet household needs without frequent interruptions or shortages.
Water Stress	The ratio of total water withdrawals to available renewable supply, indicating pressure on water resources.

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Sectors and Themes

Asian Development Bank

The Asian Water Development Outlook (AWDO) 2025 comes at a pivotal moment for Asia and the Pacific, where resource scarcity, inequality and climate risks increasingly influence prospects for sustainable growth. In this complex landscape, water security stands as a strategic foundation for health, food, ecosystems, cities and economies. Water security is essential for resilience, prosperity, and regional stability. Yet climate extremes, weak governance and financing gaps continue to undermine water security progress, with vulnerable populations most affected.

The Asian Development Bank (ADB) is scaling up action to address these challenges by mobilizing investvment, supporting innovation, and strengthening partnerships.

Recent initiatives, including a $40 billion food systems transformation plan, a $150 million Natural Capital Fund, and expanded private sector financing to $13 billion by 2030, underscore water's central role in advancing climate resilience, economic integration, and inclusive development.

AWDO 2025 provides updated national water security assessments for 50 economies, along with new insights on rural water, sanitation, and hygiene (WASH) services, adaptation planning, governance and data systems. It offers policymakers and development partners a clearer, more holistic understanding of water security across the region.

AWDO 2025 delivers a clear message: building infrastructure is not enough. What matters is whether systems are resilient, equitable, and effectively governed. These insights are directly shaping how ADB delivers its commitments, particularly in advancing climate action, private sector solutions, and regional cooperation.

Water is not only a basic human right but also a foundation of sustainable growth. ADB remains committed to working with governments, communities and partners to turn the insights of AWDO 2025 into progress toward a more water-secure and resilient Asia and the Pacific.

F. Cleo Kawawaki

Director General

Sectors Department 2

Asian Development Bank

Across Asia and the Pacific, water systems are under growing pressure. Climate extremes, rapid urbanization, shifting rural demands, and persistent service gaps are converging to test the limits of existing infrastructure. The lesson across the region is clear: accelerating water resilience requires more than traditional approaches.

Success hinges on scaling nature-based solutions, embracing digital innovation, strengthening inclusive governance, and developing sustainable financing mechanisms at both national and local levels. Expanding subnational finance and empowering cities as front line service providers are especially vital to building climate-smart water systems.

These priorities are at the heart of the AWDO 2025. The report reinforces what we see across ADB's operations: in water, urban transformation, agriculture and food, natural resources, rural development and the digital economy. The future of these interconnected sectors depends on our ability to deliver integrated, resilient, and locally grounded water solutions.

AWDO 2025 sheds light on the mounting pressures of economic water security driven by rapid urbanization, changing consumption patterns that strain food systems, the depletion of natural resources, and escalating climate risks.

It underscores the urgent need for coordinated responses across sectors. While infrastructure investments have expanded, they have not consistently translated into better health or climate outcomes. This presents an opportunity to reevaluate our strategies.

The report offers evidence-based analysis on the region's progress in advancing nature-positive watershed investments, digitally enabled WASH systems, and community-led solutions that empower women, youth, and vulnerable groups. Inclusion, as the report makes clear, is not peripheral: it is central to achieving lasting impact.

Our ambition is for governments, utilities, local authorities, civil society, and private sector partners to use AWDO 2025 as a common platform for action. Together, we can turn evidence into investment—and investment into long-term impact.

Norio Saito

Senior Director

Water and Urban Development Sector Office

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Urban water security is becoming increasingly critical across Asia and the Pacific. As of 2024, more than half of the global population lived in urban areas. This number is projected to rise to 68% by 2050. Cities in Asia and the Pacific are urbanizing rapidly, with urban populations growing at an average rate of 1.8% annually between 2017 and 2023.

AWDO 2025 provides timely insights into this shifting landscape. While service delivery has improved in many cities, especially in East and Southeast Asia, major challenges remain. Aging infrastructure continues to constrain operations and maintenance in many countries, and climate shocks threaten to reverse hard-won gains. The report draws attention to an escalating threat: urban flooding exacerbated by the changing climate, particularly in rapidly developing parts of Southeast Asia where drainage remains a concern.

These challenges demand a fundamental rethink on how cities and urban communities design, deliver, and govern water and sanitation services amid escalating climate risks, demographic change, rising energy costs, and persistent service gaps. Expanding coverage is important, but ensuring reliability and resilience is what ultimately protects people and sustains growth. This calls for a sharper focus on outcomes measured not in kilometers of pipes laid, but in lives improved, inequalities reduced, and resilience strengthened.

To address water-related disaster risk exacerbated by climate change, cities will need to adopt forward-looking solutions. These include energy-efficient technologies, decentralized treatment and reuse systems, stormwater harvesting, and upgraded drainage infrastructure – all essential for building climate-smart urban services.

At ADB's Water and Urban Development Sector Office, our investments are designed not only to expand infrastructure but also to strengthen governance and policies, facilitate innovation, harness digital tools, and build local capacity. These integrated approaches, which are central to AWDO 2025, are vital to ensuring that investments are technically sound, inclusive and sustainable over the long term.

I am grateful to our ADB team, partner institutions, contributors, and peer reviewers for producing this report. I look forward to partnering with ADB members and stakeholders to translate these insights into lasting, transformative action.

Qingfeng Zhang

Senior Director

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Asian Development Bank

Water is life—for people, ecosystems, and food systems. AWDO 2025 makes this truth unmistakably clear. Through compelling, data-driven analysis, the report underscores that rural household water security is foundational to human health, agricultural productivity, and climate resilience.

AWDO 2025 emphasizes the urgent need to prioritize environmental water security. Unchecked development and resource overuse are degrading habitats and reducing water flows, disrupting ecological balance. For agriculture, this means accelerating water-efficient irrigation, integrated watershed management, and sustainable land use. Addressing these challenges requires coordinated action across sectors to protect fresh water ecosystems, safeguard biodiversity, and ensure long-term resilience for food systems.

AWDO 2025 also documents significant gains in expanding access to rural water supply and sanitation across the region. Access to piped water has increased since 2013, now reaching 42% of the rural population in 2025–approximately 800 million people. Yet many of these systems still fall short in delivering safe or reliable services. Rural communities remain exposed to climate shocks, economic instability, and health risks. This report redefines rural water security as more than infrastructure – it is about safe, accessible, and climate-adaptive WASH services that reduce health risks and ensure long term sustainability. Over half of the economies with robust infrastructure continue to report poor health indicators, often due to inadequate service quality and lack of hygiene facilities in schools and health centers. AWDO 2025's new resilience scoring emphasizes that infrastructure alone is not enough. Service quality, governance, and equity are equally critical to achieving meaningful outcomes.

These findings resonate with ADB's broader rural agenda. Through our $14 billion food security program, we are scaling up climate-resilient irrigation, promoting nature-positive agricultural practices, expanding clean energy access for water supply, and strengthening inclusive governance to empower rural communities to adapt and thrive.

I commend the AWDO team for this vital and timely contribution. At ADB, we remain committed to turning these insights into practical investments that secure water for food, ecosystems, and resilient livelihoods across Asia and the Pacific.

Executive Summary

Since its first edition in 2007, the *Asian Water Development Outlook (AWDO)* has become the index of water security in Asia and the Pacific, highlighting key water management challenges across the region. Over nearly 2 decades, it has evolved into a flagship water knowledge product of the Asian Development Bank (ADB), offering a shared evidence base to support water-related planning, investment, and reform.

ADB published 2007, 2013, 2016, and 2020 AWDO editions, each building on the previous edition to provide snapshots of Asia and the Pacific economies' water security status.

AWDO provides a shared foundation for better decision-making. AWDO assesses water security in 50 economies, using a multidimensional framework refined over nearly 2 decades. The broad framing of water security supports national and regional progress toward sustainable and resilient development.

AWDO has a unique position in the region. Its balance of consistency and innovation enables it to track long-term trends while responding to emerging issues. In addition to its technical design strength, AWDO has fostered lasting partnerships that enhance its sustainability.

Partnerships are the engine of AWDO. While ADB leads the series, AWDO has always been a joint effort. From the outset, external partners have contributed technical expertise and financial support, shaping both the methodology and the relevance of the assessment as a decision-support tool. In this edition, ADB partnered with the University of Oxford, the International Water Management Institute (IWMI), the International WaterCentre (IWC), Griffith University, the University of Queensland, IHE-Delft, the International Centre for Water Hazard and Risk Management (ICHARM), and the Global Water Partnership (GWP).
AWDO assesses water security across five Key Dimensions (KDs), which together provide a holistic picture of how water supports people, economies, cities, ecosystems, and disaster resilience. The methodology of these dimensions has been refined over successive editions and reflects evolving water challenges in the region. Each KD draws on a distinct set of indicators, comprising the national water security score. The five KDs are:

KD1 **Rural Household Water Security**
– access to safe and inclusive drinking water and sanitation in rural areas

KD2 **Economic Water Security**
– water for agriculture, energy, and industry to support economic productivity

KD3 **Urban Water Security**
– safe, inclusive, and reliable water and sanitation services in urban settings

KD4 **Environmental Water Security**
– protection and restoration of aquatic ecosystems and water-related biodiversity

KD5 **Water-Related Disaster Security**
– capacity to manage and reduce risks from floods, droughts, and storms

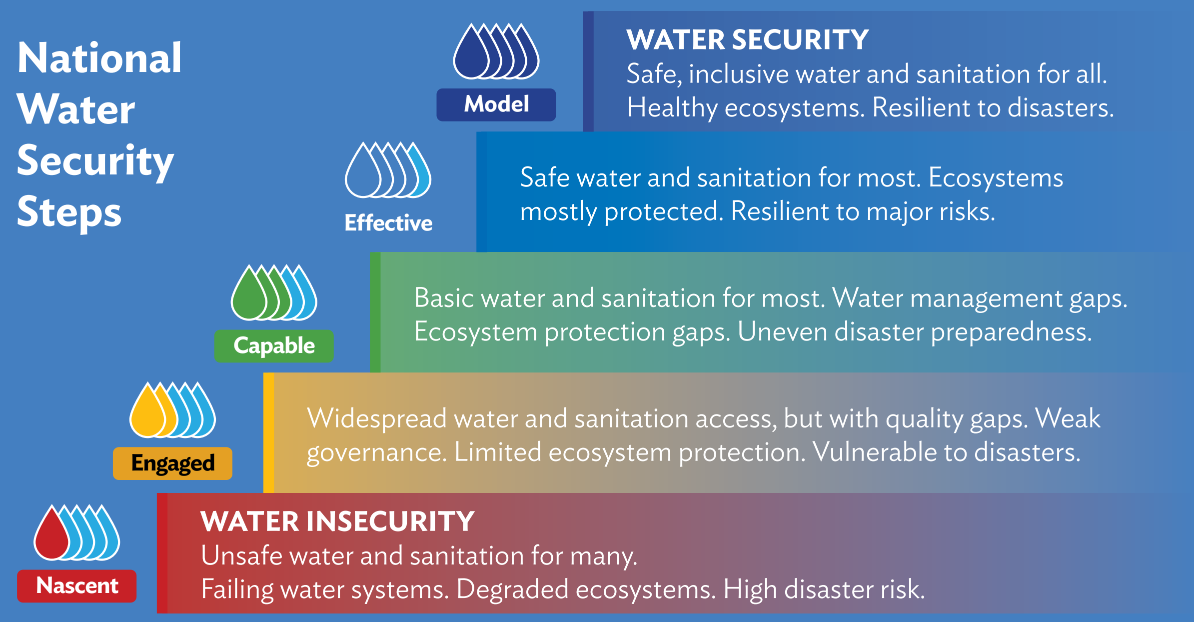
The five KDs are assessed using public datasets and composite indicators, generating both KD-specific and national water security scores. These are grouped into bands ranging from *Nascent* to *Model* steps, allowing economies to benchmark progress.

How AWDO Figures Were Calculated

Each KD is scored out of 20, then grouped into one of five water security steps: *Model, Effective, Capable, Engaged,* or *Nascent* (Figure E1). An economy's national water security (NWS) rating reflects its most insecure KD. For example, if an economy is *Capable* in three KDs, *Model* in one, and *Engaged* in another, its NWS rating would be *Engaged*. This approach highlights the areas most in need of attention. A National Water Security Index (NWSI) score, out of 100, is also calculated by adding each of the five KD scores.

AWDO 2025 continues a process of methodological improvement. This edition strengthens the underlying quantitative approach while integrating deeper qualitative analysis. It draws on publicly available datasets

Figure E1. Water Security Steps



Source: ADB.

and composite indicators to produce scores by dimension and for overall national water security. However, AWDO cautions against overinterpreting single scores, especially in a region as diverse as Asia and the Pacific.

Comparisons between economies can often be misleading. Data quality and coverage vary widely, especially in smaller or more remote economies. Country size, governance arrangements, and resource conditions also influence how relevant certain indicators are. A low or high score may reflect these structural features rather than actual water security conditions. For this reason, AWDO 2025 prioritizes tracking change within each economy rather than making direct international comparisons. This approach promotes a more honest and constructive understanding of progress, while helping to align analysis with national realities and policy processes.

Together, these design choices make AWDO 2025 not just a snapshot of regional water security, but a tool for understanding where and why change is happening.

Beyond the numbers, AWDO 2025 expands its value through new thematic chapters and country assessments. These additions unpack headline scores and offer context-specific insights to guide action. For extended information on the methodology, please refer to the AWDO 2025 Methodology and Data Report.

The four thematic chapters in AWDO 2025 are:

1. **Water Investment Needs in Asia and the Pacific**
2. **Changes to the State of the Cryosphere and the Impacts on Water Security**
3. **Unseen Impacts: Gendered Dimensions of Heat and Water Stress**
4. **Water Governance for Enhanced Water Security in the Context of SDG 6**

Boxes on youth and water security and women and girls are included throughout the report to highlight important crosscutting issues.

These additions make AWDO 2025 not only a more rigorous assessment tool but also a more practical guide for national planning, investment, and reform.

Country assessments were completed for Bangladesh, Cambodia, Nepal, Pakistan, and Tajikistan, providing deeper analysis of trends and governance progress. A special study on the Pacific was also included, reflecting the region's unique context and data challenges.

AWDO 2025 National Water Security Index: Quantitative Findings Across Key Dimensions

KEY FINDING 1

2.7 billion people in Asia and the Pacific have been lifted from extreme water insecurity over the past 12 years.

Addressing weakest water security dimensions first.

Substantial improvements in rural household water security.

Directing resources toward areas of greatest need rather than spreading efforts thinly.

Most countries are addressing their weakest water security dimensions first and it is working. This dramatic improvement shows that countries and development partners are increasingly directing resources toward their areas of greatest need. Rather than spreading efforts thinly, most have focused on improving their weakest dimensions, whether that is rural services (KD1), environmental governance (KD4), or disaster risk (KD5).

The National Water Security Index (NWSI) increased across the region during each reporting period, from 2013–2016, 2016–2020, and 2020–2025. The top 10 most improved countries are shown in Figure E3.

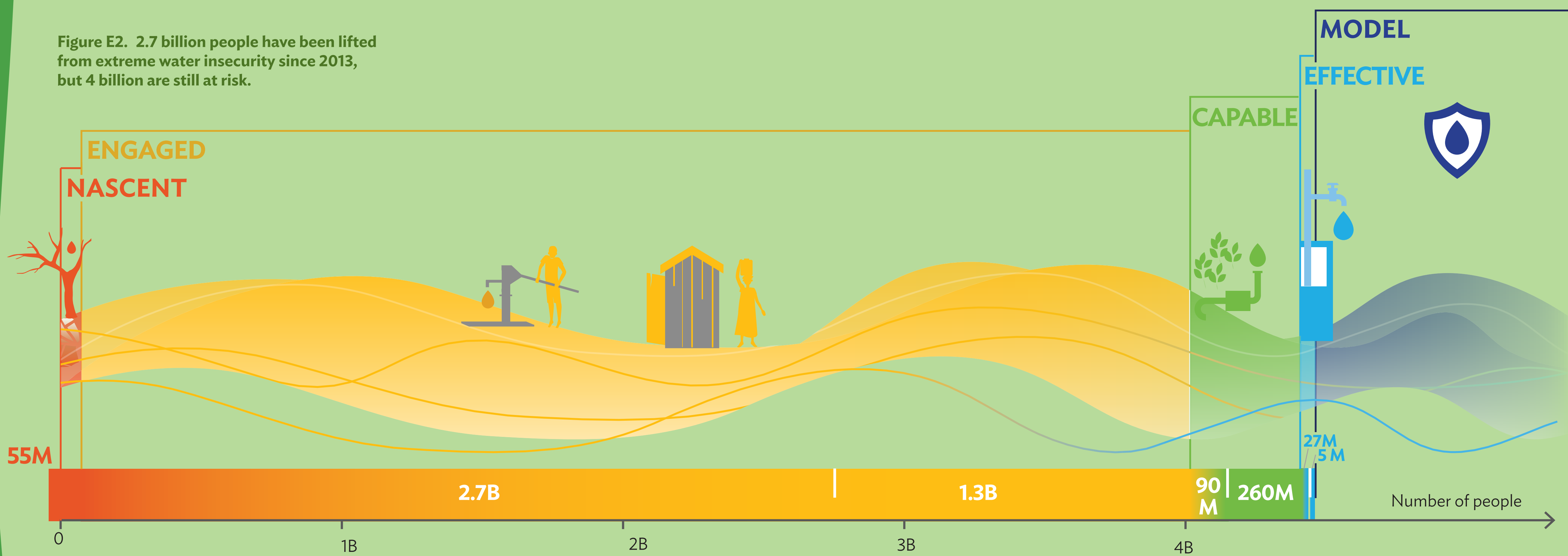
Yet, because this improvement started from a low base for most of these countries, much work remains before everyone in the region can be considered water secure. There are 4 billion people living in economies that still face quality gaps, insufficient ecosystem protection, or vulnerability to natural hazards despite having widespread water and sanitation access. Intensifying climate threats risk undermining progress.

Most of these gains came from substantial improvements in rural household water security. India's gains in rural water security (KD1) are a major contributor to the overall water security improvement in the Asia and Pacific region. In 2020, India was classified as *Nascent* in rural water security, but in 2025, it has moved out of this category, lifting hundreds of millions of people out of the lowest service tier (Figure E2). Political commitment, targeted investments, and scaled service delivery reforms have played a key role.

4 billion people still face quality gaps, insufficient ecosystem protection, or vulnerability to natural hazards.

A lady farmer in Nepal (Photo by ADB).

Figure E2. 2.7 billion people have been lifted from extreme water insecurity since 2013, but 4 billion are still at risk.



Number of people in Nascent step in 2025

Number of people moving up from Nascent step in 2013 to Engaged step in 2025

Number of people remaining in Engaged step in 2025

Number of people moving up from Engaged step in 2013 to Capable step in 2025

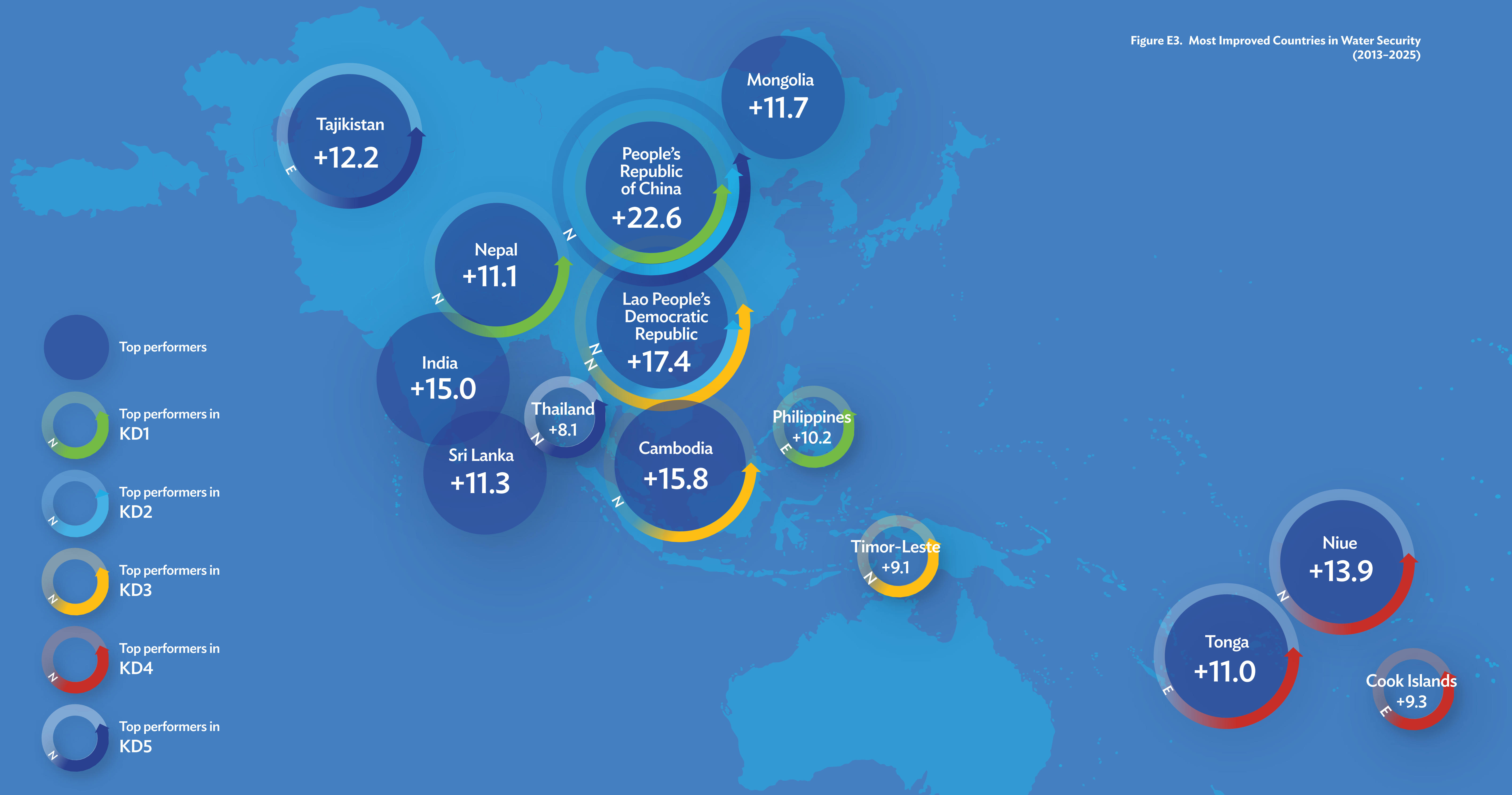
Number of people remaining in Capable step in 2025

Number of people moving up from Capable step in 2013 to Effective step in 2025

Number of people remaining in Effective step in 2025

B = billion, M = million, .
Source: ADB.

Figure E3. Most Improved Countries in Water Security (2013–2025)



E = Engaged in 2013, KD = Key Dimension, KD1 = rural household water security, KD2 = economic water security, KD3 = urban water security, KD4 = environmental water security, KD5 = water-related disaster security,
N = Nascent in 2013,
Refer to the Pacific Regional Study for more details on AWDO data for the Pacific.
Source: ADB.

Gains have not been limited to countries that previously struggled with extreme water insecurity. Aggregate water security has also steadily improved.

Bangladesh has improved economic water security. Viet Nam has advanced urban water security through integrated planning and resilience measures. The Philippines has made inclusivity a priority in its urban utilities, protecting access for low-income users. These cases demonstrate that water security is not determined solely by a country's income or natural endowment. It is shaped by policy choices, institutional capacity, and commitment to long-term planning.

AWDO 2025 confirms that meaningful progress is achievable. When efforts are data-driven and targeted toward the highest risks, real change is possible. This observation has implications for both country-level programming and development partner strategies. The goal need not be perfection across all indicators. Strategies should focus on closing the gap between the least and most secure elements of an economy's water system. Table E1 shows all the NWSI changes from 2013 to 2025.

Table E1. National Water Security Index Score Changes (2013–2025)

	Key Dimensions of Water Security					NWSI
	Rural Household	Economic	Urban	Environment	Disaster	NWSI
Economy	*Index 1–20*					*Out of 100*
Armenia	2.2	−0.1	−0.4	−1.4	1.6	**1.9**
Australia	–	0.3	0.4	0.8	0.6	**2.2**
Azerbaijan	3.4	−1.1	5.4	0.6	1.8	**10.1**
Bangladesh	2.1	2.8	1.7	0.0	2.1	**8.6**
Bhutan	4.0	1.9	3.3	−1.4	1.4	**9.2**
Brunei Darussalam	0.3	0.2	3.2	−0.2	1.3	**4.8**
Cambodia	3.0	−0.9	8.3	0.2	5.1	**15.8**
China, People's Republic of	5.6	4.1	3.3	0.6	9.0	**22.6**
Cook Islands	−1.1	2.7	0.0	4.5	3.2	**9.3**
Fiji	2.2	0.8	−0.8	−1.7	0.4	**0.8**
Georgia	3.0	1.3	1.3	0.3	−1.4	**4.5**
Hong Kong, China	–	0.5	0.0	−0.3	2.0	**2.2**
India	4.6	2.2	5.0	0.6	2.6	**15.0**
Indonesia	3.4	1.0	2.9	0.0	−0.2	**7.2**
Japan	–	0.0	0.0	0.7	0.9	**1.6**
Kazakhstan	2.0	0.7	0.0	1.5	0.3	**4.6**
Kiribati	2.7	2.8	1.7	0.0	0.9	**8.0**
Korea, Republic of	–	0.2	0.4	−0.2	1.5	**1.9**
Kyrgyz Republic	3.7	−0.5	1.7	−0.9	3.8	**7.8**
Lao People's Democratic Republic	4.4	4.3	9.2	0.5	−0.9	**17.4**

Economy	Key Dimensions of Water Security					NWSI
	Rural Household	Economic	Urban	Environment	Disaster	NWSI
	Index 1–20					*Out of 100*
Malaysia	−0.1	0.6	0.0	0.9	0.3	**1.6**
Maldives	1.7	2.2	0.0	0.0	0.1	**3.9**
Marshall Islands	2.9	2.3	−0.4	−0.5	−4.8	**−0.5**
Micronesia, Federated States of	1.0	−1.3	3.3	−2.7	−3.6	**−3.3**
Mongolia	3.3	1.1	5.0	0.6	1.8	**11.7**
Myanmar	1.4	1.7	2.9	−1.4	0.4	**4.9**
Nauru	–	1.4	0.0	−2.5	0.4	**−0.7**
Nepal	5.5	0.3	3.3	0.8	1.2	**11.1**
New Zealand	–	−0.2	−0.8	−1.9	0.9	**−1.9**
Niue	0.4	4.7	0.0	4.4	4.5	**13.9**
Pakistan	3.5	0.9	1.7	−0.4	0.8	**6.4**
Palau	−0.1	0.7	−0.4	1.5	−4.4	**−2.7**
Papua New Guinea	2.0	2.0	0.0	1.5	1.1	**6.6**
Philippines	5.4	0.0	3.3	−1.1	2.6	**10.2**
Samoa	1.7	2.4	5.4	−0.1	0.5	**9.9**
Singapore	–	0.8	0.0	0.2	0.3	**1.3**
Solomon Islands	−0.2	0.8	−0.4	−1.7	1.2	**−0.3**
Sri Lanka	1.7	1.9	3.3	0.8	3.6	**11.3**
Taipei,China	–	−0.4	0.0	−0.9	1.1	**−0.2**
Tajikistan	1.9	1.5	1.7	−0.2	7.4	**12.2**
Thailand	0.9	0.6	0.0	−0.5	7.1	**8.1**
Timor-Leste	4.3	0.4	6.3	−0.9	−1.0	**9.1**
Tonga	0.8	3.5	1.7	5.5	−0.6	**11.0**
Türkiye	2.0	0.9	2.1	0.0	0.7	**5.6**
Turkmenistan	3.9	2.4	1.8	−0.9	0.3	**7.5**
Tuvalu	2.3	4.7	−0.4	0.0	−7.3	**−0.7**
Uzbekistan	3.9	1.7	0.0	0.0	0.5	**6.1**
Vanuatu	0.2	2.8	−0.4	−0.4	1.1	**3.2**
Viet Nam	3.4	1.9	3.3	−2.3	3.7	**10.0**

NWSI = Water Security Index.
Note: Experts have not been able to verify the data on Afghanistan, and therefore, the scores will not be presented in this table.
Source: ADB.

2 KEY FINDING

Asia and the Pacific face an estimated $4 trillion investment need in WASH by 2040.

The challenge is not only the scale of investment, but whether finance reaches the right projects and people.

Asia and the Pacific face a defining challenge: the urgent need to bridge a persistent and widening gap in water investment. The region must mobilize an estimated $4 trillion to meet its WASH needs from 2025 to 2040. This translates to approximately $250 billion each year. When the People's Republic of China (PRC) and India are excluded, the financing gap for ADB's developing member countries is close to $900 billion.

However, current budgets meet only about 40% of that need, leaving a yearly shortfall of over $150 billion. This deficit significantly undermines future improvements in water security and threatens attainment of Sustainable Development Goals in a region already marked by acute disparities in water access and quality.

If financial strategies do not evolve, this gap will continue to widen, and the poorest communities will be left behind. AWDO 2025 highlights the need for financial models that are not only smarter, but also fairer. Combining public resources with private capital through mechanisms such as blended finance and green bonds can help scale investment.

Critically, the traditional reliance on concessional and commercial finance must be supplemented by a greater focus on operational efficiency, presenting opportunities for technical assistance. Focus should include loss and leakage reduction, improved tariff collection, valuing water through shadow pricing, and a targeted emphasis on cost recovery.

$250 billion

per year from 2025 to 2040 is needed to meet the rapidly growing WASH requirements in the region.

Current budgets meet **only 40%** of the investment need.

Rehabilitated existing wells, community ponds, and a small community water supply system. (Photo by ADB).

Progress in these areas supports the development of a virtuous cycle, where improved efficiencies unlock access to additional finance. However, to advance at scale, there is a policy-facing requirement to identify systemic inefficiencies and introduce incentives to address them, including encouraging private sector participation where appropriate.

But financial innovation alone is not enough. Lending must be structured to ensure long-term inclusivity and protect consumers, especially in rural and low-income communities.

Some countries are already testing new approaches. Indonesia has demonstrated how sovereign and municipal green bonds can finance integrated water resilience, directing climate-aligned capital toward flood protection, wastewater systems, and river restoration. In Cambodia, Phnom Penh's utility has expanded equitable access through a Social Fund and differential pricing model that cross-subsidises low-income households using revenue from higher-income service areas.

Multilateral development banks (MDBs) approved just $19.6 billion globally to water infrastructure, including WASH in 2024. Yet these limited resources can be catalytic if used to de-risk investment, strengthen affordability, and improve long-term service performance.

The challenge is not only the scale of investment, but whether finance reaches the right projects and people. Without public accountability and appropriate safeguards, new finance flows may deepen inequality or reinforce failing systems. Closing the investment gap will require both innovation and alignment. Financial models must deliver impact where it matters most: for communities with low levels of financial access, climate resilience, and inclusive water security. Thus, smarter investments, not just more money, is key to closing the gap.

KEY FINDING 3

Climate and water-related disaster risks are rising faster than readiness.

Resilience investments remain fragmented and insufficient.

Weak institutional capacity and limited integration with local planning and finance hinder effective response.

Adaptation planning and financing remain slow, with only 1/3 of 50 economies in the region submitting National Adaptation Plans.

Some countries like the PRC, Indonesia, and Thailand are making progress.

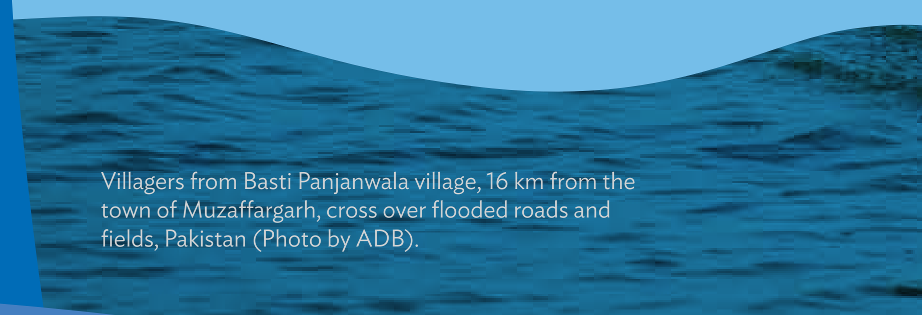
Water-related disaster risk is rising rapidly across Asia and the Pacific, yet resilience investments remain fragmented and insufficient. Between 2013 and 2023, the region experienced 244 major flood events, 104 droughts and 101 severe storms. These disasters reverse development gains, disrupt economies, degrade ecosystems, and erode community resilience.

The AWDO 2025 highlights growing exposure to floods, droughts, storms, and sea-level rise, especially in high-risk zones where infrastructure continues to expand without climate safeguards. Despite the presence of early-warning systems, weak institutional capacity and limited integration with local planning and finance hinder effective response.

Asia accounts for 41% of global flood events, with the events in the PRC and India alone impacting over 1.2 billion people. Meanwhile, small island nations in the Pacific and coastal megacities face mounting threats from rising seas, saltwater intrusion, and storm surges—putting infrastructure, fresh water supplies, and livelihoods at risk.

Climate change is accelerating these hazards and reversing water security gains. South Asia faces extreme heat and shifting rainfall, threatening agriculture and amplifying drought stress. Glacial retreat in the Hindu Kush Himalaya endangers water supplies for 2 billion people downstream, who rely on snow-fed rivers for irrigation, hydropower, and drinking water.

Countries in the Pacific could see storm surges rise by as much as 50% by 2050. Hazard exposure could increase when including geophysical hazards such as earthquakes and tsunamis. In parallel, weak environmental governance is reducing the natural protection offered by ecosystems.



Villagers from Basti Panjanwala village, 16 km from the town of Muzaffargarh, cross over flooded roads and fields, Pakistan (Photo by ADB).

Asia accounts for **41%** of global flood events, with the events in the PRC and India alone impacting over

1.2 billion people.

Despite the rising risks, disaster preparedness and climate adaptation remain inconsistent and often misaligned with the areas of greatest need. Many countries continue to build in high-risk zones, underfund resilience measures, or leave vulnerable communities without sufficient protection.

Yet adaptation planning and financing remain slow, with only a third of 50 economies in the Asia and Pacific region submitting national adaptation plans. Early-warning systems often exist but are not functioning properly and not linked to local planning. Adaptation gaps are often institutional. Climate risk data is available but not consistently used in land-use decisions or infrastructure design. Disaster response dominates budgets, leaving risk reduction and resilience underfunded. In parts of the Asia and Pacific region, repeated environmental shocks are eroding development gains faster than recovery can occur.

However, some countries are making progress. The PRC has improved its water-related disaster resilience through targeted investments in river basin planning and early-warning systems.

Southeast Asia has made steady progress in reducing water-related disaster risk. Between 2020 and 2025, capacity gains outpaced modest increases in hazard exposure, driven by investments in early-warning systems, river basin planning, and coastal protection. Thailand anchors the regional average, but countries like Cambodia and Viet Nam have shown targeted improvements. Thailand's risk decreased with increased resilience capacity.

Without targeted, inclusive, and well-funded resilience strategies, the poorest communities—least able to adapt or recover—will bear the brunt of repeated shocks. Building climate resilience demands more than infrastructure; it requires governance systems that connect data to action, prioritize prevention, and integrate equity into long-term planning.

KEY FINDING 4

Ecosystem health is declining.

In 2013, it was rural household water security that kept many countries stuck in the Nascent step. Today, it is environmental water security that threatens progress.

Ecosystems remain under pressure from unchecked development, pollution, and land conversion.

Environmental water security is the foundation that supports all other uses of water.

Protecting ecosystems is essential for sustaining long-term water security, climate resilience, and public health.

In 2013, rural household water security was the region's looming problem area. In 2025, it is environmental water security.

Ecosystems are under pressure from unchecked development, pollution, and land conversion.

Countries are expanding water infrastructure but often at the expense of rivers, wetlands, and aquatic ecosystems that sustain long-term water security. AWDO 2025 shows that environmental water security continues to lag, even as policies improve. Environmental water security consistently scores lower than other

Hunan South Dongting Lake Wetland Ecological Restoration and Sustainable Development Project 1 (Photo by ADB).

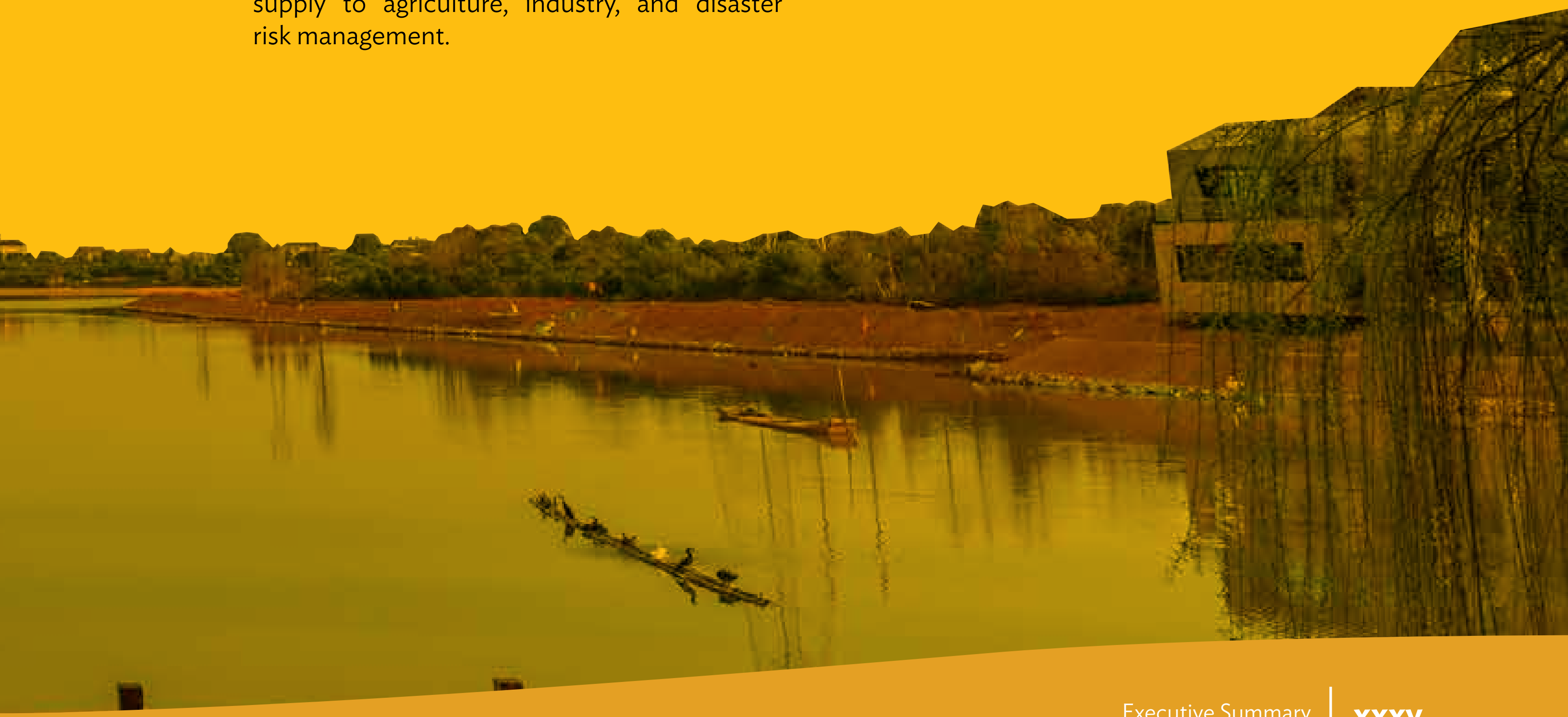
Dzud in Mongolia means where you have a drought in the summer and an extremely cold winter (Photo by ADB).

Key Dimensions, particularly in East Asia and Central and West Asia. These low scores reflect persistent degradation, limited enforcement of environmental laws, and underinvestment in nature-based solutions.

If rivers dry up, wetlands disappear, or aquifers become polluted, even the most advanced infrastructure cannot deliver reliable or safe water. Environmental water security is not a separate concern. It is the foundation that supports all other uses of water, from domestic supply to agriculture, industry, and disaster risk management.

In Cambodia, rapid infrastructure expansion and land conversion have contributed to declining catchment and aquatic system condition, as pollution and ecosystem loss intensify in key basins. Deforestation has worsened flood and drought exposure. In Uzbekistan, decades of irrigation development have disrupted natural flow regimes across the Amu Darya basin, reducing the capacity of ecosystems to regenerate and provide water during dry periods. Even countries with relatively healthy ecosystems, such as several Pacific island nations, face emerging risks due to weak environmental governance and growing development pressures.

Regulatory tools alone are not enough to protect these ecosystems. Policies are important, but enforcement is often limited, and traditional gray infrastructure projects continue to dominate water planning. Countries must do more to integrate nature-based solutions into mainstream development strategies. Protecting ecosystems is not just an environmental priority but is essential for sustaining long-term water security, climate resilience, and public health.



5 KEY FINDING

Infrastructure does not equal better health and increased economic outcomes without inclusivity, maintenance, and ecosystem support.

Many regions, despite improved access, suffer from non-functional systems and poor accountability, leading to stagnant or declining water security.

Better infrastructure does not guarantee better health. AWDO 2025 shows that long-term outcomes depend on whether water systems are inclusive, well-maintained, and supported by healthy ecosystems. Even where infrastructure has expanded access, the expected health and development benefits sometimes fail to materialize. Across Asia and the Pacific, many communities face gaps in basic maintenance. In rural Nepal, while 94% of rural households have access to basic water supply, only 55% of households have a piped connection and just 14% are free from contamination. Holistic service delivery, which includes piped water, safely managed sanitation, and hygiene, is strongly linked to health outcomes. Pakistan is a strong example, focusing on these three elements resulting in significantly improved health outcomes. Across Asia and the Pacific, many rural systems are designed and funded through one-off investments, with little attention

Urban water security is not just about expanding infrastructure. It depends on whether services are **inclusive, reliable,** and **resilient** for all.

paid to operations, repairs, or governance after construction. Without ongoing support, systems degrade over time, leading to unreliable supply, waterborne disease, and declining public trust. Pacific island countries face even greater challenges because of geographic isolation and climate pressures. Countries that succeed in rural water delivery are those that build institutional capacity, invest in long-term maintenance, and engage communities in planning and accountability.

Urban water security is not just about expanding infrastructure. It depends on whether services are inclusive, reliable, and resilient for all. Fiji has relatively low water tariffs, the utility has struggled to generate the revenue needed for sustained improvements, contributing to the country becoming the only AWDO case with declining urban sanitation and the largest fall in urban water security outside of the advanced economies.

By contrast, in Tajikistan, years of stagnant tariffs prompted recognition that tariffs were too low to cover costs. Tariffs in Dushanbe have recently increased while remaining affordable for most households, with early data showing gains in water security indicators. The Tajikistan example supports the principle that tariffs can unlock urban water security improvement when they sustainably cover costs while remaining affordable. Other countries that have made progress demonstrate a commitment to coordinated planning and social protection. In the Philippines, pro-poor tariff reforms and expanded drainage investments have improved overall performance.

The evidence from AWDO 2025 is clear: countries that manage water wisely across sectors grow their economies more sustainably, see better health outcomes, support households more effectively, and are better prepared for future risks.

Boy getting water from the community tap in Darbang, Nepal (Photo by ADB).

KEY FINDING 6

Governance deserves much greater attention.

Gaps in water governance and management across Asia and the Pacific.

If local governments lack clear mandates, reliable funding, or the capacity to act, national water goals cannot be met.

Social inclusion has a strong influence over every Key Dimension of water security.

Ensuring tools to act, and creating space for youth, women, and marginalized groups to lead.

AWDO 2025 identifies persistent gaps in water governance and management across Asia and the Pacific. Many countries develop water plans that are never implemented, policies that are not enforced, and data that are not shared. The region's continuing progress will require political will, a focus on service delivery, and the ability to manage trade-offs alongside continuing investment in gray infrastructure.

Economies with limited water resources can still enjoy strong economic water security when governance is effective, investments are targeted, and water is used efficiently. In contrast, some economies with adequate water supplies have low economic water security due to institutional gaps in planning, financing, and coordination across sectors. Countries such as Bangladesh and Viet Nam have improved their performance through targeted investments in water-efficient agriculture, better use of data, and stronger integration of water planning with national development goals. In Cambodia, economic water security declined despite improvements in the agricultural sector. Water productivity in energy and industry remains low, and hydropower production has suffered during recent droughts. Deforestation continues to worsen flood and drought exposure.

Good governance must go beyond national policy. AWDO 2025 shows that national water goals cannot be met if local governments lack clear mandates, reliable funding, or the capacity to act. However, in many economies in the region, IWRM implementation remains stalled. Of the 41 economies in AWDO 2025 to complete the SDG 6.5.1 survey, 14 have achieved less than 50% implementation, far short of the goal of 91%.

AWDO 2025 data shows that social cohesion explains more than half the variation in disaster resilience. Trust, participation, and local networks determine whether investments reach the last mile. In the PRC, community-based early-warning systems helped lift disaster resilience scores. In the Pacific, weak local governance and low social cohesion have led to only marginal resilience improvements despite high donor funding, since 2013.

West Bengal Drinking Water Sector Improvement Project in India (Photo by ADB)

Social inclusion has a strong influence over every Key Dimension of water security. When people are excluded from decision-making, when youth voices are ignored, or when gender disparities persist, systems fail to serve those who need them most. Across the region, young people and women are already improving water governance. In Bangladesh, a group of young people raised nearly half a million dollars in just four days to support flood relief efforts in 2024 and are now participating in community disaster simulations and system monitoring. In the Philippines, women-led water user groups are strengthening local supply and improving trust in public service. These examples are functional models of inclusive governance that work in real time.

To succeed, governance must shift from passive regulation to active delivery. That means building capable and accountable institutions, ensuring local governments have the tools to act, and creating space for youth, women, and marginalized groups to lead. Only then will governance and inclusion become true enablers of water security.

Correlation with ADB Projects

Table E2. Number of Projects and Economies Considered in the Correlation Analysis

	KD1	KD2	KD3	KD4	KD5
Number of Projects	14	21	79	14	17
Number of Economies	9	9	22	3	8

Source: ADB.

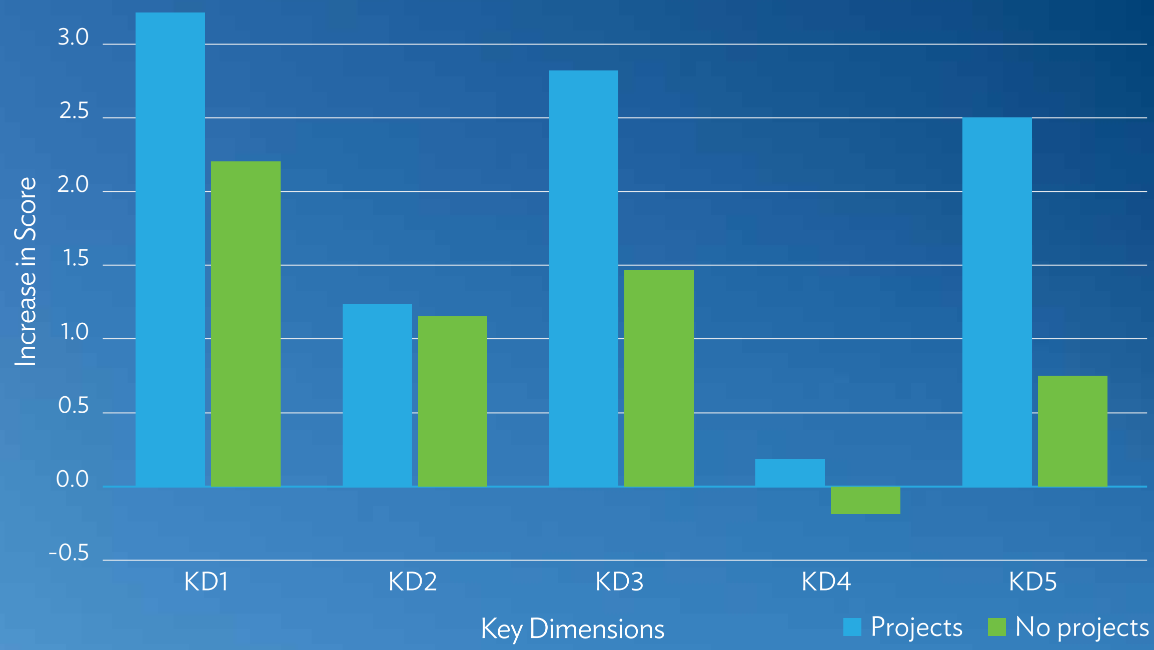
This analysis identifies broad correlations but cannot determine causation. While some increases in water security scores may align with Asian Development Bank (ADB) project timelines, many external factors affect outcomes. Therefore, results should be interpreted as indicative rather than definitive.

Around 75% of projects showed a positive correlation between their focus and improvements in the relevant KD. Most countries with ADB projects saw gains in the relevant KD scores, but the strength of this relationship varied. KD1 (Rural Household Water Security) and KD5 (Water-Related Disaster Security) showed the clearest improvements in countries with ADB projects. KD3 (Urban Water Security) and KD4 (Environmental Water Security) also recorded progress, though more modestly. By contrast, KD2 (Economic Water Security) showed little measurable change in both countries with ADB projects and those without. These results are shown in Figure E4 and the numbers of project assessed are shown in Table E2.

Another analysis examined the time lag between project implementation and the largest observed water security improvement. About 60% of projects reached their peak impact within 5 years of implementation, 30% between 5 and 10 years, and 10% after more than 10 years. On average, projects took 5 years before impacts were measurable.

KD3 and KD1 closely followed the average. KD2 had more delayed impacts, with a larger share of projects showing peak results over the longer term and an average of 7 years for measurable impacts. This may reflect that these dimensions involve more long-term “impact” indicators. By contrast, KD5 had a higher share of projects with immediate improvements and an average of 4 years before impacts could be measured, which supports the KD5 finding that capacity has the strongest correlation with water-related disaster security, as projects that improve capacity would typically deliver quick results. This analysis was unable to be completed for KD4.

Figure E4. Increase in KD Score for Economies With and Without ADB Interventions



KD = Key Dimension, KD1 = rural household water security, KD2 = economic water security, KD3 = urban water security, KD4 = environmental water security, KD5 = water-related disaster security.
Source: ADB.

An ADB funded sea wall in Barangay Katipunan, Pilar, Surigao Del Norte (Photo by ADB)

Suk Prashad Sherpa, a Nepali farmer, working in his apple nursery (Photo by ADB).

1

INTRODUCTION - THE ASIAN WATER DEVELOPMENT OUTLOOK 2025

History and Background

The Asian Water Development Outlook (AWDO) has grown through partnership. Since its first edition in 2007, the AWDO has evolved into the region's most comprehensive assessment of water security. Developed by the Asian Development Bank (ADB) in partnership with the Asia-Pacific Water Forum, AWDO was created to highlight key water management challenges in the Asia and Pacific region. Over time, it has become ADB's flagship water knowledge product. Its credibility rests on sustained collaboration with academic institutions, specialist agencies, and development partners across the region.

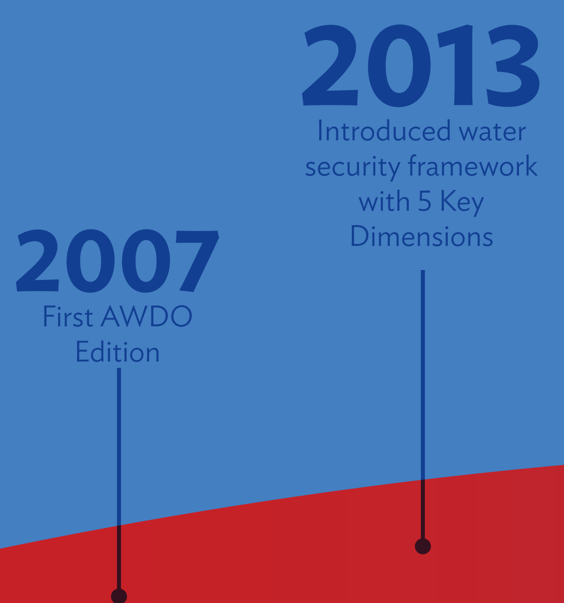
Water security underpins each of ADB's Strategy 2030 operational priorities. AWDO 2025 is fully aligned with Strategy 2030 and its vision of a prosperous, inclusive, resilient, and sustainable Asia and the Pacific, from reducing poverty and inequality and advancing gender equality to strengthening climate and disaster resilience, promoting livable cities and rural development, improving governance, and supporting regional cooperation. By linking evidence to action, AWDO 2025 provides governments and partners with a practical framework for policy dialogue, investment planning, and collaboration across borders, positioning water security at the center of sustainable development and the achievement of Strategy 2030.

A shared foundation for better decision-making. AWDO assesses water security in 50 economies[1] using a multidimensional framework refined over nearly 2 decades. The broad framing of water security supports national and regional progress toward sustainable and resilient development.

Each edition has built on the last. AWDO 2013 introduced the current framework of five Key Dimensions (KDs), shifting the series from narrative reporting to a more structured, quantitative tool. The five KDs are assessed using public datasets and composite indicators, generating both KD-specific and national water security scores. These are grouped into water security steps ranging from *Nascent* to *Model* step, allowing countries to benchmark progress.

The methodology has continuously improved. Each edition has brought refinements to the approach. AWDO 2025 continues this trajectory by strengthening the quantitative method and integrating more qualitative research to better capture emerging and context-specific challenges.

Partnerships are the engine of AWDO. While ADB leads the series, AWDO has always been a joint effort. From the outset, external partners have contributed technical expertise and financial support, shaping both the methodology and the relevance of the assessment as a decision-support tool. In this edition, ADB partnered with the University of Oxford, the International Water Management Institute (IWMI), the International WaterCentre (IWC), Griffith University, the University of Queensland, IHE-Delft, the International Centre for Water Hazard and Risk Management (ICHARM), and the Global Water Partnership (GWP).



[1] AWDO 2025 assesses water security in Afghanistan; Armenia; Australia; Azerbaijan; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; the Cook Islands; Fiji; Georgia; Hong Kong, China; India; Indonesia; Japan; Kazakhstan; Kiribati; the Kyrgyz Republic; Lao People's Democratic Republic; Malaysia; Maldives; the Marshall Islands; the Federated States of Micronesia; Mongolia; Myanmar; Nauru; Nepal; New Zealand; Niue; Pakistan; Palau; Papua New Guinea; the People's Republic of China; the Philippines; the Republic of Korea; Samoa; Singapore; Solomon Islands; Sri Lanka; Taipei,China; Tajikistan; Thailand; Timor-Leste; Tonga; Türkiye; Turkmenistan; Tuvalu; Uzbekistan; Vanuatu; and Viet Nam.

AWDO's unique position in the region. Although other water security indices exist, AWDO remains the only recurring, region-specific assessment that captures the full spectrum of water challenges. Its balance of consistency and innovation enables it to track long-term trends while responding to emerging issues. Its strength lies not only in its technical design but in the lasting partnerships that sustain it.

Asian Water Development Outlook 2025 Methodology

Five Key Dimension Framework

Water security definition: *The availability of an adequate quantity and quality of water to ensure safe, equitable, and inclusive water supply and sanitation, together with sustainable livelihoods, healthy ecosystems, and manageable water-related risks.*

AWDO assesses water security across five Key Dimensions (KDs), which together provide a holistic picture of how water supports people, economies, cities, ecosystems, and disaster resilience. These dimensions have been refined over successive editions to reflect evolving water challenges in the region. Each KD draws on a distinct set of indicators and contributes to the national water security score. The five KDs are:

KD1 — **Rural Household Water Security** – access to safe and inclusive drinking water and sanitation in rural areas

KD2 — **Economic Water Security** – water for agriculture, energy, and industry to support economic productivity

KD3 — **Urban Water Security** – safe, inclusive, and reliable water and sanitation services in urban settings

KD4 — **Environmental Water Security** – protection and restoration of aquatic ecosystems and water-related biodiversity

KD5 — **Water-Related Disaster Security** – capacity to manage and reduce risks from floods, droughts, and storms

Figure 1 provides an overview of the five KDs and their relationship to national water security.

Each KD is scored out of 20 and placed into one of five water security steps: ***Model, Effective, Capable, Engaged,*** or ***Nascent***, shown in Table 1. A country's national water security rating reflects its most insecure KD. For example, if a country scores *Capable* in three areas, *Model* in one, and *Engaged* in another, its national rating would be *Engaged*. This method helps spotlight the areas that need the most attention. In addition to this stepped rating, countries also receive a National Water Security Index (NWSI) score out of 100, based on the sum of all five KD scores.

Figure 1. KD Framework of Water Security Under the Asian Water Development Outlook

Source: ADB.

Beneficiaries of Tonle Sap Rural Water Supply and Sanitation Project in Kampong Chhnang Province. The project promotes the use of safe water and hygiene, stops open defecation, constructs improved latrines, and maintains the water points (Photo by ADB).

Table 1. Water Security Step Descriptions

Step	KD1	KD2	KD3	KD4	KD5
Model	Nearly all rural households have safe water, toilets, and hygiene.	Water is well-managed and used efficiently across sectors.	Cities have safe, inclusive services and low flood risk.	Ecosystems are healthy with strong protections.	Disaster risks are well-managed across all levels.
Effective	Most rural people have safe water and toilets; health is improving.	Most needs are met; systems manage risks well.	Most people access basic, inclusive services.	Environmental rules work in most places.	Strong disaster policies are in place and used.
Capable	Basic services are common but not always safe or reliable.	Some systems work, but big gaps remain.	Basic services exist; one area may lag.	Some protections exist, but pressure remains.	Risk planning exists but is not yet widespread.
Engaged	Access is common, but service quality is poor.	Water is poorly managed with major gaps.	Many struggle to access services.	Protections are weak and ecosystems under strain.	Some efforts made, but many at risk.
Nascent	Few have safe water or sanitation; disease is common.	Water systems are mostly absent or failing.	Most lack access to services.	Ecosystems are in crisis with little protection.	Little or no action; most are unprepared.

KD = Key Dimension, KD1 = rural household water security, KD2 = economic water security, KD3 = urban water security, KD4 = environmental water security, KD5 = water-related disaster security.
*Note: This table is simplified; more detailed descriptions can be found in each KD chapter.
Source: ADB.

Improvements in Asian Water Development Outlook 2025

Every iteration of AWDO has brought methodological and thematic improvements, and the 2025 edition is no exception. The updates in this edition enhance both the rigor and the relevance of AWDO, aligning the framework more closely with advances in data availability, a stronger focus on climate change, and greater attention to inequality, including wealth and gender dimensions. Together, these refinements aim to improve the utility of AWDO for decision-makers across Asia and the Pacific.

Several important changes have been made to the quantitative assessment since the 2020 edition. KD1 (Rural Household Water Security) now uses three core indicators instead of four, but with a greater focus on quality through the inclusion of safely managed water, sanitation, and hygiene. A new indicator on climate resilience has also been introduced, and links have been made to countries' national adaptation plans (NAPs). In KD2 (Economic Water Security), the method now draws on new satellite-based data streams, while a new indicator tracks per capita investment in water infrastructure. For KD5 (Water-Related Disaster Security), the framework has been updated with climate change adjustments and integration of

NAP-related data, strengthening its ability to capture vulnerability and resilience. For KDs 3 and 4, the indicator sets remain unchanged, but refinements to sub-indicator methods have improved consistency, data treatment, and comparability across countries. All KDs use the 2025 method to backcast results for 2013, 2016, and 2020, ensuring comparability through time.

Beyond indicator updates, AWDO 2025 addresses persistent data challenges while also expanding its thematic coverage. Reliable and comparable data remain a key limitation, particularly for climate-related indicators, and the report highlights how gaps in data availability continue to affect all KDs. These issues are especially important for measuring climate change impacts, inequalities, and disaster risk, and will remain priorities for future methodological refinement. At the same time, AWDO 2025 advances the analysis of inequalities by incorporating wealth-based indicators in several KD chapters. The framework also places greater emphasis on the integration of finance, governance, and national-level assessments, highlighting how these interact to shape water security outcomes.

AWDO 2025 also expands its value through new thematic chapters and country assessments. Four thematic chapters focus on priority issues: water investment needs in Asia and the Pacific; changes in the cryosphere and their impacts on water security; gendered dimensions of heat and water stress; and water governance in the context of Sustainable Development Goal (SDG) 6. Boxes on youth and water security and on women and girls are included throughout the report to highlight critical crosscutting issues. Country assessments were completed for Bangladesh, Cambodia, Nepal, Pakistan, and Tajikistan, providing a deeper analysis of trends and governance progress in support of ADB's in-country planning. A special study on the Pacific was also included, reflecting the region's unique context and data challenges.

Taken together, these updates make AWDO 2025 a more rigorous and relevant assessment tool, while also strengthening its role as a practical guide for national planning, investment, and reform. For extended information on the methodology, please refer to the AWDO 2025 Methodology and Data Report.

AWDO 2025 - a practical guide for national planning, investment, and reform.

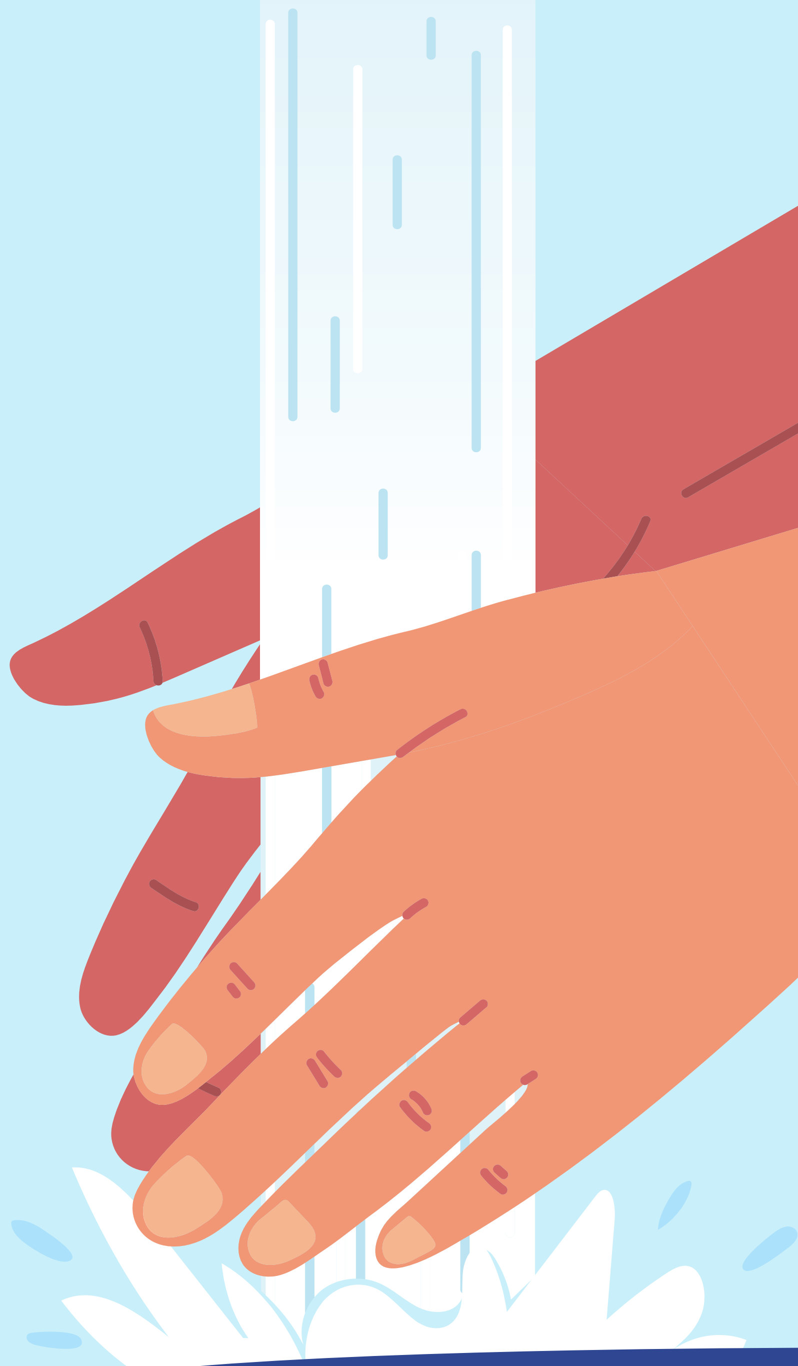
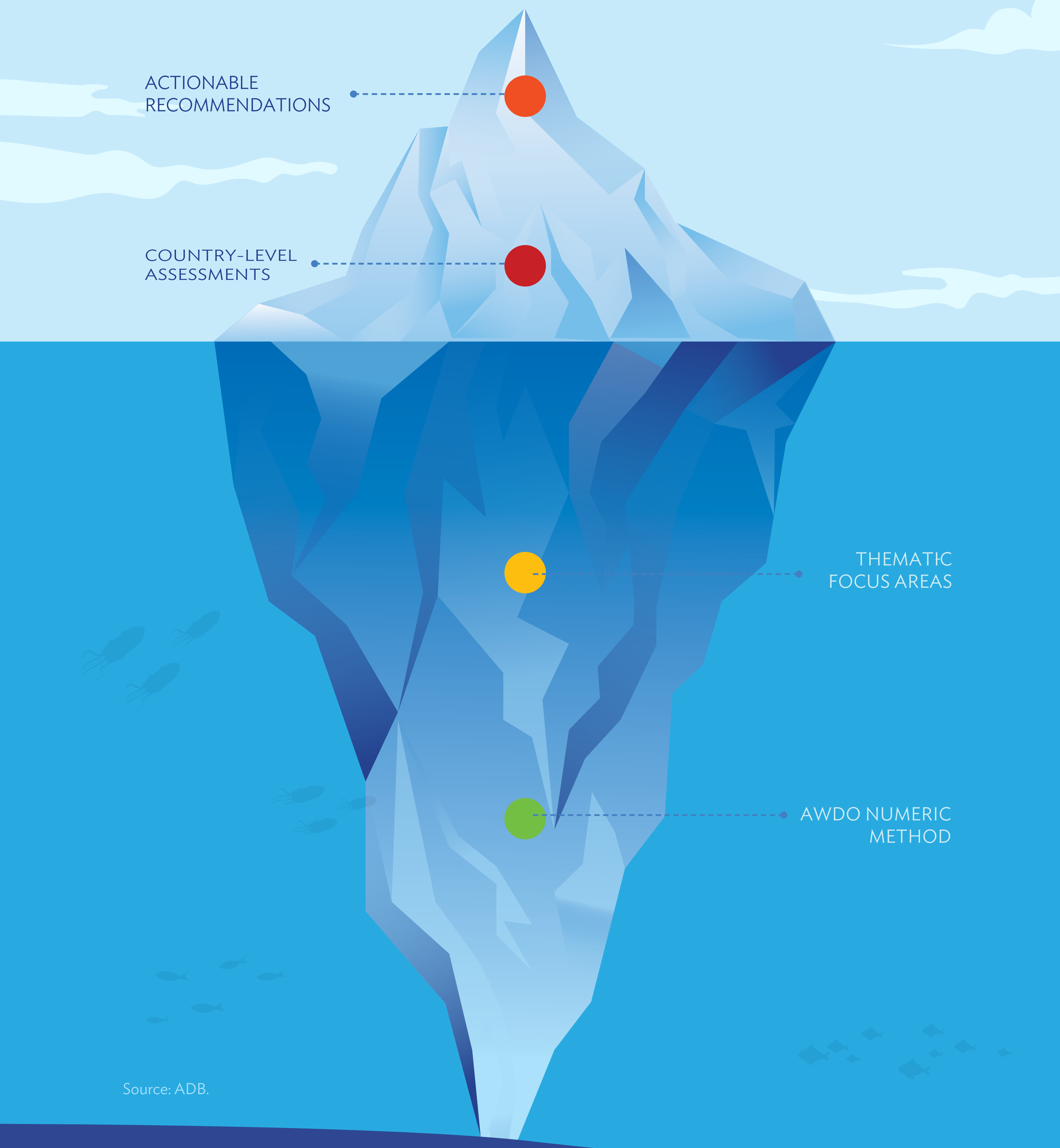


Figure 2. The Asian Water Development Outlook Construction Iceberg Metaphor



Source: ADB.

Interpreting and Using Asian Water Development Outlook 2025

Quantitative assessments offer a powerful way to track progress and identify risks, but they can also be difficult to interpret. When metrics are complex or unfamiliar, they are more likely to be misunderstood. One common risk is overinterpreting a single number. A national water security score can offer a useful snapshot, but on its own, it may oversimplify the reality on the ground.

AWDO 2025 addresses this challenge by going beyond the numbers. Country assessments and thematic chapters are designed to unpack each score, layer in policy and contextual insights, and offer practical, actionable findings. The thematic chapters include: Water Investment Needs in Asia and the Pacific, Changes to the State of the Cryosphere and the Impacts on Water Security, Gendered Dimensions of Heat and Water Stress, and Water Governance for Enhanced Water Security in the Context of SDG 6. These narratives help ensure that the underlying data is interpreted with the nuance it deserves. They also help transform technical assessments into tools for decision-making.

AWDO is designed as a tool to understand where and why changes in water security are happening. It can help identify good practices, highlight potential gaps, and guide areas for improvement. The purpose is not to compare countries or to label some as "poor" performers. In many cases, factors outside the scope of AWDO shape outcomes, and these need to be understood in their local context.

Cross-country comparisons are often misleading in a region as diverse as Asia and the Pacific. Differences in data quality, country size, and governance structures can all affect the relevance and reliability of results. For this reason, AWDO 2025 focuses on trends within each country, providing a more meaningful assessment of progress. This approach ensures that analysis reflects local realities and methodological limitations, allowing results to be interpreted fairly and consistently.

AWDO 2025 focuses on trends between 2013 and 2025, drawing on the latest data collected for respective editions published in 2013, 2016, 2020, and 2025. This time frame reflects the full history of AWDO and provides the most consistent basis for tracking progress in water security. Looking across the entire period makes it possible to see how countries have moved within and between water security steps, while also accounting for shifts in data quality and coverage. Although the primary emphasis is on long-term trends, the analysis also highlights any significant changes between individual years where these reveal important developments.

A helpful way to understand AWDO is through the iceberg metaphor (Figure 2). The foundation of the iceberg is the quantitative assessment, large, rigorous, and mostly below the surface. This base supports the visible layers above: country-specific narratives, thematic analyses, and policy recommendations. These upper layers offer the real value to decision-makers, translating data into insight and guiding action.

Every effort has been made to ensure transparency. All underlying data and methodological processes have been published alongside this report, allowing readers to explore, question, and build on the results.

AWDO 2025 draws mainly on publicly available data sources. Most indicators are based on internationally recognized datasets, which provide consistency across the region. Many of these sources are informed by national governments, ensuring that the data used is both reputable and widely accepted.

Outline of the Report

ASIAN WATER DEVELOPMENT OUTLOOK 2025

AWDO 2025 is organized to move from high-level findings to detailed evidence and practical applications. The structure begins with a summary of results and methods, then examines each Key Dimension, explores thematic issues, and presents country and regional perspectives before concluding with future directions. Each section builds on the last to provide a comprehensive view of water security in Asia and the Pacific.

Executive Summary

This section highlights the purpose of AWDO 2025 and distills its most important findings. It sets out the evidence of progress in water security across Asia and the Pacific, while drawing attention to the persistent gaps, risks, and opportunities for collective action.

Section 1: Introduction

The introduction explains the background and evolution of AWDO, the 2025 methodology, and how the report can be used. It positions AWDO as a practical tool for governments and partners, linking evidence to action for policy, investment, and regional collaboration.

Section 2: Key Dimension Reports

Each of the five KDs is assessed in detail. Rural water security examines household access and reliability. Economic water security analyzes productivity and cross-sector use. Urban water security considers accessibility, service delivery, and resilience. Environmental water security explores ecosystem health and governance. Water-related disaster security measures readiness and response capacity.

Section 3: Thematic Deep Dives

This section explores priority issues shaping water security beyond the core indicators. It assesses investment needs; the impacts of cryosphere change; the intersection of gender, heat, and water stress; and the role of governance in achieving SDG 6. These deep dives provide additional context for decision-makers.

Section 4: Country and Regional Assessments

National case studies for Bangladesh, Cambodia, Nepal, Pakistan, and Tajikistan, together with a regional analysis of the Pacific, illustrate how water security trends play out in practice. Each assessment reviews progress since 2013, governance performance, and key recommendations tailored to local contexts.

Section 5: Conclusions

The final section brings together quantitative results, overall findings, and lessons for the future. It reflects on progress to date, outlines what remains to be done, and sets out directions for the next cycle of AWDO.

References

Asian Development Bank (ADB) and University of Technology Sydney. 2024. *Gender Equality and Water Security: A Critical Framework for Asia and the Pacific.*

ADB. 2020. *Asian Water Development Outlook 2020: Advancing Water Security across Asia and the Pacific.*

World Health Organization/ United Nations Children's Fund Joint Monitoring Programme and Emory University. 2024. *Priority Gender-Specific Indicators for WASH Monitoring.*

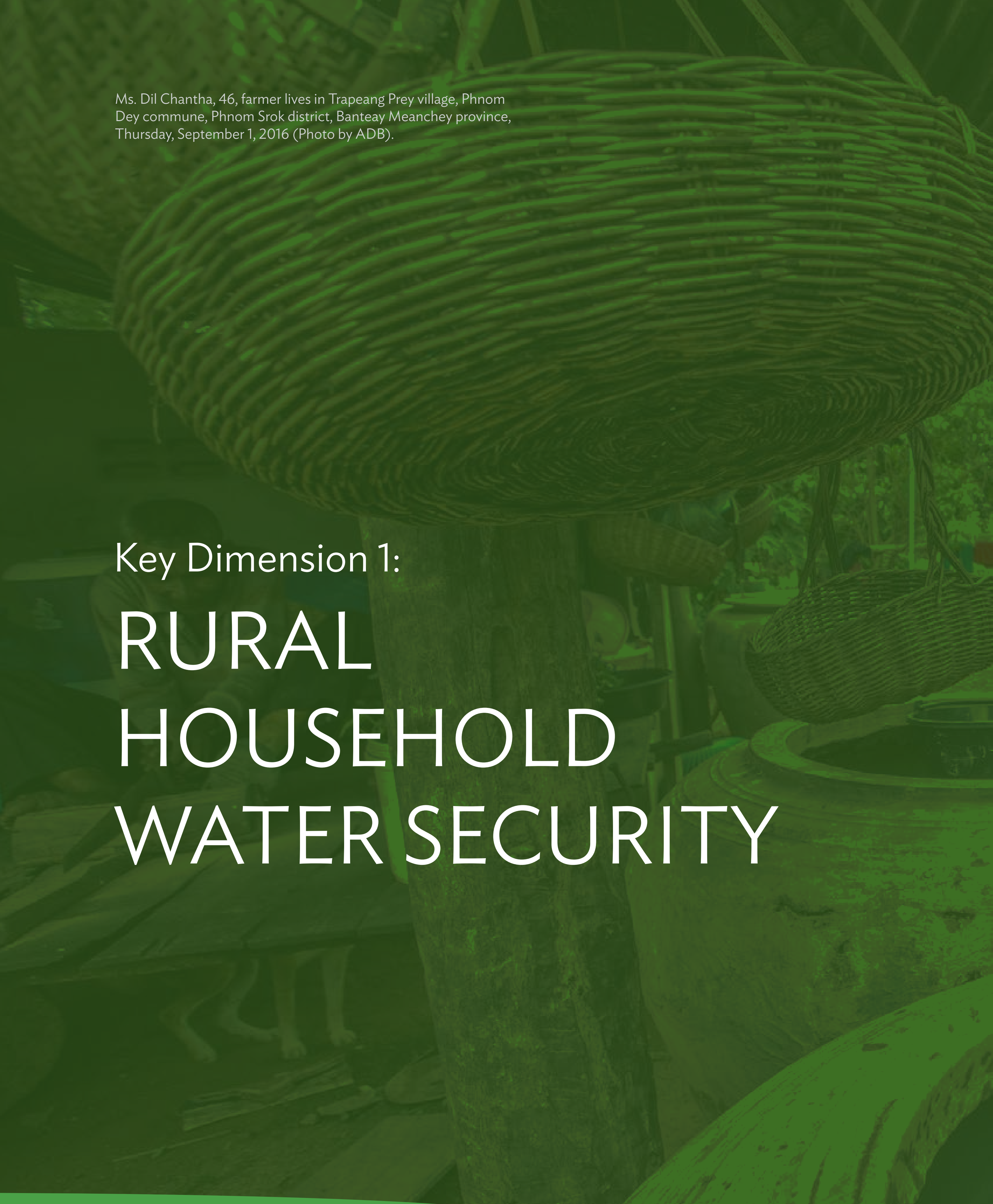
Young, S.L. et al. 2021. The Individual Water Insecurity Experiences (IWISE) Scale. *BMJ Global Health.* 6(10): e006460.

Young, S.L. et al. 2022. Estimating National, Demographic, and Socioeconomic Disparities in Water Insecurity. *The Lancet Planetary Health.* 6(11): e880–91.

Young, S.L. et al. 2024. *Making the Invisible Visible: Insights from Measuring the Inclusivity of Water Security in Asia.* ADB and IWISE.

Ms. Herath Mudiyanselage Biso Menike, a beneficiary of the Polonnaruwa-Ikiriwewa rural water supply scheme, watering her pepper plants, Tuesday, 26 August, 2014. The Polonnaruwa-Ikiriwewa rural water supply scheme is an ADB supported project that provides clean water to more than 600 homes in Polonnaruwa, Sri Lanka (Photo by ADB).

2 KEY DIMENSION REPORTS

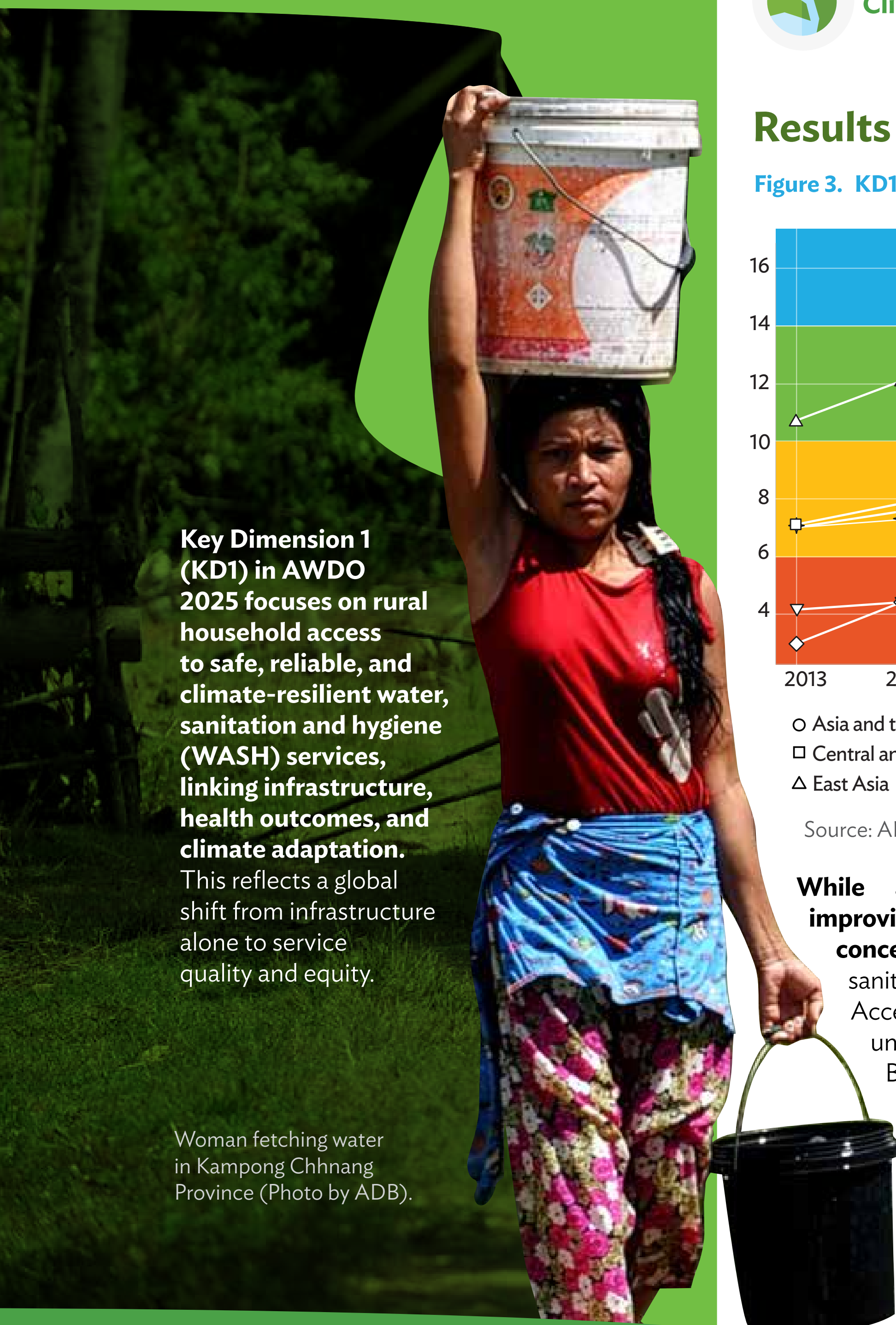


Ms. Dil Chantha, 46, farmer lives in Trapeang Prey village, Phnom Dey commune, Phnom Srok district, Banteay Meanchey province, Thursday, September 1, 2016 (Photo by ADB).

Key Dimension 1:

RURAL HOUSEHOLD WATER SECURITY

Key Dimension in Brief



Key Dimension 1 (KD1) in AWDO 2025 focuses on rural household access to safe, reliable, and climate-resilient water, sanitation and hygiene (WASH) services, linking infrastructure, health outcomes, and climate adaptation. This reflects a global shift from infrastructure alone to service quality and equity.

Woman fetching water in Kampong Chhnang Province (Photo by ADB).

Indicators included in KD1:

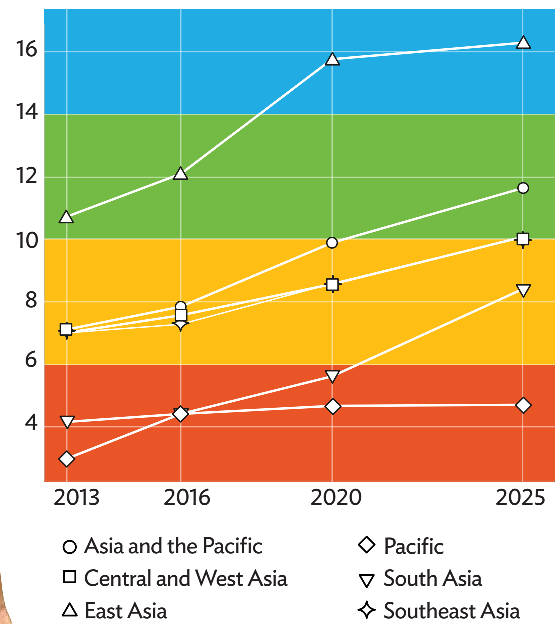
WASH Infrastructure

Health Outcomes

Climate Resilience

Results

Figure 3. KD1 Regional Scores (2013–2025)



Source: ADB.

While access to infrastructure is improving, service quality remains a concern. Basic water access is high, but sanitation and hygiene continue to lag. Access to higher levels of service is also unequal. In many countries such as Bangladesh and Indonesia, more people have access to safely managed sanitation than to safely managed drinking water, underscoring challenges around water quality, reliability, and safe on-premises supply.

Table 2. Top Performers on KD1

Country	China, People's Republic of	Nepal	Philippines	India	Lao People's Democratic Republic
KD1 gain (2013–2025)	+5.6	+5.5	+5.4	+4.6	+4.4

Source: ADB.

Largest gains (≥4 points) were recorded in the People's Republic of China (PRC), Nepal, the Philippines, India, the Lao People's Democratic Republic (Lao PDR), Turkmenistan, and Timor-Leste, where substantial rural WASH investments expanded both water supply and sanitation coverage, and improved service reliability and quality.

Moderate gains (2-3.9 points) were achieved by 18 countries, which were supported by targeted rural WASH programs, donor-funded projects, and policy reforms.

Smaller gains (0.1-1.9 points) were recorded in 14 countries. Many of these countries already have strong rural household water security; therefore, they were unable to show significant improvement. In contrast, in small island and resource-constrained countries, geographic isolation, limited scale, and high costs slow progress.

The PRC recorded the largest gain and highest KD1 score increase (+5.6), driven by large-scale rural WASH infrastructure expansion, improved sanitation coverage, and enhanced service reliability, resulting in high scores for water supply and sanitation and excellent health outcomes.

Most countries lack solid evidence of climate resilience. Many have not included rural WASH in their adaptation plans. Without action, current WASH gains are at risk from future climate pressures like flooding, drought, and water scarcity.

Findings and Recommendations

1.

Rural water security in Asia and the Pacific has improved since 2020. Access to WASH has expanded, but challenges remain, particularly in service quality and resilience. Any definition of rural household water security must focus on services, not just infrastructure, defined as the use of accessible, reliable, and safe WASH services that reduce diarrheal disease and are adapted to future climate risks.

2.

Higher service levels are linked to better health outcomes. Countries in the *Effective* step for KD1 also report higher access to basic water supply (piped and safely managed drinking water), 38% greater access to safely managed sanitation, and 16% more access to basic hygiene, but these depend on sustainability and reliability. **Over half of the countries with strong WASH infrastructure still perform poorly on health outcomes** due to low service quality, poor governance, unequal access, and a lack of WASH services beyond the home, such as in schools and health facilities.

3.

To deliver the full health benefits of rural WASH investments, countries should strengthen climate resilience by including rural WASH in national adaptation plans. They should focus on service quality and strong governance to turn infrastructure into real health improvements, and extend access beyond households, especially for the poor and in public institutions. Stronger integration with rural health and education services would maximize health outcomes, particularly in remote and marginalized communities. Uzbekistan's progress illustrates what is achievable with sustained investment, multisector coordination, and proactive climate risk management.

Introduction

KD1 definition:

Rural household use of accessible, reliable and safe WASH services, which contribute to reducing the burden from diarrheal diseases, where services are supported to adapt to future climate.

This updated definition reflects how the sector has changed. KD1 in AWDO 2025 now emphasizes three components: access to WASH infrastructure, health outcomes, and climate resilience. Rural livelihoods are a key part of water security. However, a lack of comparable national data has limited how these aspects can be measured and included.

The global conversation on water and health has shifted. During the Millennium Development Goals (MDG) era, the focus was on building infrastructure. But in the SDG era, the emphasis has moved to service delivery. This means focusing on safety, reliability, and equity. Sanitation goals now include fecal sludge management. Hygiene and access to WASH services outside the home, like in schools and health facilities, are now part of the agenda. Today, unsafe WASH is estimated to cause 69% of diarrheal diseases, 14% of acute respiratory infections, and 10% of undernutrition (Wolf et al. 2023).

The Asia and Pacific region presents both shared and unique challenges. The 42 countries in this assessment include 62% of the world's rural population. Nearly half of that population live in South Asia, while only 0.6% live in the Pacific. A small number of countries with large rural populations drive most of the regional trends. Economic status also matters. Just under half of the countries are high- or upper-middle-income. The rest are lower-middle or low-income. While child mortality is declining, partly due to better WASH access, inequalities remain.

Rural water security varies across time, place, and gender. Seasonal rainfall shifts affect water availability (Elliott et al. 2017; Hoque et al. 2021) and water quality (Charles et al. 2022; BBS and UNICEF 2019). These changes influence both source selection and household spending (Hoque and Hope 2025). Social and gender inequalities shape water-related experiences. Wealthier households may manage gaps in public supply by investing in bottled water or private systems. Within homes, women and girls often carry the burden of water collection and face added hygiene challenges, especially during menstruation.

Many of these issues are not reflected in global datasets. Nationally representative surveys are often infrequent and limited by cost. As a result, statistics often fail to capture seasonality, inequality, and climate risks. This makes it difficult to build strong, evidence-based assessments of rural water security.

Climate change poses an escalating threat. Coastal areas, especially in deltas like the Ganges and Mekong, are facing increased salinity risks due to sea-level rise (FAO and AWP 2023). Across the region, floods, droughts, and cyclones are becoming more intense and more frequent (WMO 2024, Shaw et al. 2022, Mycoo et al. 2022). Mountain areas in South and Central and West Asia also face shrinking glaciers and snowpack, which threaten seasonal meltwater supplies (Wood et al. 2020, Barandun et al 2021).

Methodology

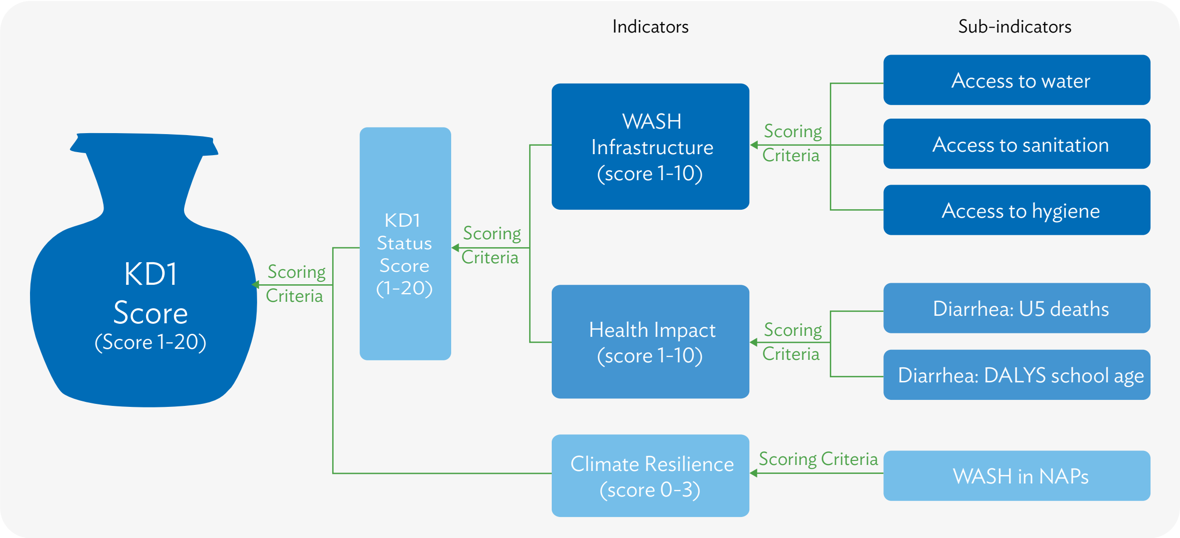
The KD1 assessment method has been updated from AWDO 2020 to match the revised definition of rural water security. For AWDO 2025, the method was redesigned to reflect a focus on service delivery, health outcomes, and climate resilience (Figure 4).

The analysis covered 42 of the 50 economies in the Asia and Pacific region. Eight economies with more than 80% of their populations living in urban areas were excluded: Australia; Hong Kong, China; Japan; Nauru; New Zealand; the Republic of Korea; Singapore; and Taipei,China.

The assessment produced two key scores:

- **KD1 status score** – This combines the WASH infrastructure and health outcome indicators to reflect current rural water security. This is considered the KD1 score and used to calculate the NWSI.
- **KD1 resilience score** – This builds on the status score by factoring in the climate resilience of rural WASH services.

Figure 4. Methodology for KD1



DALYS = disability-adjusted life years, KD = Key Dimension, KD1 = rural household and water security, NAP = national adaptation plan, U5 = under 5, WASH = water, sanitation and hygiene.
Source: ADB.

The KD1 status score places countries into five steps of rural water security, shown in Table 3
These steps reflect progress based on access to WASH services and associated health outcomes.

Table 3. Narrative Description of the Steps and Corresponding KD1 Scores

Water Security Step	KD1 Score (out of 20)	Description
Model	>18	Nearly all rural households have access to safely managed drinking water, sanitation, and hygiene. Health outcomes are strong, with low levels of diarrheal disease.
Effective	14–18	Most rural households have access to safely managed water, sanitation, and hygiene. Diarrheal disease rates have declined.
Capable	10–14	Basic services are widespread. Piped water is common, but safely managed standards are not consistently met. Health outcomes are improving but still suboptimal.
Engaged	6–10	Basic access is common, but service levels are low. Poor health outcomes suggest current water, sanitation, and hygiene services are not enough to reduce disease.
Nascent	<6	Many households lack even basic services. Open defecation remains widespread. The burden of diarrheal disease is high.

Source: ADB.

WASH Infrastructure

The WASH infrastructure indicator measures rural access to water, sanitation, and hygiene services. It uses 2024 data from the WHO/UNICEF Joint Monitoring Programme (JMP 2025). If recent rural data were unavailable, earlier rural data from the same AWDO cycle was used without penalty. However, if only national data was available, either from the same year or earlier, penalties were applied to reflect the lower reliability for rural analysis.

Backcasting was used to support comparisons over time. Data for 2013, 2016, and 2020 were recalculated using JMP data from 2011, 2014, 2018, and 2024, following the updated 2025 methodology.

Each sub-indicator was scored from 1 to 5, based on access thresholds. These thresholds were tailored to each sub-indicator to help differentiate service levels.

Water access includes:

- Basic drinking water, meaning an improved source with a roundtrip collection time under 30 minutes;
- Piped water supply, which reflects progress toward networked services;
- Safely managed drinking water, defined as water from improved sources that is available on premises, when needed, and free from contamination.

Basic water access is the core metric, but it does not reflect quality or reliability. Piped supply was included in AWDO 2016 but not in 2020. It shows potential for safe and scalable delivery. Safely managed water, available for 26 countries, includes quality and reliability but can obscure seasonal variation.

Sanitation access includes:

- Open defecation;
- At least basic sanitation, which means improved and non-shared facilities;
- Safely managed sanitation, which includes safe disposal or treatment of excreta but does not account for groundwater risks. This data was available for 26 countries.[2]

Hygiene access measures: Household access to basic handwashing facilities with soap and water. This data was available for 35 countries.[3]

The overall WASH Infrastructure Score ranges from 1 to 10. It is the average of the three sub-indicators, adjusted for missing data and national substitutions:

$$\text{WASH Infrastructure score} = (\mu_{WSH} - \alpha M - \beta N) \times 2$$

μ_{WSH}	=	*average of water, sanitation and hygiene sub-indicator scores (out of 5)*
M	=	*number of sub-indicators with missing data (1 to 3)*
N	=	*number of national datasets used in place of rural data*
α	=	*0.8*
β	=	*1*

2. Afghanistan, Azerbaijan, Bangladesh, Bhutan, Cambodia, Fiji, Georgia, India, Kiribati, the Kyrgyz Republic, Lao People's Democratic Republic, Mongolia, Myanmar, Nepal, Pakistan, Papua New Guinea, the People's Republic of China, the Philippines, Samoa, Tajikistan, Thailand, Tonga, Türkiye, Tuvalu, Uzbekistan, and Viet Nam

3. Afghanistan, Armenia, Azerbaijan, Bangladesh, Bhutan, Cambodia, Fiji, Georgia, India, Indonesia, Kazakhstan, Kiribati, the Kyrgyz Republic, Lao People's Democratic Republic, Maldives, the Marshall Islands, Mongolia, Myanmar, Nepal, Pakistan, Papua New Guinea, the People's Republic of China, the Philippines, Samoa, Solomon Islands, Sri Lanka, Tajikistan, Thailand, Timor-Leste, Tonga, Turkmenistan, Tuvalu, Uzbekistan, Vanuatu, and Viet Nam

Health Outcome

The health outcome indicator measures how well WASH services reduce the burden of diarrheal disease. It uses national-level data from the 2021 Global Burden of Disease (GBD 2021) study. The health outcome indicator measures how well WASH services perform, through their impact on the burden of diarrheal disease. Previous AWDO methods risked double-counting, using health data that was already linked to WASH access, which could have overstated the benefits of infrastructure alone.

Two metrics are used to measure health impacts from diarrhea as a proportion of the disease burden:

- **Under-five mortality from diarrheal disease** reflects how critical WASH services are in preventing childhood deaths. Diarrhea remains the third leading cause of death in children under five.
- **Disability-Adjusted Life Years (DALYs) in children aged 5 to 14** capture the wider effects of diarrheal illness. These include time lost to sickness and long-term effects on development, learning, and productivity.

Scores for the health outcome indicator range from 1 to 10. More weight is given to under-five deaths than to DALYs to reflect the severity of child mortality.

$$\text{Health Outcome Score} = (\log_{10}[1/(\text{u5 deaths}^2 \times \text{DALYs})] + c) \times 2$$

c = 3.4

Climate Resilience

The climate resilience indicator measures how well rural WASH systems are prepared for future climate impacts. It is used to calculate the KD1 resilience score, which reflects the long-term sustainability of rural water security.

This indicator is based on NAPs submitted to the United Nations Framework Convention on Climate Change (UNFCCC). As of March 2025, only 16 countries had submitted a plan. Mongolia submitted its NAP in April 2025 and was excluded. Brunei Darussalam's plan is still under review. Eighteen countries are developing plans, five have no public information, and Solomon Islands has not started one.[4]

Each NAP was evaluated using a structured scoring system. The framework, adapted from UNFCCC guidance, includes four components:

- Risk Assessment (20%)
- Goals and Objectives (40%)
- Implementation (20%)
- Monitoring and Evaluation (20%)

Each component was scored from 0 to 3. These were then combined into a weighted average.

Outdated plans were capped below the top score. Plans that did not extend beyond 2024 were considered outdated and could not receive the maximum score. Where countries lacked NAPs, no climate resilience or KD1 resilience scores were assigned. As many countries lacked NAPs, in AWDO 2025 the KD1 status score was used as the KD1 score.

4. Armenia, Azerbaijan, Bangladesh, Bhutan, Cambodia, Fiji, Kiribati, the Marshall Islands, Nepal, Pakistan, Papua New Guinea, the Philippines, Sri Lanka, Thailand, Timor-Leste, and Tonga

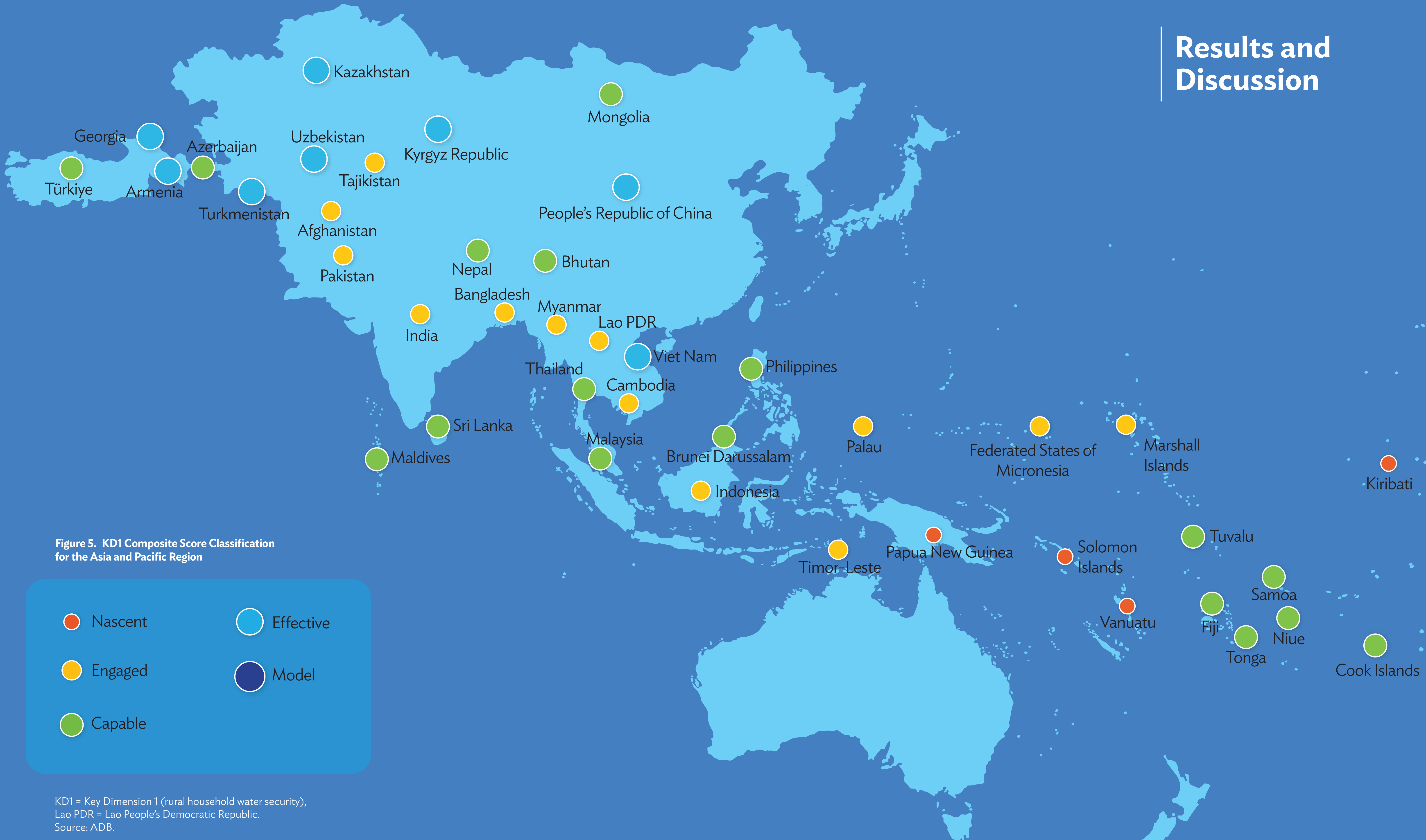


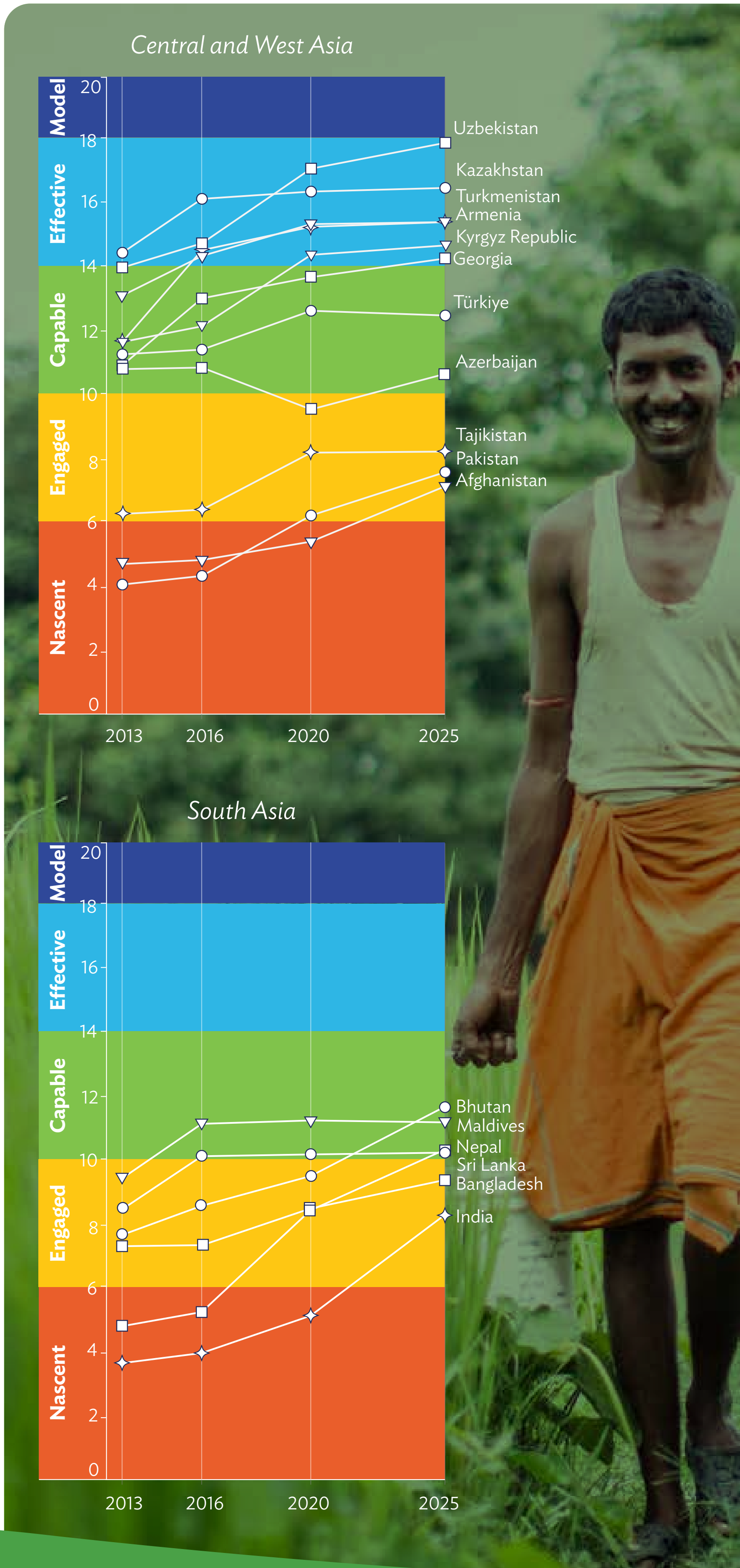
Figure 5. KD1 Composite Score Classification for the Asia and Pacific Region

KD1 = Key Dimension 1 (rural household water security),
Lao PDR = Lao People's Democratic Republic.
Source: ADB.

Trends in Rural Water Security

Rural water security has improved significantly across the region between 2013 and 2025. On average, countries saw a 38% improvement in WASH infrastructure scores, from 4.5 to 6.2, reflecting broad progress in access to basic and safely managed WASH services. This equates to the average household in the Asia and Pacific region improving from *Engaged* to *Capable* in rural household water security. Health outcomes improved by 15%, from 3.9 to 4.5, indicating reductions in under-5 mortality and water-related disease burden. The overall KD1 status score increased by 27%, showing steady gains in infrastructure, health, and resilience. When weighted by population, progress is even more pronounced, KD1 scores rose by 62%, driven largely by improvements in populous countries such as the PRC, India, and Bangladesh. This means that millions more rural people now have access to safer and more reliable WASH services. These results are illustrated in Figure 6.

Figure 6. Trends in KD1 Scores (2013–2025)



PRC = People's Republic of China,
KD1 = Key Dimension 1 (rural household water security),
Lao PDR = Lao People's Democratic Republic,
FSM = Federated States of Micronesia.
Note: KD1 status scores over four iterations of the Asian Water Development Outlook.
Source: ADB.

Banana farmer carrying water to start the water pump in Nepal (Photo by ADB).

Data availability has generally improved, but gaps persist. Information on safely managed services and hygiene remains limited in some countries, particularly for rural areas. In several upper-middle-income DMCs such as **Malaysia, Thailand,** and **Kazakhstan,** disaggregated rural data is often missing or inconsistently reported to global databases like the JMP, even though these are collected by national systems. This limits confidence in their KD1 scores. Among **small population countries** such as **Niue, Tuvalu, the Cook Islands,** and **Palau**, greater year-to-year variation is observed due to their small sample sizes and reliance on intermittent surveys, making it harder to interpret long-term trends. Improved transparency and rural data reporting, especially for hygiene and safely managed services, remain critical for accurate regional assessments.

Despite progress, no country reached the *Model* step of rural water security in 2025. The *Model* category requires near-universal access to safely managed drinking WASH, and a low burden of diarrheal disease. No country met all those criteria.

612 million people or **8** Countries

Including: Armenia, the People's Republic of China, Georgia, Kazakhstan, the Kyrgyz Republic, Turkmenistan, Uzbekistan, and Viet Nam

were classified as ***Effective*** with widespread access to safely managed services and improving health outcomes. However, some still lacked full datasets.

166 million people or **17** Countries

Including: Azerbaijan, Bhutan, Brunei Darussalam, the Cook Islands, Fiji, Malaysia, Maldives, Mongolia, Nepal, Niue, the Philippines, Samoa, Sri Lanka, Thailand, Tonga, Türkiye, and Tuvalu

were classified as ***Capable*** with widespread access to basic services but limited provision of safely managed services. Health gains were modest.

1.4 billion people or **13** Countries

Including: Afghanistan, Bangladesh, Cambodia, India, Indonesia, the Lao People's Democratic Republic, the Marshall Islands, the Federated States of Micronesia, Myanmar, Pakistan, Palau, Tajikistan, and Timor-Leste

were classified as ***Engaged*** They had common access to basic services, but these were not sufficient to reduce disease burdens.

Source: ADB.

WASH Infrastructure Indicator

Access to basic water remains higher than sanitation and hygiene in rural areas. In 2025, approximately 91% of the rural population covering 1.9 billion people had access to basic drinking water. This compares to 78% with access to basic sanitation comprising 1.7 billion people across the Asia and Pacific region, and 76% with access to basic hygiene facilities across the Asia and Pacific region, with 1.6 billion people.

In most countries, safely managed sanitation has now overtaken safely managed drinking water. Among the 19 countries with available data, 12 reported higher access to safely managed sanitation. The trend may reflect how countries report on-site sanitation systems such as septic tanks and pit latrines. These systems are sometimes classified as safely managed even if fecal sludge is not regularly emptied, treated, or safely disposed of, leading to an overestimation of service quality. On average, safely managed sanitation services reached 52% of the rural population (1.1 billion people), while safely managed drinking water reached only 44%, or 1.0 billion people.

Open defecation remains a serious public health issue. In 2025, around 5% of the rural population, or roughly 100 million people, still practiced open defecation. Rates remained above 20% in 3 countries and above 5% in 10 others. Papua New Guinea was the only country where open defecation increased, rising from 1 million people in 2013 to 1.9 million in 2025. The proportion rose slightly mainly because of increasing population. The practice continues to be strongly associated with under-five mortality from diarrheal diseases, showing its ongoing public health risks.

Access to piped water has improved but varies in quality. Access to piped water has expanded since 2013, now reaching 42% of the rural population in 2025. This means approximately 800 million people now have piped water supply. However, many systems still lack verified data on water quality, reliability, and service continuity. As a result, piped access alone cannot be assumed to meet safety standards.

Between 2020 and 2025, open defecation fell by 6% across the region. This corresponds to approximately 240 million fewer people practicing open defecation, reflecting substantial but uneven progress in rural sanitation.

Health Outcome Indicator

The burden of diarrheal disease is decreasing across the Asia and Pacific region, but not as rapidly as the increase in WASH access. On average, the share of under-five deaths attributed to diarrheal diseases fell from 6.2% in 2013 to 3.5% in 2025. This means that diarrheal diseases now account for just over 1 in 20 under-five deaths in the region, down from roughly 1 in 16 in 2013. The reduction in DALYs related to diarrhea was smaller, dropping from 4.6% to 3.6%, indicating more modest progress in reducing the overall health burden.

Some countries have made significant progress, particularly in reducing child mortality. In the share of under-five deaths from diarrhea, India has seen a 4.8% decline, and Pakistan a 4.9% decline between 2013 and 2025. These improvements reflect high-impact investments in rural sanitation and hygiene. Tajikistan also showed progress, reducing diarrheal deaths by 3.4% between 2013 and 2020, but has since plateaued. In contrast, countries such as Azerbaijan, Thailand, and several Pacific island countries still report relatively high shares of under-five mortality caused by diarrheal disease.

Reductions in DALYs have been uneven across the region. The greatest improvements were recorded in Nepal (2.6%), India (1.4%), and Indonesia (1.3%). However, in 14 countries, DALY levels have stagnated or increased since 2013.[5]

Two clear patterns emerged from the data. DALY rates were higher in countries where open defecation remains common. In contrast, countries with broader access to piped water reported lower DALY levels. This highlights the importance of both eliminating unsafe sanitation practices, and improving service quality to reduce health risks.

5. These countries are the Cook Islands, Fiji, Kiribati, Maldives, the Marshall Islands, the Federated States of Micronesia, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu.

Climate Resilience in Rural WASH Services

Climate change is putting rural water security at increasing risk. Heatwaves, droughts, and disruptions to rainfall patterns are already affecting rural water supplies across the region. While data remains limited, the climate resilience indicator offers a repeatable method for assessment. It shows that high KD1 status scores do not always mean a system is climate-resilient (Figure 7). This highlights the need to assess resilience separately within rural water security.

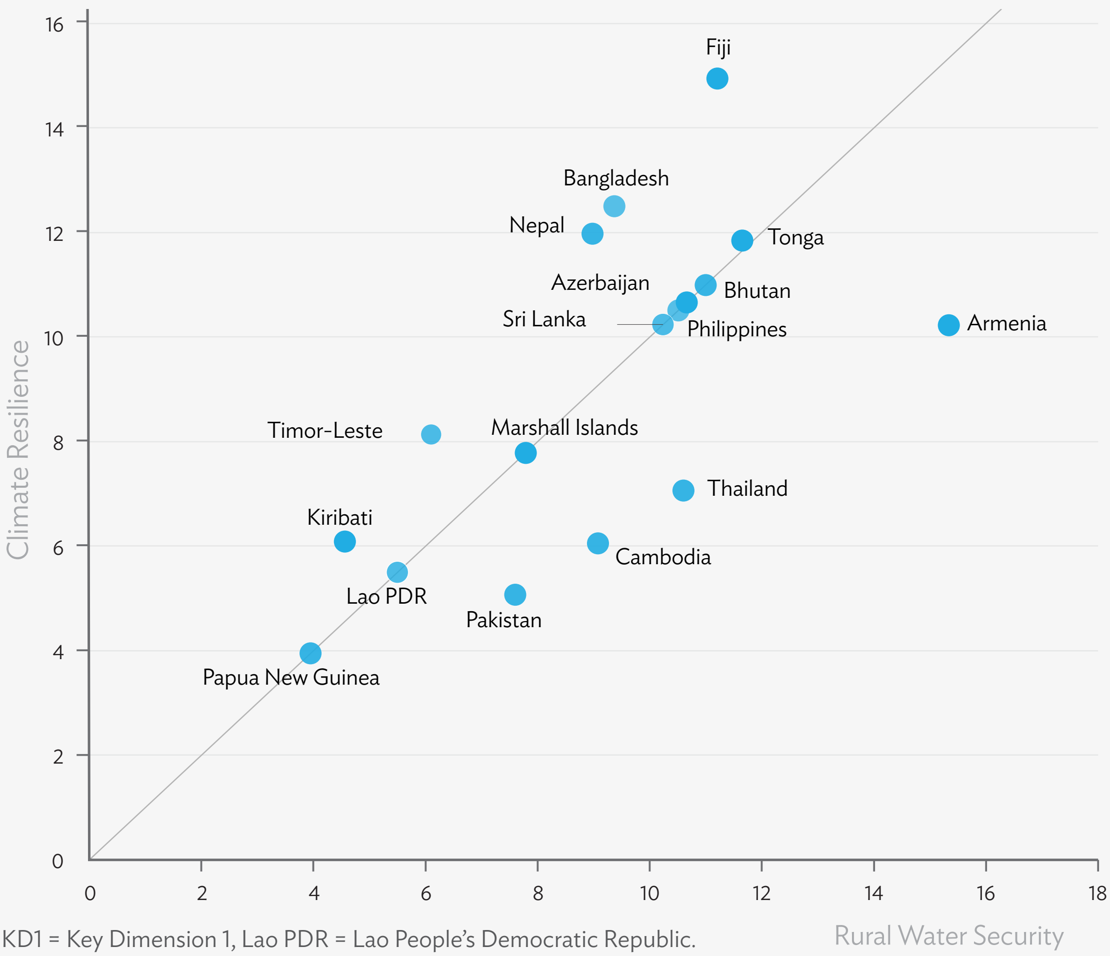
Across the Asia and Pacific region, 16 out of 42 countries have submitted NAPs, covering about 665 million rural residents. This represents roughly 31% of the total rural population in the region, leaving nearly 1.5 billion rural residents that are not covered by a NAP.

Implementation and monitoring are the weakest elements across most NAPs. While many plans identify risks, few include concrete strategies or effective systems to track progress. Only Bangladesh and Nepal received top scores for both implementation and monitoring.

- Bangladesh's NAP includes a clear list of rural WASH interventions and a monitoring framework with measurable indicators.
- Nepal's plan sets specific rural WASH goals and outlines infrastructure strategies to meet them.

Low-scoring NAPs often address water risks without focusing on rural WASH. Armenia's plan, for example, identifies water as a priority sector but does not mention rural-specific challenges. Cambodia's plan is outdated and lacks the detail needed to support action.

Figure 7. Progress on Rural Water Security



KD1 = Key Dimension 1, Lao PDR = Lao People's Democratic Republic.
Source: ADB.

Progress in Rural Household Water Security Since 2013

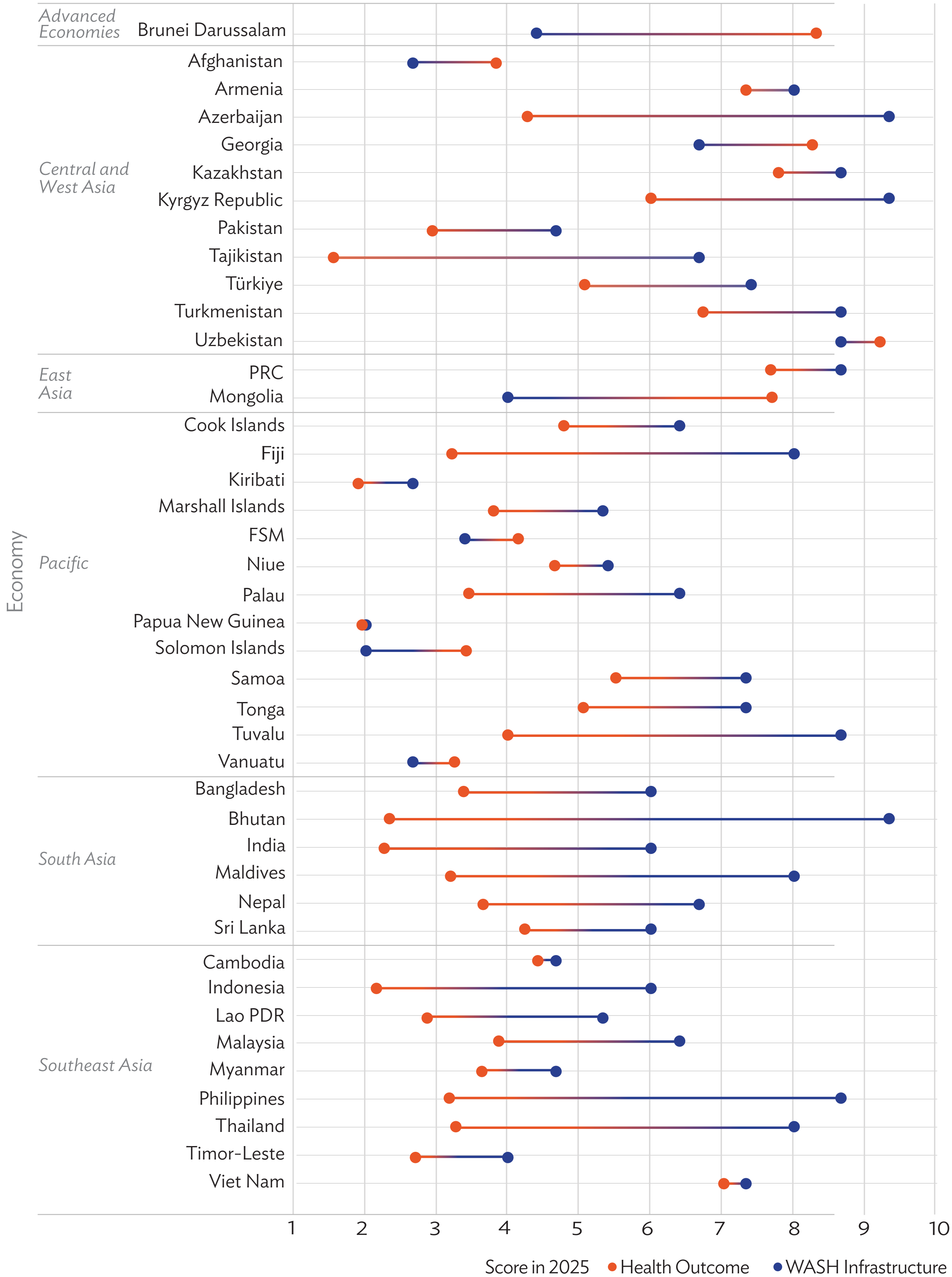
Comparing infrastructure and health outcomes helps assess the impact of WASH investments. This comparison shows whether improved access to services is leading to better public health. As shown in Figure 8 countries generally fall into three groups:

- Poor WASH and poor health;
- Good WASH and good health;
- Good WASH but poor health.

The *Good WASH but poor health* group raises critical concerns. Fifteen countries have made substantial progress in WASH infrastructure but continue to report weak health outcomes. These countries represented all regions. This challenges the assumption that infrastructure alone is enough to reduce the burden of diarrheal disease. **However, health improvements may still be emerging in some cases.** Countries in this group may simply need more time for health impacts to follow infrastructure upgrades, particularly if changes have occurred since 2020.

Vegetable farmer watering plants at the organic farm in Boung Phao Village, Lao PDR (Photo by ADB).

Figure 8. Gaps Between WASH Infrastructure and Health Outcome Scores (2025)



PRC = People's Republic of China, Lao PDR = Lao People's Democratic Republic, FSM = Federated States of Micronesia.
Source: ADB.

However, in other cases, progress has stalled. Maldives and Tuvalu, for example, have maintained strong WASH infrastructure scores since 2013 but their health outcomes have shown little improvement over the same period. This suggests that other factors, such as service quality, equity, and access in schools or clinics, or factors outside of WASH, may be limiting the health benefits of WASH investments.

Additional analysis identified four key factors behind the disconnect between WASH infrastructure and health outcomes. These factors help explain why improved services do not always result in reduced diarrheal disease.

1.

Higher service levels lead to better health outcomes.

Countries with stronger health results tend to have greater access to high-quality services. Compared to countries with weaker health outcomes, they have:

29% more access to piped and safely managed drinking water.

38% more access to safely managed sanitation.

16% more access to basic hygiene.

2.

Governance makes a significant difference.

Data from the *Global Analysis and Assessment of Sanitation and Drinking Water* (GLAAS) from 27 countries shows that weak implementation limits progress. Countries with poor health outcomes often have WASH policies in place but have less funding and trained staff to implement them.

3.

Access to WASH must extend beyond the household.

Many countries with strong household infrastructure still lack services in schools and other public spaces. This limits the broader health benefits that WASH services can deliver.

4.

Equity matters.

Wealth-based inequality plays a clear role. Countries with strong infrastructure but weak health outcomes tend to have higher inequality in WASH access. Data from the JMP (2025), using Gini coefficients, show that unequal distribution of services can undermine health gains, even in countries that appear to be performing well overall.

Box 1.

Empowering Women Through Rural Water Management in South Asia

Within homes, women and girls often carry the burden of water collection and laundry and face hygiene challenges during menstruation. They walk long distances, facing health risks and, in some cases, gender-based violence. This unpaid labor limits their opportunities for education or income, reinforcing cycles of poverty and dependence on unreliable water sources. Bringing safe, accessible water closer to home is essential for improving health, reducing time burdens, and protecting women's safety.

In Bangladesh, the Participatory Small-Scale Water Resources Sector Project shows what is possible when women are included in water management. The project supported 412 small-scale schemes for irrigation, drainage, and flood control. These schemes reached 220,000 hectares and benefited around 160,000 rural households. A strong gender action plan ensured that women made up 37% of Water Management Cooperative Association members. One in three committee leaders were women.

Women gained skills to operate and maintain systems, manage payments, and plan schemes. Their voices became more prominent in local decisions. As a result, cropped areas grew by 21%, cereal production increased, and household incomes improved. By involving women as co-managers of water systems, the project reduced unpaid workloads, boosted food security, and strengthened resilience to both floods and droughts.

Source: ADB. 2021. Bangladesh: Participatory Small-Scale Water Resources Sector Project.

Regional Analysis

Rural water security has improved in all subregions, but progress has not been even. Between 2013 and 2025, KD1 status scores rose across the board. East Asia and Central and West Asia made the strongest gains. In contrast, many countries in the Pacific and Southeast Asia saw slower progress.

Local Marma woman collects water from a water reservoir tank, Boli Para, Thanchi, Banderban, Bangladesh (Photo by ADB).

Central and West Asia

Central and West Asia has made steady gains in rural water security over the past decade. Across the region's 11 countries, the population-weighted KD1 status score increased from 7.1 in 2013 to 10.1 in 2025, moving the region from the lower to the higher end of the "emerging" water security step. This was supported by a 23% improvement in WASH infrastructure and a 29% improvement in health outcomes, which means that rural populations now have substantially better access to WASH services, alongside improved health outcomes, making it possible to focus more on service quality, sustainability, and reaching the last pockets of underserved communities.

Access to piped water is relatively high in this region. In eight countries, more than half of the rural population has access to piped water. Countries with legacy infrastructure from the Soviet era continue to perform well. Uzbekistan stands out, with both high coverage and a low burden of diarrheal disease.

However, gaps in system maintenance are holding some countries back. In Tajikistan, sanitation access is high, but water access is weaker, and under-five mortality from diarrheal disease remains high. This reflects a lack of investment in the maintenance and expansion of water systems. In Pakistan, both WASH infrastructure and health outcomes remain low. Open defecation is widespread as well. In Azerbaijan, inconsistent hygiene data suggests challenges in monitoring or reporting.

The region's progress is real but fragile. There is a clear link between infrastructure investment and better outcomes. However, future resilience is a concern. Few countries in the region have NAPs, and those that do often score poorly. Armenia and Pakistan are among the lowest performers on resilience.

To sustain and build on these gains, the region must strengthen climate adaptation and governance. Tajikistan offers a useful example. Its progress on sanitation shows what is possible, but its weaknesses in water access and health outcomes highlight the need for more balanced, long-term strategies. Expanding WASH access beyond the household, including in schools, is one step that could help ensure improvements are both equitable and lasting. Trajectories of indicator scores in this region are shown in (Table 4).

Table 4. KD1 Indicator Scores by Year in Central and West Asia (2013–2025)

	2013		2016		2020		2025	
Country	WASH Infrastructure Score	Health Outcome Score	WASH Infrastructure Score	Health Outcome Score	WASH Infrastructure Score	Health Outcome Score	WASH Infrastructure Score	Health Outcome Score
Afghanistan	2.0	2.7	2.0	2.9	2.0	3.4	2.7	3.8
Armenia	7.3	5.8	7.3	7.0	8.0	7.3	8.0	7.3
Azerbaijan	6.0	4.2	6.7	4.2	7.3	4.2	9.3	4.3
Georgia	5.4	6.5	6.7	7.0	6.7	7.7	6.7	8.3
Kazakhstan	8.0	6.4	8.7	7.5	8.7	7.7	8.7	7.8
Kyrgyz Republic	7.3	4.3	7.3	4.8	8.0	5.7	9.3	6.0
Pakistan	2.7	1.4	2.7	1.7	3.3	2.3	4.7	2.9
Tajikistan	5.3	1.0	6.0	1.1	6.7	1.5	6.7	1.6
Türkiye	6.4	4.1	6.4	4.0	7.4	4.0	7.4	5.1
Turkmenistan	6.7	4.9	7.3	5.0	8.7	5.2	8.7	6.7
Uzbekistan	6.4	7.6	6.4	8.3	8.0	9.1	8.7	9.2

KD1 = Key Dimension 1 (rural household water security), WASH = water, sanitation, and hygiene.
Source: ADB.

East Asia

East Asia has made strong progress in rural water security, though challenges remain. The region includes two countries: The PRC and Mongolia. Between 2013 and 2025, their combined population-weighted KD1 score rose from the *Capable* to the *Effective* water security step (10.7 to 16.3). This means that rural communities, particularly in the PRC, now have much greater physical access to WASH services. Trajectories of indicator scores for this region are in Table 5.

The PRC has led the way in expanding rural WASH services. Its WASH infrastructure score rose from 3.4 (2013) to 8.7 (2025). By 2025, 96% of the rural population had access to basic water, 93% to basic sanitation, and 72% to piped water. The PRC's health outcome score remained steady at 7.7, reflecting a low baseline burden of diarrheal disease.

Mongolia has improved more slowly, with major gaps still to address. Its WASH infrastructure score doubled from 2.0 in 2013 to 4.0 in 2025, meaning it moved from a situation where large parts of the rural population lacked even basic services to one where most households now have basic access to water, sanitation, and hygiene. However, higher service levels and quality remain limited. Only 16% of rural residents have safely managed drinking water, less than 9% have piped supply, and 15% still practice open defecation. Despite these gaps, Mongolia's health score reached 7.7, suggesting that targeted interventions such as rural health outreach and hygiene education may be helping to reduce disease burden. **Geographic and climate conditions are key constraints.** Harsh winters and limited heating, especially in Mongolia, make it difficult to deliver conventional WASH services, especially in rural and nomadic areas.

Climate adaptation remains a gap in the region. While Mongolia has yet to submit a NAP, the PRC has established the National Climate Adaptation Strategy 2035, which provides a comprehensive long-term framework even though it has not been formally submitted under the UNFCCC. The absence of a submitted NAP from either country still limits regional alignment under global adaptation processes, even as WASH service coverage and health outcomes continue to improve.

Table 5. KD1 Indicator Scores by Year in East Asia (2013–2025)

	2013		2016		2020		2025	
Country	WASH Infrastructure Score	Health Outcome Score	WASH Infrastructure Score	Health Outcome Score	WASH Infrastructure Score	Health Outcome Score	WASH Infrastructure Score	Health Outcome Score
China, People's Republic of	3.4	7.3	4.4	7.7	8.0	7.8	8.7	7.7
Mongolia	2.0	6.4	2.7	7.0	3.3	7.5	4.0	7.7

KD1 = Key Dimension 1 (rural household water security), WASH = water, sanitation, and hygiene.
Source: ADB.

Pacific

The Pacific has made modest but uneven progress in rural water security. Between 2013 and 2025, the region's population-weighted WASH infrastructure score more than doubled from 1.1 to 2.5, while the KD1 status score rose from 2.9 to 4.7. While this is a significant improvement, the region remains in the *Nascent* water security step. Health outcomes, however, showed minimal change, increasing only from 1.9 to 2.2. Most gains occurred between 2016 and 2020, with little improvement since. This means that while basic access is improving in some countries, poor health outcomes point to persistent service quality issues and the need for stronger integration of WASH with health and hygiene behavior change programs.

Small population size and data gaps limit planning and monitoring. Except for Papua New Guinea, countries in the region have populations under 1 million. Data collection is often infrequent, and four countries (Kiribati, the Marshall Islands, the Federated States of Micronesia, and Tuvalu) rely on projections based on data that is more than five years old. This lack of reliable information makes it difficult to design and target effective investments.

Access to services remains low, especially for sanitation and hygiene. Across the region, just 16% have access to safely managed sanitation and hygiene services, leaving 10.4 million people without these services. Open defecation remains widespread in Kiribati, the Marshall Islands, and Papua New Guinea. The Pacific has the lowest levels of access to basic sanitation, safely managed sanitation, hygiene facilities, and WASH in schools.

Some countries show leadership, while others face stagnation or decline. Samoa performs well on WASH indicators but has seen no recent gains. Tuvalu has nearly universal access to basic water, but only 5% of it is safely managed. The Cook Islands, despite being a high-income country, has limited WASH data and declining health outcomes. Health scores vary across the region, often due to the small size of each population.

Climate resilience remains a major concern. Only 5 out of 13 Pacific countries have submitted NAPs. This is concerning given the region's exposure to sea-level rise.[6] However, the existing NAPs cover 91% of the region's rural population. Strong regional coordination through the Pacific Islands Forum supports cooperation, but national adaptation planning remains limited.

The region needs better data, stronger planning, and tailored governance. Priorities include improving WASH data systems, accelerating national adaptation plans that include rural water security, and developing governance models that reflect the geographic spread and small population size of Pacific countries. Special attention is needed to ensure reliable and inclusive WASH access, especially in schools. Table 6 shows the trajectories of indicator scores in the Pacific from 2013 to 2025.

6. Fiji, Kiribati, the Marshall Islands, Papua New Guinea, and Tonga

Table 6. KD1 Indicator Scores by Year in the Pacific (2013–2025)

	2013		2016		2020		2025	
Country	WASH Infrastructure Score	Health Outcome Score	WASH Infrastructure Score	Health Outcome Score	WASH Infrastructure Score	Health Outcome Score	WASH Infrastructure Score	Health Outcome Score
Cook Islands	6.4	5.9	6.4	5.5	6.4	5.4	6.4	4.8
Fiji	6.4	2.6	7.4	2.9	8.0	3.1	8.0	3.2
Kiribati	0.4	1.4	2.7	1.5	2.7	2.0	2.7	1.9
Marshall Islands	2.4	3.8	4.7	3.8	4.7	3.8	5.3	3.8
Micronesia, Federated States of	2.4	4.1	3.4	4.0	3.4	3.9	3.4	4.1
Niue	5.4	4.3	5.4	4.1	5.4	4.5	5.4	4.7
Palau	6.4	3.6	6.4	3.6	6.4	3.5	6.4	3.4
Papua New Guinea	0.4	1.6	2.0	1.6	2.0	1.8	2.0	1.9
Samoa	5.4	5.8	6.4	5.7	6.7	5.6	7.3	5.5
Solomon Islands	2.7	3.0	2.0	3.2	2.0	3.0	2.0	3.4
Tonga	6.4	5.1	7.3	5.0	7.3	4.8	7.3	5.5
Tuvalu	5.4	5.0	5.4	6.5	8.7	6.6	8.7	4.0
Vanuatu	2.7	3.0	2.7	3.2	2.7	2.9	2.7	3.2

KD1 = Key Dimension 1 (rural household water security), WASH = water, sanitation, and hygiene.
Source: ADB.

South Asia

South Asia has made steady but uneven progress in rural water security. Between 2013 and 2025, the population-weighted WASH infrastructure score rose from 2.8 to 6.0, moving from moderate basic coverage to widespread basic coverage with some safely managed services. Health outcomes improved more sharply, rising from 1.3 to 2.4, reflecting significant reductions in diarrheal disease but still lagging infrastructure gains. Across the region, the KD1 status score increased from 4.1 to 8.4, with Bangladesh, India, and Sri Lanka moving out of the *Nascent* to the *Engaged* or *Capable* step.

WASH infrastructure improvements have not been evenly distributed. Bhutan has made rapid progress, now achieving full piped water coverage and high scores for safely managed drinking water. On the other hand, Bangladesh, with a rural population of 103 million, has the lowest piped water coverage in the region, at just 3%. India, Nepal, and Sri Lanka also score low on the rural drinking water index, with many households receiving basic water access, but few with safely managed services, or a piped supply. In Nepal, for example, 94% of the rural population has basic water access, but only 14% has safely managed water, reflecting quality issues. Sri Lanka continues to show an imbalance, with better access to sanitation than to water.

Open defecation has declined significantly since 2013. India reduced open defecation from 48% to 11%, and Nepal from 35% to less than 1%. These two countries also achieved very strong improvements in health outcomes. These gains highlight the major health benefits of eliminating open defecation.

In India, government programs have played a central role. The Swachh Bharat Mission improved rural toilet access. The Jal Jeevan Mission is expanding piped water coverage and is expected to deliver similar gains once newer data become available. These programs also support broader social benefits, such as reducing the burden on rural women (Singh 2024). Initiatives like Jal Jeevan Mission, Swachh Bharat Mission and AMRUT have already resulted in significant improvements; however, as 2024 is the most recent reference year available (found in the Joint Monitoring Report 2025 by WHO and UNICEF), to maintain a common reference year across countries, the full extent of these improvements may not yet be reflected. Future AWDO reports, drawing on data from 2025 or later, are expected to show further and more substantial progress. The long-term impact will depend on service quality, including reliability, water safety, and equitable access. Bangladesh's SafePaani program shows how professional service providers can improve outcomes in schools through results-based contracts (Charles et al. 2023).

Climate resilience in South Asia is strong. Many countries in the region have high-scoring NAPs and show good preparedness for future climate risks.

Table 7. KD1 Indicator Scores by Year in South Asia (2013–2025)

	2013		2016		2020		2025	
Country	WASH Infrastructure Score	Health Outcome Score	WASH Infrastructure Score	Health Outcome Score	WASH Infrastructure Score	Health Outcome Score	WASH Infrastructure Score	Health Outcome Score
Bangladesh	4.0	3.3	4.0	3.3	5.3	3.2	6.0	3.4
Bhutan	6.0	1.7	6.7	1.9	7.3	2.2	9.3	2.3
India	2.7	1.0	2.7	1.3	3.3	1.8	6.0	2.3
Maldives	6.4	3.1	8.0	3.2	8.0	3.3	8.0	3.2
Nepal	2.7	2.1	2.7	2.6	5.3	3.1	6.7	3.6
Sri Lanka	4.4	4.1	6.0	4.1	6.0	4.2	6.0	4.2

KD1 = Key Dimension 1 (rural household water security), WASH = water, sanitation, and hygiene.
Source: ADB.

The gap between infrastructure and health outcomes remains a concern. It highlights the need for ongoing investment in WASH systems that are not only expanded but also designed and managed to deliver high-quality, equitable services. The trajectories of indicator scores in South Asia from 2013–2025 can be found in Table 7.

Southeast Asia

Southeast Asia has made moderate gains in rural water security. Between 2013 and 2025, the region's population-weighted KD1 status scores rose from 7.0 to 10.1, moving from the low end of the *Engaged* into the *Capable* step. WASH infrastructure score increased the most 4.1 to 6.5, while health outcomes improved more slowly, rising from 2.9 to 3.6, or 24% overall.

Performance varies widely across the nine Southeast Asian countries. Despite the largest improvements, the Lao PDR and Timor-Leste continue to have lowest KD1 scores in Southeast Asia, with high open defecation and poor access to hygiene. The Lao PDR's KD1 score increased from 3.8 in 2013 to 8.2 in 2025, and Timor-Leste's from 2.4 to 6.7. Both entered the *Engaged* step between 2020 and 2025.

Indonesia's Pamsimas Program has expanded infrastructure, but governance is essential to maintain results. The Philippines showed a large jump in WASH infrastructure scores from 2020 to 2025. However, this rise is mainly due to the structure of the scoring method and is not yet matched by improvements in health outcomes.

Climate resilience remains a weak point for Southeast Asia. Fewer than half of the region's countries, including Cambodia, the Lao PDR, Myanmar, and Timor-Leste, have yet to submit NAPs, and most existing plans do not fully address rural needs. Cambodia's low KD1 scores reflect slow improvements in rural WASH coverage, ongoing open defecation, and poor service quality. Thailand's infrastructure coverage is high, but low health scores point to hygiene and water quality issues. Across the region, hygiene access, service quality, and open defecation remain persistent challenges, particularly in lower-income countries.

Viet Nam leads the region, improving from 10.9 in 2013 to 14.4 in 2025, moving from *Capable* into *Effective*. Viet Nam's rural WASH infrastructure score rose from 4.7 to 7.3, while health outcomes improved from 6.3 to 7.0. This reflects an integrated approach combining large-scale infrastructure investment, hygiene promotion, school WASH programs, and strong local governance. These combined efforts have significantly reduced diarrheal disease and improved overall rural health. The trajectories of indicator scores for this region from 2013 to 2025 can be seen in Table 8.

Table 8. KD1 Indicator Scores by Year in Southeast Asia (2013–2025)

	2013		2016		2020		2025	
Country	WASH Infrastructure Score	Health Outcome Score	WASH Infrastructure Score	Health Outcome Score	WASH Infrastructure Score	Health Outcome Score	WASH Infrastructure Score	Health Outcome Score
Cambodia	2.7	3.4	2.7	3.8	4.0	4.2	4.7	4.4
Indonesia	3.3	1.4	3.3	1.7	4.7	2.0	6.0	2.2
Lao PDR	2.0	1.8	2.0	2.1	2.7	2.5	5.3	2.9
Malaysia	6.4	4.0	6.4	4.1	6.4	4.0	6.4	3.9
Myanmar	4.0	2.9	4.0	3.1	4.7	3.3	4.7	3.6
Philippines	4.0	2.5	4.0	2.9	5.3	3.2	8.7	3.2
Thailand	7.3	3.0	7.3	3.2	7.3	3.4	8.0	3.3
Timor-Leste	0.4	2.0	2.0	2.2	3.3	2.4	4.0	2.7
Viet Nam	4.7	6.3	4.7	6.5	6.0	6.7	7.3	7.0

KD1 = Key Dimension 1 (rural household water security), Lao PDR = Lao People's Democratic Republic, WASH = water, sanitation, and hygiene.
Source: ADB.

Box 2.

Empowering the Next Generation: Youth Action for WASH and Climate Resilience

Most countries in South and Southeast Asia still lag in providing adequate water, sanitation, and hygiene (WASH) services to rural populations. This condition is exacerbated by climate change. The Key Dimension 1 indicators reflect more than just infrastructure, they represent a gateway to well-being and human development. One of the prominent examples in Indonesia is the province of East Nusa Tenggara (NTT). This area is known for prolonged drought, water scarcity, and poor WASH services, which places this province as one of the highest stunting prevalence in Indonesia.

Meanwhile, a growing number of youth movements are stepping up to address these issues. One of the examples is the Solar Chapter, a nonprofit organization established in 2017 by a young female from Indonesia, who graduated abroad. Driven by the passion to aid rural communities and solve water problems in NTT, they collect donations from within and outside Indonesia and engage the diaspora to install solar-powered water pumps in rural NTT. Using advanced technology and an innovative approach, they introduce and provide cutting-edge solutions in effective and sustainable water management in rural areas. They also use their networks to get support from the government and various private institutions for their project. Until mid-2025, about 32,000 people in more than 20 villages in NTT have benefited. More than 400 youths are involved in the projects, and they also prepare "The Next Generation of Water Leaders" by training and empowering more than hundreds of local youths to manage the water services in their communities. This example shows how youth can play a critical role in improving rural household water security and drive water access innovation through their enthusiasm, network, diaspora engagement, digital and technology literacy.

Source: D. Daniel, Lecturer in Environmental Health, Gadjah Mada University, Indonesia.

Author of this box: D. Daniel
Daniel is an Environmental Health lecturer at Gadjah Mada University, Indonesia, focusing on WASH, rural and indigenous communities, water quality and risk assessment, sustainability, and climate resilience, with research on behaviors, inclusive access, and youth adaptation to climate change across Indonesia's rural areas.

ADB provided over $20 million for the construction and rehabilitation of water and sanitation services in 400 villages in Nias and Aceh (Photo by ADB).

Conclusion and Findings

Rural water security in Asia and the Pacific has improved since 2020, but progress has been uneven and significant challenges remain. The 2025 assessment shows that while access to basic water has expanded across the region, sanitation and hygiene continue to lag. However, 280 million have access to basic sanitation without access to basic water. Health outcomes have not kept pace with these infrastructure gains. Since 2013, population-weighted KD1 scores have shown that, on average, households within the Asia and Pacific region have improved from the *Engaged* to the *Capable* water security step. WASH infrastructure scores increased by 37%, causing many of these improvements, but health outcome scores also rose by 14%. In around one-third of countries, strong infrastructure has not led to better health outcomes. This disconnect reflects a complex mix of factors, including low service levels, poor implementation, limited access beyond the household, and high inequality.

Improved services do not always translate into reduced diarrheal disease. Countries with stronger health outcomes tend to have higher levels of service. Compared to countries with weaker outcomes, they have better access to piped water, safely managed drinking water and sanitation, and basic hygiene. This shows that infrastructure quality matters as much as infrastructure coverage. Governance capacity is also critical. Data from the GLAAS survey shows that while many countries have WASH policies in place, those with weaker health outcomes often lack the funding and human resources to implement them effectively. Only 38% of these countries had funding available for planned rural water improvements, compared to 69% in stronger-performing countries, and only 43% had enough trained staff, compared to 63%.

Access to WASH also needs to go beyond the household. Many countries with good household infrastructure still lack reliable services in schools and public spaces. This gap undermines the broader health benefits of WASH. Inequality in access is another key issue. Countries with strong WASH infrastructure but poor health outcomes tend to have higher wealth-based disparities. Analysis using Gini coefficients from the JMP (2025) shows that unequal access to basic services can prevent infrastructure gains from reaching those who need them most.

For the first time, the 2025 assessment also considered climate resilience in rural WASH systems. This highlights a major area of concern. Most countries still lack reliable data or detailed national adaptation plans. Without stronger climate planning, current WASH systems remain vulnerable to risks like flooding, drought, and sea-level rise. Many of the gains made over the past decade could be reversed if climate threats are not addressed directly.

The findings of AWDO 2025 make it clear that investments in rural water security must focus on more than infrastructure. To maintain and build on current progress, countries must embed rural WASH into national adaptation plans and strengthen climate resilience. They must improve service quality, ensuring that the WASH systems are safe, reliable, and equitably delivered. Governance systems need support to close the gap between policy and practice. Countries should also expand WASH access beyond the home, especially in schools and health facilities. Without addressing these underlying drivers of inequality and system performance, the full health benefits of rural water security will remain out of reach.

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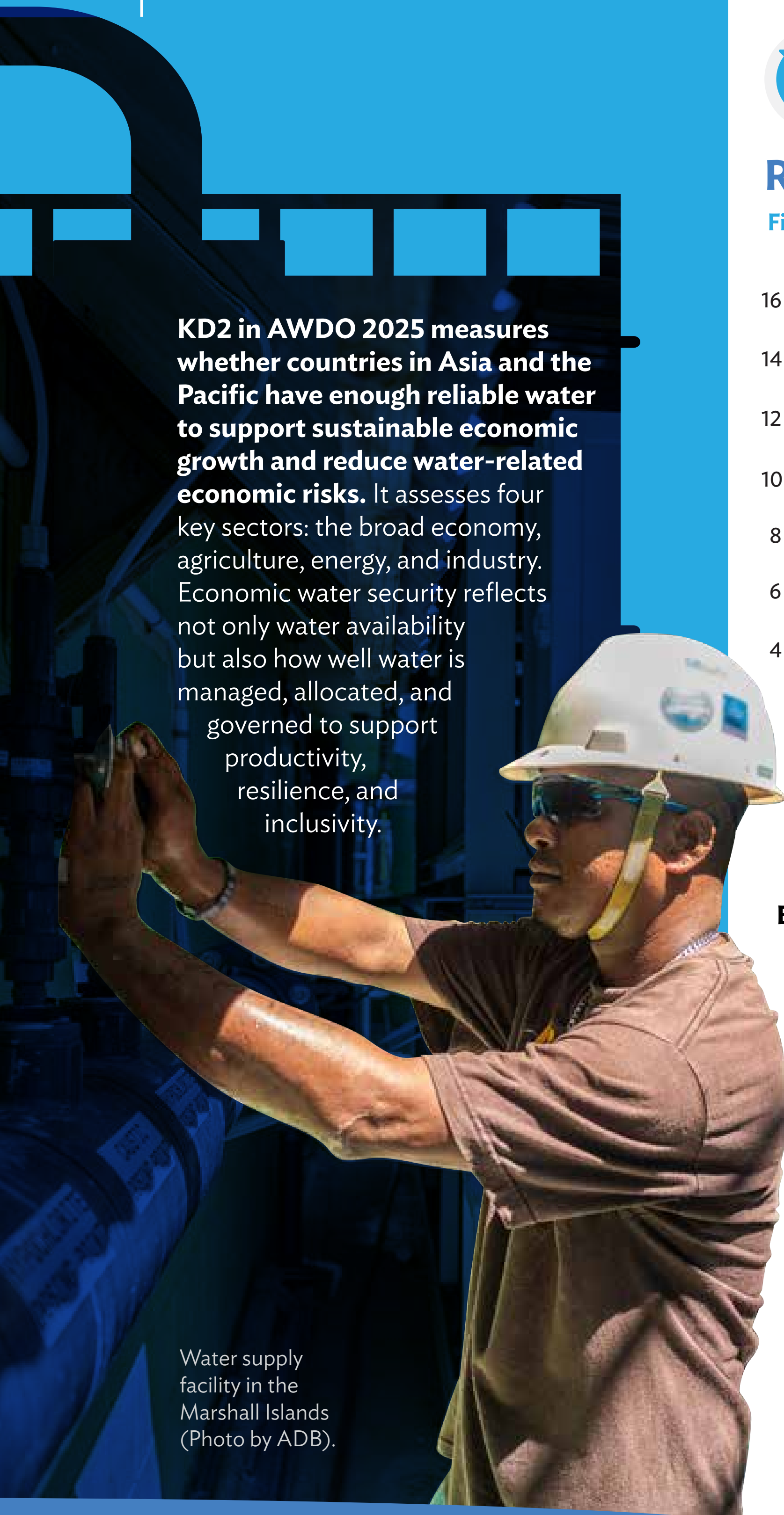
Indonesia Geothermal Power Generation Project (Photo by ADB).

Key Dimension 2:

ECONOMIC WATER SECURITY

Key Dimension in Brief



KD2 in AWDO 2025 measures whether countries in Asia and the Pacific have enough reliable water to support sustainable economic growth and reduce water-related economic risks. It assesses four key sectors: the broad economy, agriculture, energy, and industry. Economic water security reflects not only water availability but also how well water is managed, allocated, and governed to support productivity, resilience, and inclusivity.

Water supply facility in the Marshall Islands (Photo by ADB).

Indicators included in KD2:

 Broad Economy

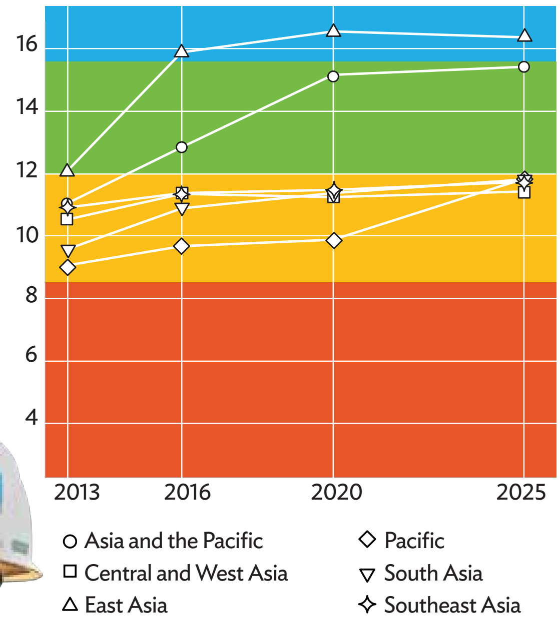
 Agriculture

 Energy

 Industry

Results

Figure 9. KD2 Regional Scores (2013–2025)



Source: ADB.

Economic water security has improved modestly across the region since 2013. The average KD2 score increased from 11.1 to 13.4 out of 20, moving from the *Engaged* to *Capable* water security step. Most gains came from agriculture, driven by improved irrigation efficiency, greater food self-sufficiency, and higher water productivity. Energy and industry also made moderate advances through renewable energy adoption, water-efficient manufacturing, and expanded circular water use such as wastewater recycling and industrial reuse.

Progress is uneven across countries and income groups. The largest gains (≥3 points) were recorded in the PRC, the Lao PDR, Niue, Tuvalu, and Tonga, supported by targeted investments in multiple sectors.

Table 9. Top Performers on KD2

Country	Niue	Tuvalu	Lao People's Democratic Republic	China, People's Republic of	Tonga
KD2 gain (2013–2025)	+4.7	+4.7	+4.3	+4.1	+3.5

Refer to the Pacific Regional Study for more details on AWDO data for the Pacific.
Source: ADB.

The largest KD2 gains were achieved by Niue and Tuvalu at +4.7, the Lao PDR at +4.3, and the PRC at +4.1 points, through sustained investments in water infrastructure, improved water productivity in agriculture and industry, and strengthened governance.

Moderate gains (1-2.9 points) were achieved by 20 countries, with 5 in South Asia including India, Bhutan, Sri Lanka, Bangladesh, and Maldives, often linked to energy sector improvements and economic growth enabling better water infrastructure. The Pacific also performed well in this group, reflecting incremental improvements in governance, data coverage, and water service reliability despite geographic and economic constraints.

Smaller gains (0.1-0.9 points) were recorded in 15 countries. These are either high-performing economies, starting from a high baseline and remaining stable, or several other stagnating countries. Timor-Leste and Nepal both improved the agriculture scores, but decreasing scores in other indicators resulted in no significant changes to KD2.

Cambodia recorded a decline of 0.9 points between 2013 and 2025 in KD2, reflecting fragmented water governance, weak institutional capacity, and rising pressures from rapid urbanization, industrial growth, and climate variability, which together constrained progress in integrated water resources management.

Findings and Recommendations

The 2025 KD2 findings reinforce that inclusive, integrated water management is essential for resilient economic growth. Innovation, regional partnerships, and targeted support are key to helping all countries in the region secure water as a foundation for sustainable development.

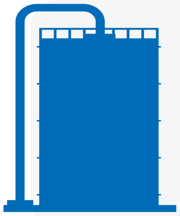
1. Asia and the Pacific is home to over 4 billion people, with **water demand rising due to rapid urbanization, population growth, and expanding economic activity.** Agriculture accounts for nearly 90% of fresh water withdrawals, well above the global average, while water use in energy and industry continues to grow. Climate change is intensifying these pressures by altering rainfall patterns and increasing the frequency of floods and droughts.

2. **Economic water security is not about how much water a country has. It is about how effectively that water is managed, governed, and used to support sustainable economic growth.** Some countries with limited water resources, such as Kazakhstan and the PRC, achieved effective economic water security through strong institutions and well-planned infrastructure despite having high levels of water stress. Others, such as Papua New Guinea, Nepal, and Georgia, underperform despite abundant water due to fragmented governance and outdated systems.

   In the Pacific, data gaps remain a major barrier to fully recognizing progress; several countries still appear as "No Data" for many indicators, highlighting the need to strengthen national water data systems and statistical capacity.

3. **To strengthen economic water security,** countries should invest in climate-resilient infrastructure and local storage systems, including nature-based solutions; improve water monitoring and governance through real-time data and digital platforms; promote water-efficient practices across agriculture, industry, and energy; strengthen regional cooperation in transboundary basins and shared economic systems; and ensure inclusive planning that reflects the needs of women and vulnerable communities.

Introduction



KD2 definition: *The assurance of adequate and reliable water to sustain economic growth and reduce vulnerability to water-related disruptions.*

Water security is now one of the most pressing economic and development issues for Asia and the Pacific. Rapid population growth, urbanization, and expanding economies have sharply increased demand for already limited water resources. With more than 4 billion people, the region is experiencing mounting water stress, and large parts of the population now face increasing exposure to water scarcity (FAO and AWP 2023). Agriculture is the main driver of demand in Asia, using nearly 90% of all fresh water withdrawals, which is far above the global average. This reflects the sector's central role in the region's economies, from the agricultural basins of India and the PRC to the remote islands of the Pacific.

Pressure on limited water resources continues to grow, especially as demand for food and energy rises. Climate change intensifies this stress. It increases the variability of water supply, causes more frequent droughts and floods, and shifts seasonal rainfall and snowmelt patterns (WMO 2024). These changes threaten the reliability of water for households, farms, factories, and power systems. Water security is a foundation for sustainable economic growth, disaster resilience, and regional stability.

KD2 assesses how effectively countries manage and allocate water across four sectors: the broad economy, agriculture, energy, and industry. These sectors are central to national development and rely heavily on water for continued productivity. They also underpin food security, energy generation, and industrial output, all of which are essential for inclusive and resilient growth.

Since the last AWDO assessment in 2020, the region has faced overlapping shocks. The coronavirus disease (COVID-19) pandemic disrupted agriculture, industry, and supply chains, revealing how dependent economic systems are on water. At the same time, the region has experienced inflation, energy price volatility, and rising geopolitical risk (S&P Global 2025). Climate impacts have made this worse, with more variable rainfall, unexpected dry seasons, and damaging floods (UNDP 2024). These effects are straining surface and groundwater supplies across sectors, while rising demand continues from growing cities, expanding industries, and changing diets.

Despite these pressures, many countries have taken steps to protect their water security and strengthen economic resilience. The 2025 KD2 update builds on AWDO 2020 by refining the framework, improving data quality, and increasing granularity. It presents updated KD2 scores for countries across the region, revealing current trends and persistent inequalities in economic water security. To ensure consistency, scores from 2013, 2016, and 2020 have been recalculated using the updated method.

Methodology

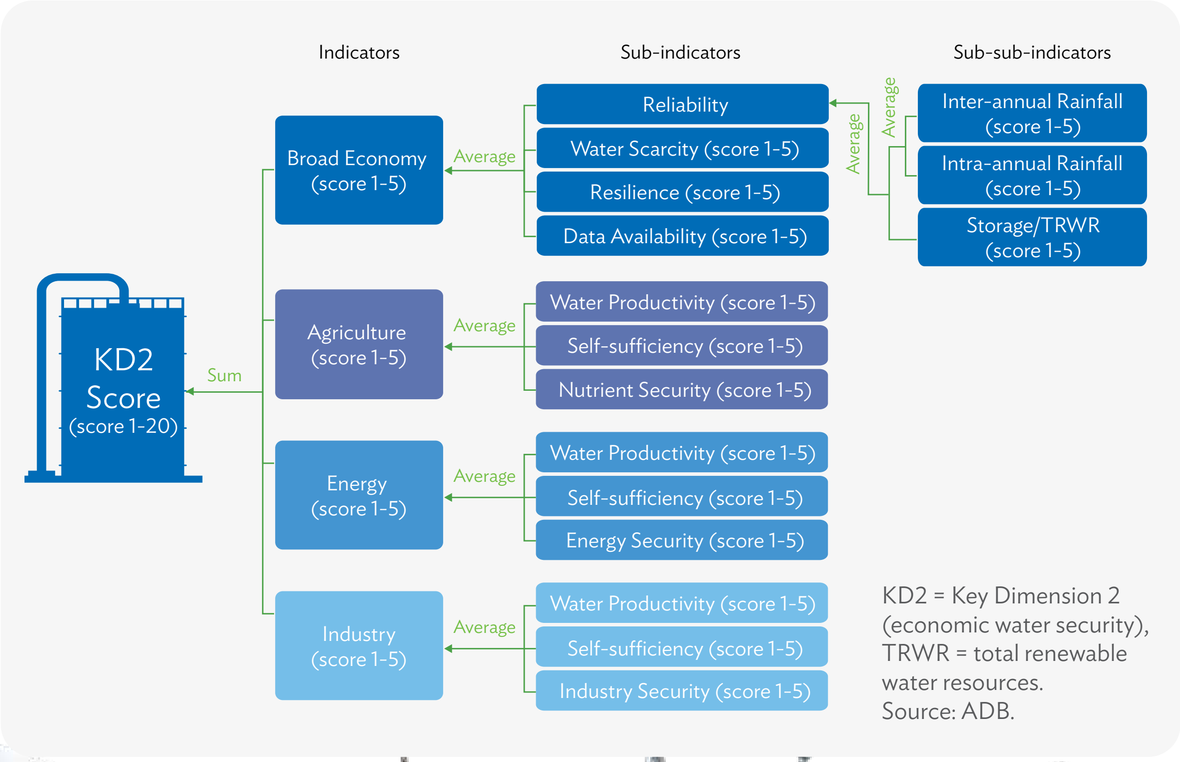
The 2025 AWDO assessment of KD2 builds on the framework and structure established in AWDO 2020 (ADB 2020b) (Figure 10). The overall approach remains consistent, organized around four sectors: broad economy, agriculture, energy, and industry. Each sector is assessed through a set of indicators that capture water's role in economic security, including aspects such as productivity, self-sufficiency, and reliability.

Each indicator is made up of sub-indicators, which represent the most detailed level of measurement in the KD2 framework. These sub-indicators draw data from national statistics, satellite observations, and outputs from global models. Sector scores are calculated by averaging three to four sub-indicators, each scored on a scale from 1 to 5. A country's KD2 score is the sum of its four sector scores, with a maximum possible score of 20.

The **broad economy** sector includes indicators related to resilience, reliability, water scarcity, governance, and investment. The **agriculture, energy,** and **industry** sectors each use indicators that reflect productivity, self-sufficiency, and sector-specific water security. These indicators combine hydrological, economic, and operational metrics to assess how effectively countries manage and allocate water for sustainable economic development.

As in earlier editions, the 2025 assessment applies a data-driven approach. It draws on globally available sources, including remote sensing data, to ensure complete regional coverage. To enable comparison across time, historical KD2 scores from 2013, 2016, and 2020 have been recalculated using the updated 2025 methodology. This ensures consistency and allows for clearer analysis of trends over the past decade.

Figure 10. Methodology for KD2



KD2 = Key Dimension 2 (economic water security), TRWR = total renewable water resources.
Source: ADB.

A worker operating a water pump system to provide water for irrigation fields area (Photo by ADB).

Final KD2 scores are grouped into five performance steps: ***Model, Effective, Capable, Engaged***, and ***Nascent***, based on composite score ranges from 8.4 to above 19.2 (Table 10).

Table 10. Narrative Description of the Steps and Corresponding KD2 Scores

Water Security Steps	KD2 Score (out of 20)	Description
Model	>19.2	Economic water security is very high. Water is available, well-managed, and used efficiently across all sectors. • Water supply meets all needs, including environmental flows. • Storage and infrastructure are sufficient to manage demand, floods, and droughts. • Agriculture, energy, and industry use water efficiently and productively. • The country is largely self-sufficient in key goods and does not need additional water to ensure supply. • Monitoring systems are in place, and data are used to guide management.
Effective	15.6–19.2	Economic water security is high. Most water-related needs are met, and systems are in place to manage key risks.
Capable	12–15.6	Economic water security is moderate. Some systems are in place, but important gaps remain in water availability, efficiency, or management.
Engaged	8.6–12	Economic water security is low. Several criteria are not met, and systems for managing water are underdeveloped.
Nascent	<8.6	Economic water security is very low. Few or no systems are in place to manage water availability, risks, or sectoral needs.

Source: ADB.

While the overall architecture remains consistent with the 2020 assessment, the 2025 update includes several important improvements. These include refinements to how indicators are calculated, increased resolution of underlying data, and better alignment with evolving global targets such as the SDGs. These changes included:

Broad Economy

- Water scarcity: Updated to align with SDG 6.4.2, combining FAO Aquastat data with remote sensing (ESA land cover and SSEBop ETa) for improved accuracy.
- Resilience: Drought duration now calculated using higher-resolution (1 kilometer [km]) monthly discharge data from the updated PCR-GLOBWB model.
- New indicator: Per capita water infrastructure investment added, reflecting national investment in water systems relative to population.

Crosscutting Updates

- Sub- and sub-sub-indicators refreshed with 2021–2024 data to capture post-COVID and climate impacts.
- Enhanced use of satellite data improved spatial accuracy and consistency.
- Adjusted scoring and proxies applied to address missing data, especially for small island states.
- Historical scores (2013–2020) were back casted using the 2025 method to allow trend analysis.

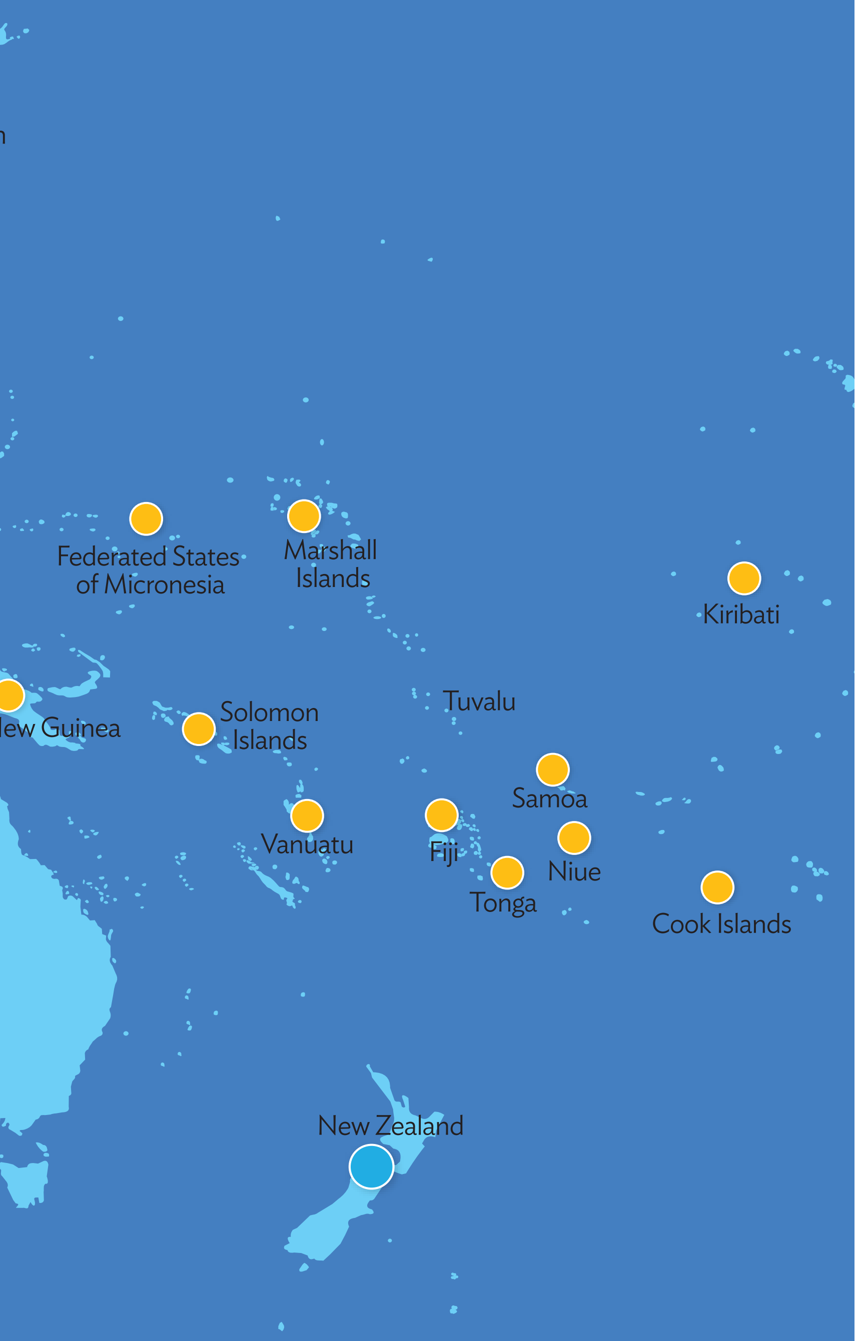
Agriculture

- Water productivity: Now uses consistent annual data for both GDP and water use, with improved cropland mapping (ESA 10m mask) and ETa estimates.
- Nutrient security: Scored against a 2,500 kilocalories/day benchmark using FAOSTAT data to assess food availability and dietary adequacy.

Figure 11. KD2 Composite Score Classification for the Asia and Pacific Region

KD2 = Key Dimension 2 (economic water security),
Lao PDR = Lao People's Democratic Republic.
Source: ADB.

Results and Discussion



Economic Water Security 2025 Overview

Economic water security is improving, but gains are uneven and sector-specific. Between 2013 and 2025, the region's average KD2 score rose from 11.1 to 13.4 out of 20, moving from the *Engaged* to *Capable* water security step. This has reflected incremental progress in agriculture, energy, industry, and the broad economy, but with wide disparities between countries and persistent gaps in governance and investment.

The strongest gains were in the agriculture sector, which improved by 0.6 points on average. This reflects measurable increases in water productivity (more value or yield per unit of water used), greater domestic food self-sufficiency (a higher share of demand met locally), and improved food security (reduced undernourishment and more stable supply). Many countries, however, still need targeted investment in modern irrigation, climate-resilient farming systems, and better storage and distribution networks.

The other elements of KD2 showed more modest gains. The industry sector improved from 2.7 in 2013 to 3.0 in 2025, reflecting better water-efficient processes in manufacturing and other water-intensive industries. Small and medium-sized enterprises, however, still face barriers in accessing finance and incentives for technology upgrades. **The energy sector gained 0.2 points,** from 3.1 in 2013 to 3.3 in 2025, driven mainly by increased electricity generation and more efficient water use in thermal and hydropower plants. **The broad economy score rose modestly from 2.6 in 2020 to 2.7 in 2025.** Gains in this area depend on reliable water services for economic activity, but many lower- and middle-income countries continue to underinvest in industrial water recycling and water distribution networks.

The 2025 results highlight both emerging strengths and areas that need continued focus, especially in governance and investment.

Figure 11 shows the KD2 classification for 2025 across Asia and the Pacific, highlighting wide variation in performance. High-income economies tend to score consistently well, while middle-income economies have shown progress since 2013, though with varying trajectories.

General Trends and Distribution

Economic water security shows wide variation across Asia and the Pacific. In 2025, KD2 composite scores for 50 economies ranged from 8 to 17.8 out of 20, reflecting major differences in water governance, infrastructure, and economic productivity (Figure 12). Higher scores indicate stronger performance in securing water for agriculture, energy, and industry, supported by robust governance, infrastructure, and self-sufficiency. Lower scores signal weaker capacity, low sectoral productivity, and limited resilience to shocks.

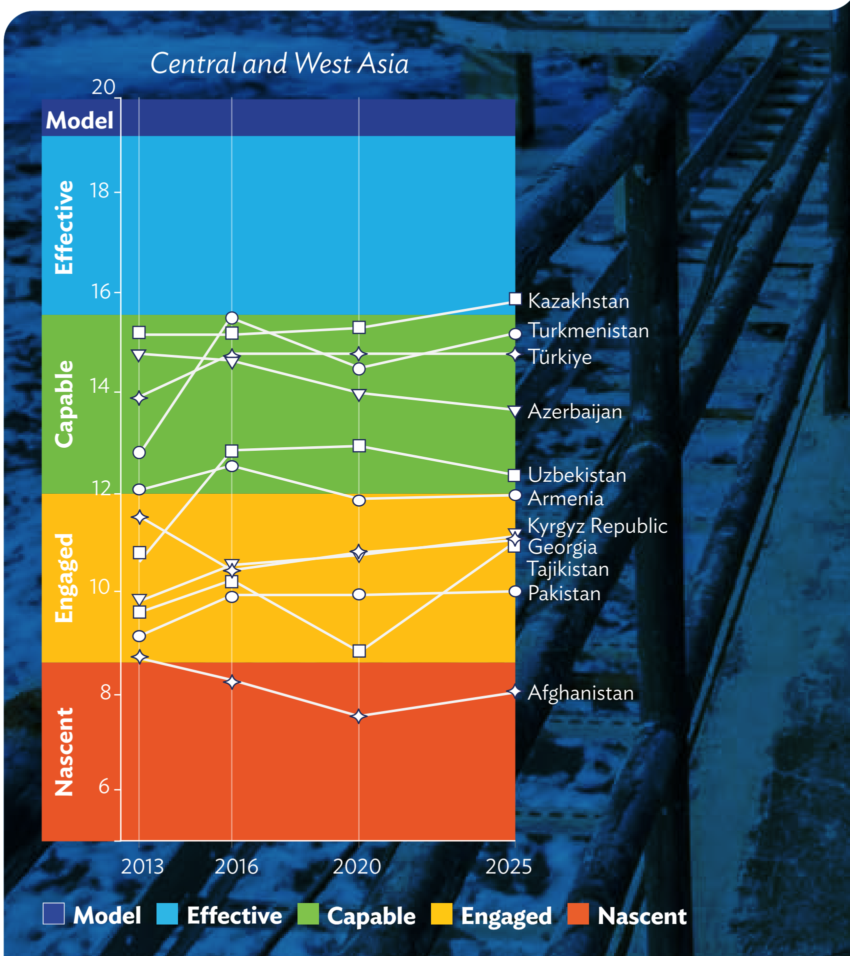
No economy reached the top *"Model"* step, which requires consistently high performance across all economic sectors alongside strong governance and infrastructure. Only eight economies were classified as *Effective,* meeting many criteria for economic water security. These include high-income economies such as Australia; the Republic of Korea; Taipei,China; and New Zealand, as well as Hong Kong, China and city-state Singapore, where well-developed infrastructure and strong cross-sector coordination underpin performance.

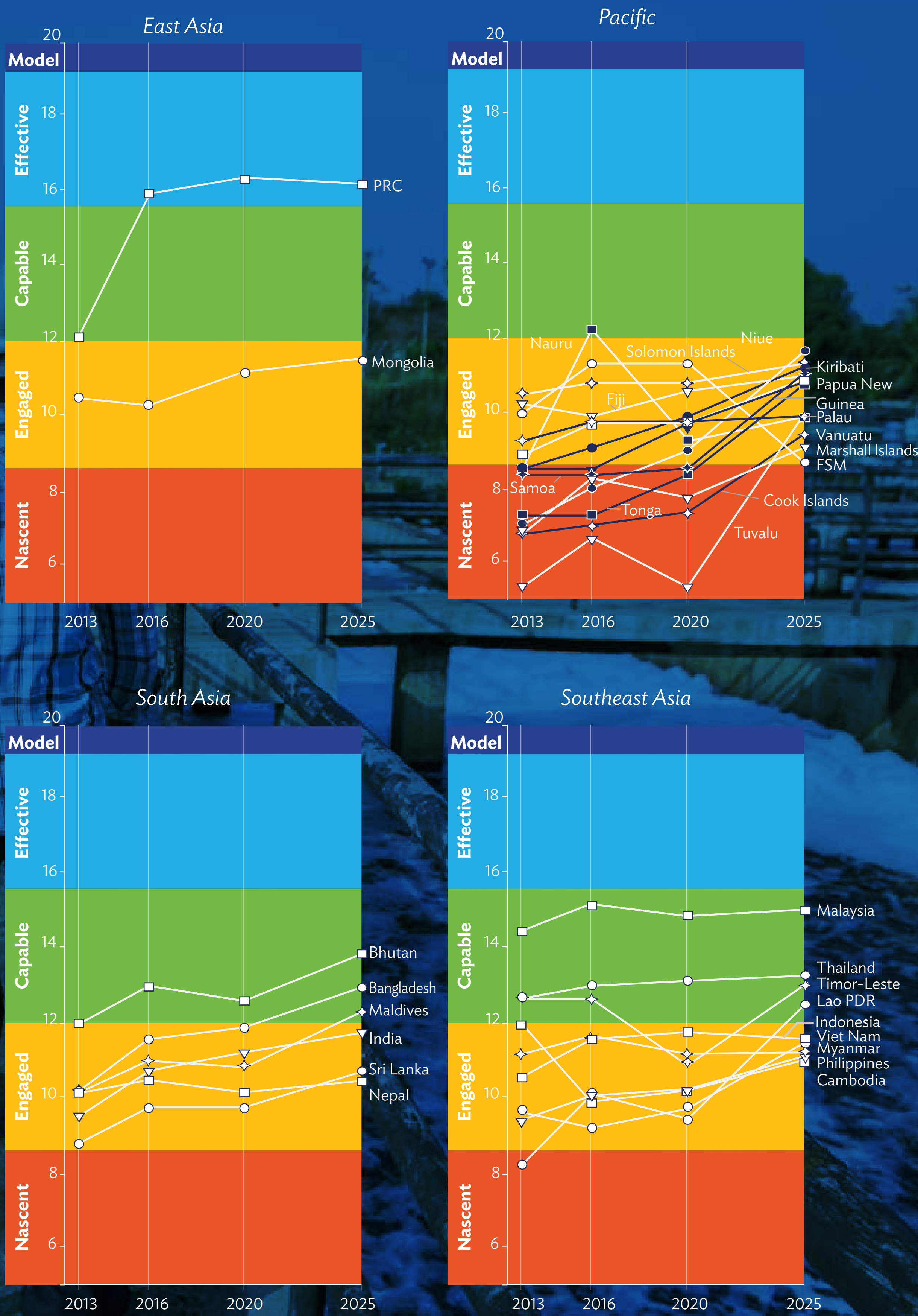
Upper-middle-income economies show more mixed results. Countries such as the PRC and Malaysia perform strongly, but others, including Georgia, Indonesia, and Armenia, face challenges in scaling infrastructure, modernizing institutions, and integrating water management across sectors. Several small island developing states (SIDS) in this group score lower due to small economies, geographic isolation, and high climate vulnerability.

Lower-middle-income economies generally score between 10 and 14, spanning the higher end of *Engaged* to the lower end of *Capable*. Examples include Bangladesh, India, Pakistan, the Philippines, and Viet Nam, where irrigation expansion, industrial upgrades, and energy improvements are evident. However, bottlenecks in governance, service reliability, and technology adoption limit overall gains. Fourteen countries fall into the *Capable* step, showing improvement in one or more sectors but still facing constraints such as low investment in water infrastructure, limited climate resilience, or gaps in industrial water productivity. A further 27 countries are in the *Engaged* step, where weak infrastructure, low agricultural productivity, and underdeveloped energy and industrial sectors constrain progress. Around 2.5 billion people, 62% of the region's population, live in countries in these two steps, making progress here critical for regional advancement.

Low-income economies face the steepest barriers. Most score below 10, in the *Nascent* or *Engaged* steps, reflecting limited infrastructure, weak institutions, and high exposure to climate and conflict risks. Afghanistan, with a score of 8, is the only country classified as *Nascent*, highlighting very low economic water security and underdeveloped enabling systems. Other countries, such as Papua New Guinea and Solomon Islands, also face high service delivery costs, geographic isolation, and climate-related shocks. About 34 million people remain in the lowest step of economic water security, where urgent action is needed to address entrenched vulnerabilities.

Figure 12. Trends in KD2 Scores (2013–2025)





PRC = People's Republic of China, KD2 = Key Dimension 2 (economic water security), Lao PDR = Lao People's Democratic Republic, FSM = Federated States of Micronesia.
Source: ADB.

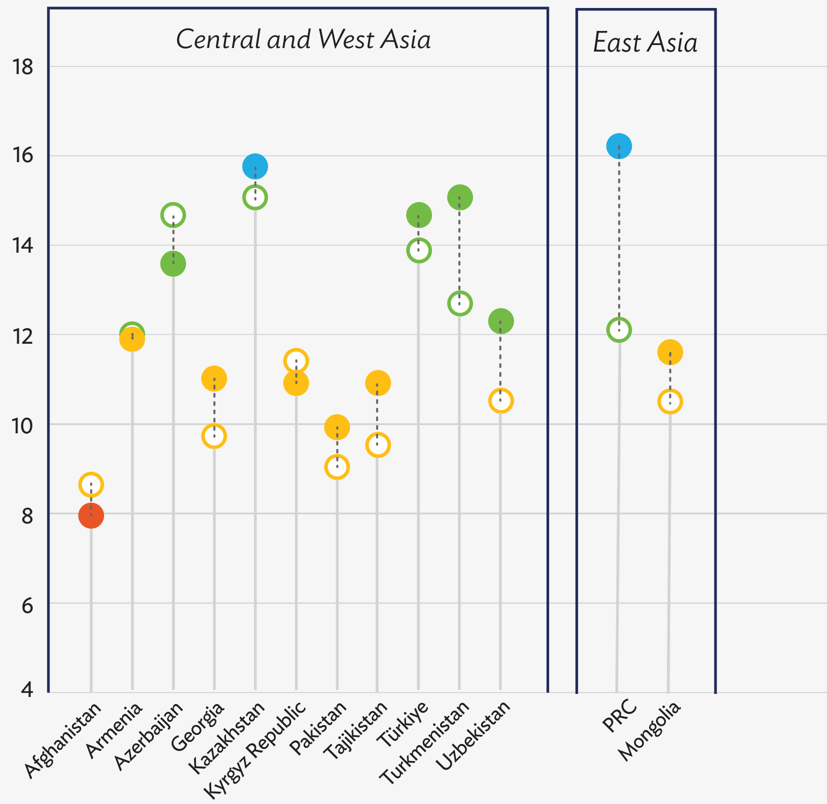
Progress in Economic Water Security

Several countries have made notable progress in economic water security since the 2013 AWDO assessment, as reflected in improved KD2 scores (Figure 13).

The Lao PDR recorded the most significant increase, with a 4.3-point gain in its KD2 score, it is now at the *Capable* water security step. This progress was driven by strong performance in the energy sector, linked to the operationalization of major hydropower projects such as Xayaburi and Nam Theun (ANDRITZ Hydro 2020, Indradipradana and Sari 2024), which have expanded water storage and increased energy production capacity. However, these projects are also the cause of the decreasing KD4 CASCI score, highlighting the importance of balancing impacts across KDs. Three island nations, Tuvalu, Niue, and Tonga, also recorded increases of more than 3.0 points; however, this was primarily due to data inconsistencies. In these cases, the gain reflects updated data on energy production, particularly from oil-based systems supplemented by solar expansion, as well as methodological adjustments in 2025 that gave greater weight to indicators with complete data. The higher scores may indicate more efficient energy generation with lower water use, but the absolute volume of water saved is small, and agriculture and industry often remain underdeveloped. These results underscore the importance of interpreting score changes in context and highlight the need for robust, sector-level data to track real progress.

A larger group of countries achieved moderate gains of 1 to 2.9 points. These include 20 countries form all regions. Improvements in energy sector scores were common across many of these countries, partly due to updated data and improved estimates of water productivity. In larger economies such as Bangladesh, Tajikistan, and Viet Nam, gains were spread across multiple sectors. Increases in GDP contributed to stronger scores in agriculture, industry, and infrastructure indicators. These gains reflect how economic development often supports investment in water systems and governance, leading to more efficient and productive water use.

Figure 13. Changes in Economic Water Security Scores (KD2) (2013–2025)

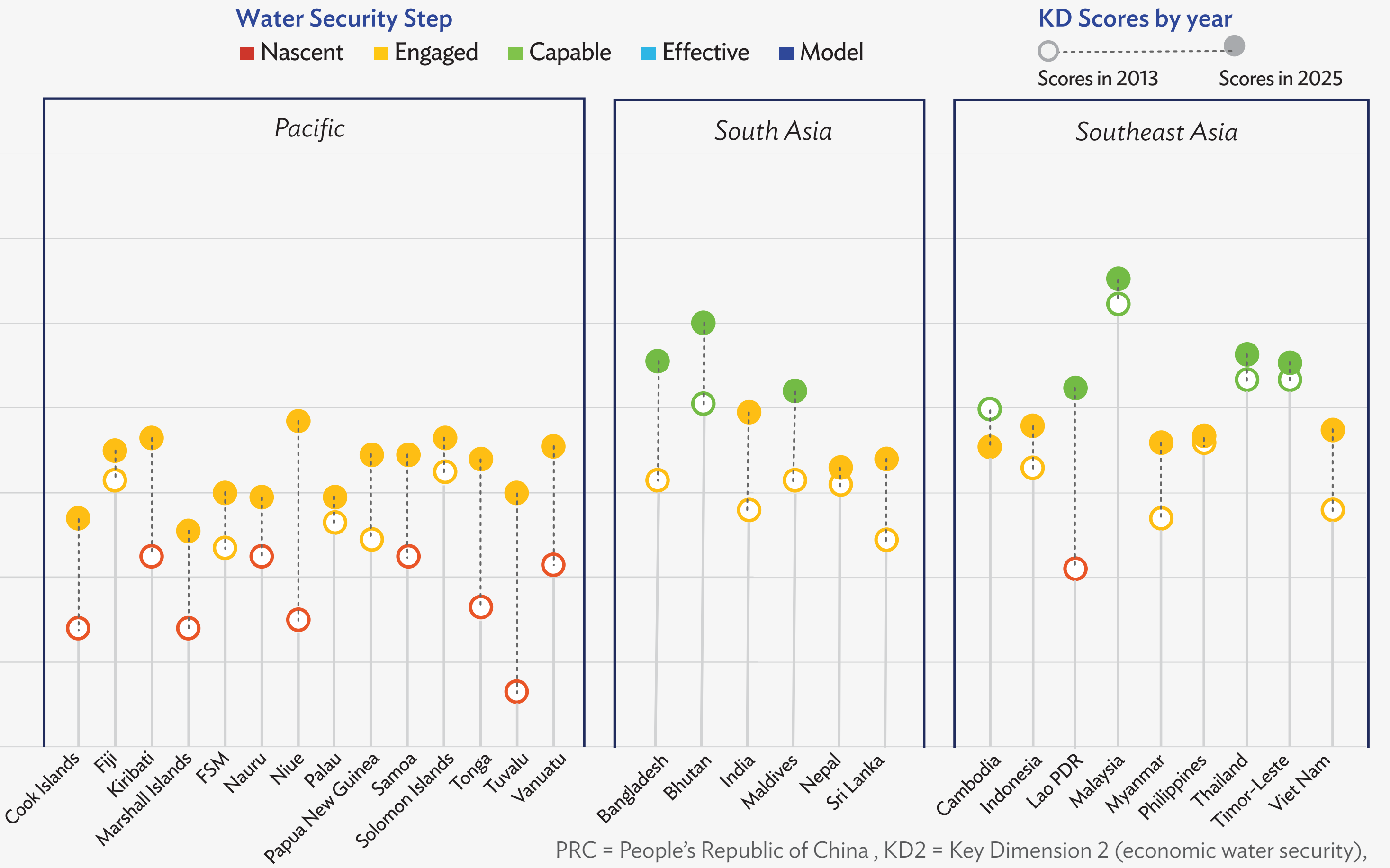


Source: ADB.

Sri Lanka's KD2 score increased despite an economic crisis, suggesting that the scoring framework emphasizes medium-term structural trends over short-term shocks. Myanmar also posted gains due to ongoing infrastructure operation and earlier investments.

Fifteen countries recorded smaller increases of between 0.1 and 1 point. This group includes both high-income economies and developing countries. In these economies, most systems are already mature, so large gains are harder to achieve. Modest increases were linked to gradual transitions to renewable energy, adoption of efficient industrial processes, and modernization of irrigation. Expanding circular water use, including wastewater recycling and industrial reuse, also contributed to higher sectoral productivity.

Pakistan's score has remained largely flat across the 2016, 2020, and 2025 assessments, remaining in the *Engaged* water security step. Despite being one of the region's largest economies with a significant agricultural base,



PRC = People's Republic of China , KD2 = Key Dimension 2 (economic water security), Lao PDR = Lao People's Democratic Republic, FSM = Federated States of Micronesia.

persistent inefficiencies in water use, weak industrial performance, and limited infrastructure upgrades have constrained progress.

Some countries have shown little or no change in KD2 scores since 2013. In some cases, this reflects persistent structural challenges, while in others it is due to limited or outdated data. For example, the Federated States of Micronesia rely on older or proxy data for parts of the agriculture, energy, and industry components, making it difficult to capture recent developments.

In high-income economies, score stagnation may reflect a leveling-off effect, where earlier gains from infrastructure and governance reforms have been fully realized. For these economies, the priority now is maintaining and adapting strong systems by renewing and upgrading infrastructure, investing in advanced monitoring and leak detection, improving efficiency in agriculture (e.g., precision irrigation), in industry (e.g., closed-loop cooling systems), and in energy (e.g., low-water renewable generation), and strengthening resilience to climate variability. In rapidly developing economies, growing water demand and regional disparities may have introduced new pressures, particularly in the agriculture and energy sectors. Here, the challenge is to expand coverage while balancing demand, for example through investment in diversified water sources, demand management policies, and better integration of water planning with economic growth strategies. In several cases, apparent score declines were linked to gaps in data availability rather than an actual deterioration in water security.

Several countries in the Pacific still appear as "ND" (no data) for many KD2 indicators (including Kiribati, Tuvalu, Nauru, Niue, the Marshall Islands, the Federated States of Micronesia, and Palau). In cases where proxies or partial inputs were used, results are reported with clear notes on uncertainty. Some of these countries have made real progress in infrastructure or service delivery, but poor data coverage prevents full recognition in the KD2 scores. This highlights the need for investment in water data systems and national statistical capacity across data-scarce countries.

Regional Results

Central and West Asia: Stable Scores But Emerging Risks

Central and West Asia maintained average KD2 scores between 10.6 and 11.4, with little change over time. While basic infrastructure remains in place, progress has slowed in sectoral efficiency and governance reform. More advanced water management and cross-sector coordination will be needed to accelerate improvement. The region is increasingly vulnerable to upstream glacier melt in the Tian Shan and Pamir mountains and snowpack loss in key basins like the Amu Darya and Syr Darya (Maharjan et al. 2018, Khan et al. 2024). These changes threaten dry-season flows and may intensify water competition between riparian states, especially for irrigation.

East Asia: High Performance with Continued Investment

East Asia leads the region in economic water security, reaching the *Effective* step in 2025. Strong institutional frameworks, reliable infrastructure, and high productivity across agriculture, energy, and industry underpin this performance. Since 2013, and led by the PRC, East Asia has improved its KD2 score by over four points, while Mongolia has also improved at a slightly slower rate. This reflects sustained investment in water-related infrastructure and governance. For example, the PRC invested $187.8 billion in water conservancy infrastructure in 2024 (SCIO 2024).

Pacific: Data Gains and Energy Transitions, But Deep Structural Challenges

The Pacific remains the most vulnerable subregion. Most improved from the *Nascent* to *Engaged* step. Increased renewable energy capacity and improved data availability were key drivers of this progress. Between 2013 and 2025, in Nauru, renewable capacity rose by 30% from 650 kilowatts (kW) to 830 kW (IRENA 2023). However, structural constraints remain. Many Pacific island nations face geographic isolation, limited fresh water, and high exposure to climate risks. These conditions continue to limit economic water security, despite recent gains.

South Asia: Gradual Gains from a Low Starting Point

South Asia has shown steady, moderate improvement since 2013. The regional average rose from 9.6 to 11.9 in 2025. Countries like Bangladesh and India have contributed

Dil Maya Magar shows off some of her bumper crop from her farm in Thade, Nepal (Photo by ADB).

most to this progress through gains in agricultural productivity and food security (Morita, 2021; Sulakshana, 2024). However, gaps remain in industrial water use, infrastructure reliability, and institutional coordination.

Southeast Asia: Sectoral Progress with Regional Disparities

Southeast Asia has also made moderate progress over the last decade, increasing from 10.9 to 11.8. KD2 scores have climbed steadily, with improvements seen in water use efficiency and broader sectoral development. However, performance varies across economies. Some, like Malaysia and Viet Nam, have shown cross-sector gains, while others continue to face challenges in energy access, data availability, and water productivity (Liu et al. 2020).

Asia and the Pacific Overall: Uneven Progress

Across the region, average KD2 scores rose from around 11.1 in 2013 to just above 13.4 in 2025 (Figure 14). This reflects broader efforts to improve water infrastructure and governance, but the average masks deep disparities. Some countries remain well below the regional average, while others have made only incremental gains.

The 2025 KD2 results reaffirm that economic water security is not determined by water abundance alone. Countries in arid and semi-arid areas, such as parts of Central and West Asia, have exceeded expectations through investment in water storage, sectoral productivity, and governance. In contrast, countries like Nepal, despite relatively abundant resources, continue to underperform due to governance fragmentation, unmanaged demand, and inadequate infrastructure.

These findings reassert a critical distinction: **economic water security is not about absolute water availability, but about an economy's ability to sustainably manage and deliver water to support resilience under variable and sometimes adverse conditions.** In a region where many major rivers are transboundary, the 2025 KD2 results highlight the growing importance of regional cooperation. Countries with declining or stagnant scores can benefit from peer learning with neighbors that have improved water security through policy reform and strategic investment.

Box 3.

Inclusive Irrigation Strengthens Economic Water Security in Nepal

Equitable access to irrigation is essential for economic water security, especially in rural areas where women are often excluded from water decisions. In Nepal, the Community Irrigation Project rehabilitated 190 farmer-managed systems across 12 districts. These systems now serve about 16,000 hectares and benefit roughly 160,000 farmers.

The project included a strong focus on gender equality. Through its Gender Equality and Social Inclusion Action Plan, the share of women in Water User Associations increased to between 25 and 33%. More than 4,000 women received training in water scheduling, fee collection, recordkeeping, and basic system operation, all tasks traditionally handled by men.

Women's increased involvement made irrigation more reliable. Their participation improved transparency, boosted fee collection, and helped ensure timely maintenance. As a result, irrigation coverage expanded and cropping intensity increased by 20-30%, improving food security and household incomes.

While some cultural barriers to leadership remain, the project shows that targeted training and inclusive water governance can strengthen women's economic roles and improve water system performance.

Source: ADB. 2020. Performance Evaluation Report: Nepal Community Irrigation Project.

Box 4.

Tapping Youth Energy to Boost Water Productivity (and Efficiency)

In the push for economic water security across Asia and the Pacific, youth, who comprise more than half of the region's population, represent a largely untapped yet incredibly potent force. If young people today are not made aware of the urgent and interlinked challenges in securing water for productive sectors, the region risks facing a dual crisis: resource scarcity and a deficit in future leadership.

Water productivity and efficiency—getting more economic value per drop—are not just technical challenges; they are also deeply social ones, shaped by how policies land at the local level. And that is precisely where young people shine. Yet, their participation in economic water security remains minimal.

Imagine a group of tech-savvy vocational students stationed across irrigated districts—not as spectators, but as real-time observers of how water systems are actually used. With mobile tools in hand, they log anomalies, track leakages, and report how water plans translate into field realities. Their hyper-local insights do not just fill data gaps—they provide project teams with the actionable intelligence needed to fine-tune implementation and improve outcomes.

Mobilizing youth as monitors, communicators, and field-level connectors does not just close feedback loops—it creates a pipeline of skilled water stewards ready to lead tomorrow's systems. In this landscape, youth engagement is not a courtesy—it is a strategic upgrade.

Source: Abu Touhid Hossain, Junior Program Officer, Global Center on Adaptation (GCA), Bangladesh.

Author of this box: Abu Touhid Hossain

Abu Touhid Hossain is a Junior Program Officer at the Global Center on Adaptation (GCA), working on climate-resilient infrastructure and nature-based solutions. He holds an Erasmus Mundus MSc in Euro Hydroinformatics and Water Management and has experience supporting adaptation projects across Asia and Africa.

Students attending a class at Menengah Kejuruan Negeri, or State Vocational School, Sleman, Yogyakarta Province, Java, Indonesia (Photo by ADB).

For countries with moderate scores, especially those that share river basins or depend on cross-border trade in food, energy, and water-related goods, there are strong incentives to collaborate. Joint efforts in water infrastructure, early-warning systems, data sharing, and allocation mechanisms will be essential to prevent disruptions and build shared resilience. This is particularly relevant for South and Central and West Asia.

The KD2 assessment also reveals opportunities for deeper knowledge exchange. Countries with limited progress, often due to institutional fragmentation or data gaps, can learn from those that have advanced through innovation, investment, and governance reforms. Regional platforms and river basin organizations can play a central role in facilitating this exchange and promoting harmonized approaches to water management across borders and sectors.

Figure 14. Regional KD2 Economic Water Security Scores for Asia and the Pacific

KD2 = Key Dimension 2 (economic water security).
Source: ADB.

Conclusion and Findings

The 2025 assessment of KD2 economic water security shows clear, though uneven, progress across Asia and the Pacific. Most countries have improved their scores since 2013, reflecting growing investment in infrastructure, governance, and water-related services. However, the pace and depth of progress vary across countries, sectors, and income groups.

Some upper-middle-income countries such as the PRC, Malaysia, Thailand, and Kazakhstan have made strong cross-sector gains, particularly in industrial water productivity and energy efficiency. In lower-middle-income countries like Bangladesh, India, Viet Nam, and Nepal, improvements are linked to investments in irrigation, electrification, and agricultural productivity.

By contrast, many low-income countries and SIDS continue to face serious constraints. While some Pacific island countries show improved scores, this is often due to better energy data rather than structural change. These cases highlight the need for targeted support that strengthens institutions, improves data systems, and increases access to climate finance.

Across the region, the broad economy sector remains the weakest KD2 component, particularly in governance and resilience to drought. The agriculture and energy sectors show the most visible gains, supported by investments in food self-sufficiency and renewable power. The industry sector remains mixed, with growing gaps in countries where diversification is limited or water productivity remains low.

Looking ahead, countries can strengthen economic water security by focusing on a few critical areas:

1. **Invest in smart water infrastructure**, including small-scale storage and nature-based solutions that improve drought resilience and reduce flood risk.
2. **Improve water monitoring and data systems** to support transparent, evidence-based planning across all economic sectors.
3. **Adopt water-efficient technologies and practices** in agriculture, industry, and energy systems to increase productivity, reduce waste, and enhancements to water allocation regimes.
4. **Ensure inclusive water governance**, with investments that empower women and marginalized groups in water-related decision-making.

AWDO 2025 reinforces that economic water security is not about how much water a country has. It is about how effectively water is managed, governed, and used to support sustainable economic growth. Ultimately, building economic water security is not just a technical challenge. It is a governance and policy challenge that requires aligning water management with national development goals, climate adaptation strategies, and inclusive growth priorities.

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City of Khulna in Bangladesh, the leader of a community water user group (Photo by ADB).

Key Dimension 3: URBAN WATER SECURITY

Key Dimension in Brief

KD3 measures the ability of urban populations to access inclusive, safely managed water and sanitation services, while experiencing low impacts from floods and storms and maintaining strong environmental water security.

Unlike KD1, which measures rural water security, **KD3** emphasizes drainage and environmental management as well as including affordability as a narrative indicator, reflecting the distinct infrastructure, governance, and climate-related challenges in urban settings.

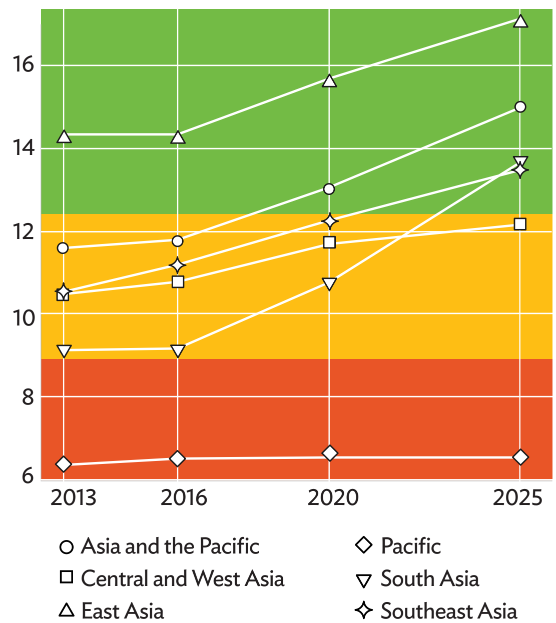
Sun Linzai, who washes dishes and vegetables in the cafeteria at Jinggangshan University in Ji'an City, says the strong supply of cold and hot water has made her job easier (Photo by ADB).

Indicators included in KD3:

- Water Supply
- Sanitation
- Drainage
- Environmental

Results

Figure 15. KD3 Regional Scores (2013–2025)



Source: ADB.

Urban water security has improved across much of Asia and the Pacific since 2013. Gains have been strongest in East, South, and Southeast Asia, driven by investments in water supply and sanitation infrastructure, policy reforms, and increased reporting of safely managed services. Drainage performance shows mixed trends, with climate change driven hazards such as sea-level rise and storms eroding scores in vulnerable countries.

Table 11. Top Performers on KD3

Country	Lao People's Democratic Republic	Cambodia	Timor-Leste	Azerbaijan	Samoa
KD3 gain (2013–2025)	+9.2	+8.3	+6.3	+5.4	+5.4

Source: ADB.

Largest gains (≥4 points) were recorded in eight countries where targeted urban infrastructure investments and service expansion improved both water supply and sanitation.

The Lao PDR and Cambodia recorded the strongest gains in KD3 from 2013 to 2025. The Lao PDR improved by 9.2 points out of 20, and Cambodia by 8.3. Both countries raised water tariffs, signaling movement toward more sustainable cost-recovery models. In Cambodia, wealthier urban households cross-subsidize poorer communities, as highlighted in the country assessment. These sustainable tariffs have supported tailored technical solutions, expanded coverage, and better service quality.

Moderate gains (1-3.9 points) were achieved by 19 countries supported by incremental improvements in service reliability and policy reforms.

Smaller gains (0.1-0.9 points) were seen in only two countries. In many advanced economies, urban water systems are already highly developed, so further progress depends on innovation and building climate resilience rather than expanding infrastructure. In contrast, several small island and resource-limited nations, particularly in the Pacific, such as Niue and the Cook Islands, face slower improvements due to geographic isolation, high costs, and limited economies of scale. In addition, **several Pacific island nations saw stagnant or declining water supply scores**, largely due to limited fiscal capacity, high infrastructure costs, and exposure to extreme weather events.

Findings and Recommendations

1. **Drainage scores show mixed trends.** Many countries experienced declines, particularly those exposed to climate change-driven hazards like sea-level rise and storms, which can overwhelm existing drainage systems and lead to more frequent flooding and service disruptions. Others, such as those implementing smart city plans or sponge city projects, made progress by investing in climate-resilient infrastructure and national drainage strategies. These examples show that effective governance and targeted planning can reduce future risks.

2. **Improving urban water security requires forward-looking strategies.** Rapid population growth, increasing disaster risks, and rising energy costs are placing new pressures on water systems. Investments in energy-efficient technologies, water reuse, and decentralized solutions such as rainwater or stormwater harvesting can help reduce costs and build resilience. Drainage infrastructure upgrades are particularly important to reduce future flood risks and protect urban water services.

3. **Investments should prioritize integrated support for urban water security.** This includes inclusive, climate-resilient infrastructure and services, policy reform, and technical assistance. Special attention is needed for Pacific island nations, where water supply scores have declined and data gaps persist. Efforts should focus on improving basic service reliability and building local capacity for monitoring and planning.

4. **There is a divide between countries able to provide reliable, affordable services and those caught in cycles of underinvestment.** Where tariff reforms are needed to strengthen financial sustainability, governments face the difficult task of protecting vulnerable households from exclusion. Fiji's low tariffs appear to have limited the utility's ability to fund sustainable service expansion, making it the only AWDO country to experience a decline in urban sanitation and the steepest drop in urban water security outside the advanced economies.

Introduction

KD3 definition: *The extent to which countries are providing safely managed and inclusive water and sanitation services and drainage for their urban communities, while maintaining environmental water security.*

Urban water security is a growing priority across Asia and the Pacific. As of 2024, 55% of the world's population lived in urban areas, and this figure is expected to rise to 68% by 2050 (United Nations 2018). Cities in East Asia and the Pacific are urbanizing rapidly, with urban population growth averaging 1.8% per year between 2017 and 2023 (World Bank 2025).

Urbanization trends in Pacific island countries differ in scale but not in importance. The region has a lower baseline urbanization rate, at 21% overall or 41% when excluding Papua New Guinea. However, many countries are urbanizing quickly (SPC 2021). In both contexts, delivering safe, sustainable, and resilient water services is essential to building productive and livable cities.

Increasing urban populations, climate variability, and limited infrastructure capacity are placing growing pressure on urban water systems. Water supply, sanitation, and drainage are all under strain. Without timely action, the urban water security challenges facing Asia and the Pacific will deepen.

Persistent Challenges Across the Four Indicators of Urban Water Security

Despite major infrastructure investments, AWDO 2025 shows that urban water security gaps persist in every income group. New analysis finds that more than one-third of countries score below the *Capable* water security step for KD3, meaning at least part of their urban population lacks reliable, or safe services. This includes several upper-middle-income countries where infrastructure exists but service quality remains inconsistent. These results confirm that strong policy, governance, and innovation can sustain high levels of urban water security even in lower-income settings, while also showing that infrastructure alone does not close the gap. The challenges are explored across four indicators: water supply, sanitation, drainage, and environment.

Water Supply

Access to safely managed drinking water remains uneven. Thirty-six percent of countries in the Asia and Pacific region had less than 80% of their urban population using safely managed drinking water services (JMP 2025). Coverage is below 30% in Kiribati (39,000), the Lao PDR (5.3 million), and Nepal (21.5 million) where people are without safely managed drinking water. In many cases, progress has stalled as rapid population growth, climate disasters, and conflict place additional strain on water systems. Reversing these trends will require strong political commitment and sustained investment from development partners.

Sanitation

Access to safely managed sanitation services also lags. Sixty-four percent of countries had less than 80% urban coverage to safely managed sanitation (JMP, 2025). While there has been progress since 2015, especially in Central and West, South, and Southeast Asia, the pace remains too slow to meet demand. Expanding centralized sewer systems, improving service quality, and ensuring equity remain key priorities (UNICEF 2023).

Drainage

Urban flooding is an escalating risk, particularly in rapidly urbanizing parts of Southeast Asia such as Indonesia, Myanmar, and the Philippines, where the drainage index has declined since 2013. In many cities, informal urban expansion has outpaced infrastructure development, leaving neighborhoods without adequate drainage and more exposed to flood damage. Since 1985, settlements in high flood-risk zones in East Asia have expanded 60% faster than those in safer areas, underscoring the rising vulnerability of urban areas (World Bank 2022).

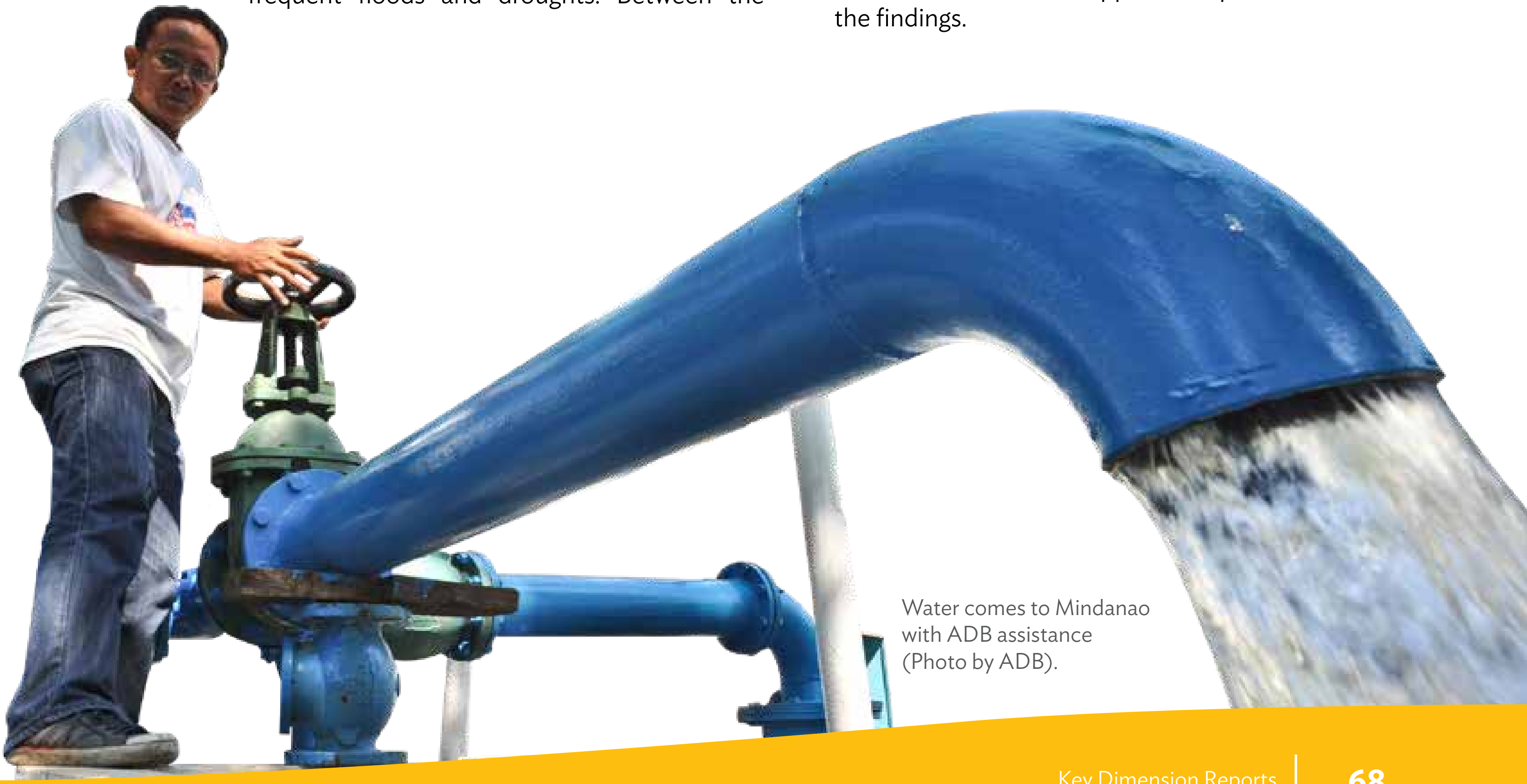
Environment and Climate Change

Asia and the Pacific faces critical environmental pressures. **Nine of the world's 10 most polluted rivers are in the region** (UNEP–DHI 2022), with key sources of pollution including untreated sewage, agricultural runoff (Osti 2020), and industrial waste (Australian Water Partnership 2025). Transboundary cooperation is essential to protect shared rivers, reduce water scarcity, and maintain ecological and political stability (United Nations 2023). Climate change is intensifying these risks. Sea-level rise threatens many coastal cities, especially in the Pacific (Australian Water Partnership 2024). Changes in rainfall patterns are driving more frequent floods and droughts. Between the 1970s and 2010s, the number of flood events in Asia increased fivefold, while droughts more than doubled (ADB 2021). These pressures will further test the resilience of urban water systems in the years ahead.

Narrative Indicator: Affordability

Water services are relatively affordable but the relationship with urban water security is complex. Low water tariffs do not always mean better outcomes. If tariffs are too low it may lead to reduced maintenance, service expansion, and underinvestment in infrastructure.

The AWDO 2025 affordability narrative indicator describes costs to households, not the financial sustainability of services. The approach assesses tariff structures in cities across the Asia and Pacific region, estimating what households would pay as a share of their expenditure to consume 15 kiloliters per month. However, no comprehensive dataset exists to show whether utilities recover enough revenue to fund operations, maintenance, and future investment. As a result, the indicator cannot confirm whether tariffs are sustainable or simply too low, potentially leaving infrastructure underfunded and urban water security at risk. Due to these challenges, it is not used as a primary indicator and does not contribute to the KD3 score. Instead, it is retained as a narrative indicator to support interpretation of the findings.



Water comes to Mindanao with ADB assistance (Photo by ADB).

Methodology

The 2025 assessment improves on the 2020 methodology across all urban water security indicators, refining weightings and using updated data sources to enhance comparability and accuracy. The KD3 method includes two primary indicators, water supply and sanitation, two secondary indicators, drainage and environment, and one narrative indicator, affordability (Figure 16).

Water Supply

The Water Supply Index draws on the JMP WASH service ladders and assesses access to safely managed, basic, and limited services. The 2025 method revises weightings to better reflect data availability and avoid penalizing countries with limited safely managed data. Scores are calculated by weighting service levels accessed by the urban population, then banded into index scores.

Sanitation

Similar to the Water Supply Index, the Sanitation Index uses JMP WASH ladders to evaluate access to safely managed sanitation. It considers factors such as location of facilities, safe disposal, and treatment. Like the water supply sub-indicator, the 2025 method adjusts bandings and weightings to better reflect minimum service levels and improve comparability across countries.

Drainage

The Drainage Index estimates how well urban people are protected from flooding. It is based on two EM-DAT indicators: the proportion of the population affected by floods and the duration of events over a 15-year period. These are combined and scaled to generate a drainage performance score. Higher values indicate worse drainage outcomes. While the method uses best available data, limitations remain due to gaps in disaster reporting and the complexity of flood dynamics.

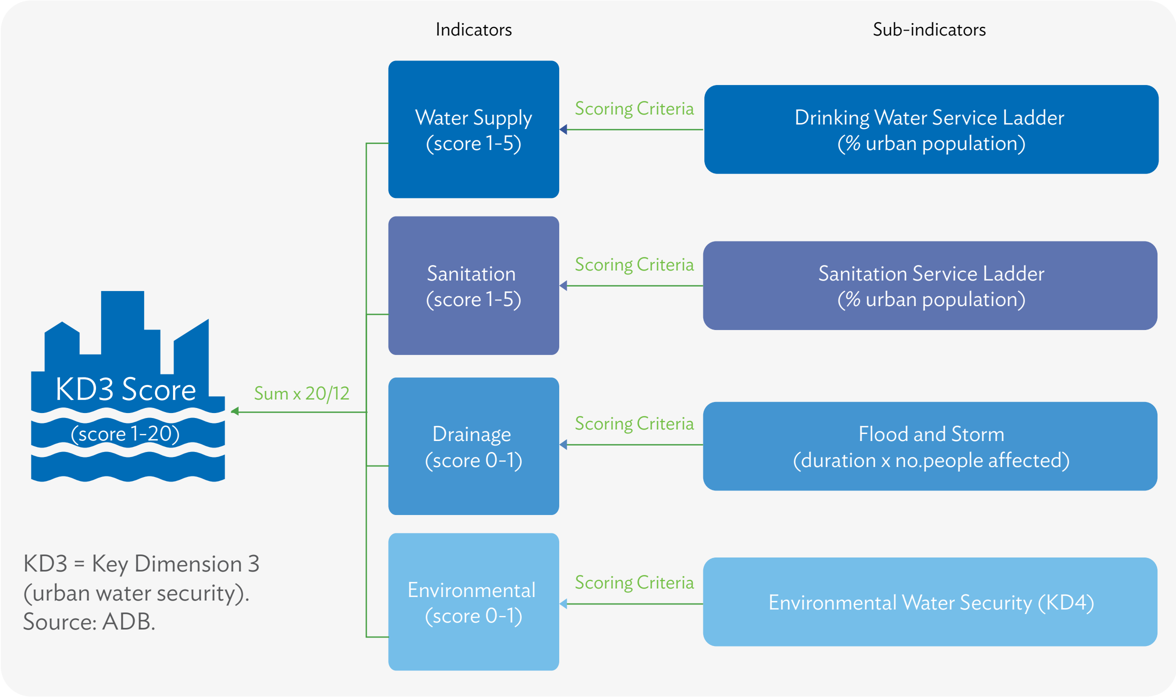
Environment

This indicator is aligned with KD4, using the KD4 score as the source data. Therefore, it considers pollution in urban environments. It includes variables such as river water quality, exposure to climate hazards, and coastal vulnerability.

Narrative Indicator

Affordability discusses the proportion of household expenditure spent on water services, both water supply and sanitation. It uses benchmark consumption assumptions and national household expenditure data. As explained, affordability is an important inclusion in KD3, however as higher affordability is not always positive for urban water security, it is not considered in the KD3 calculations.

Figure 16. Methodology for KD3



KD3 = Key Dimension 3 (urban water security).
Source: ADB.

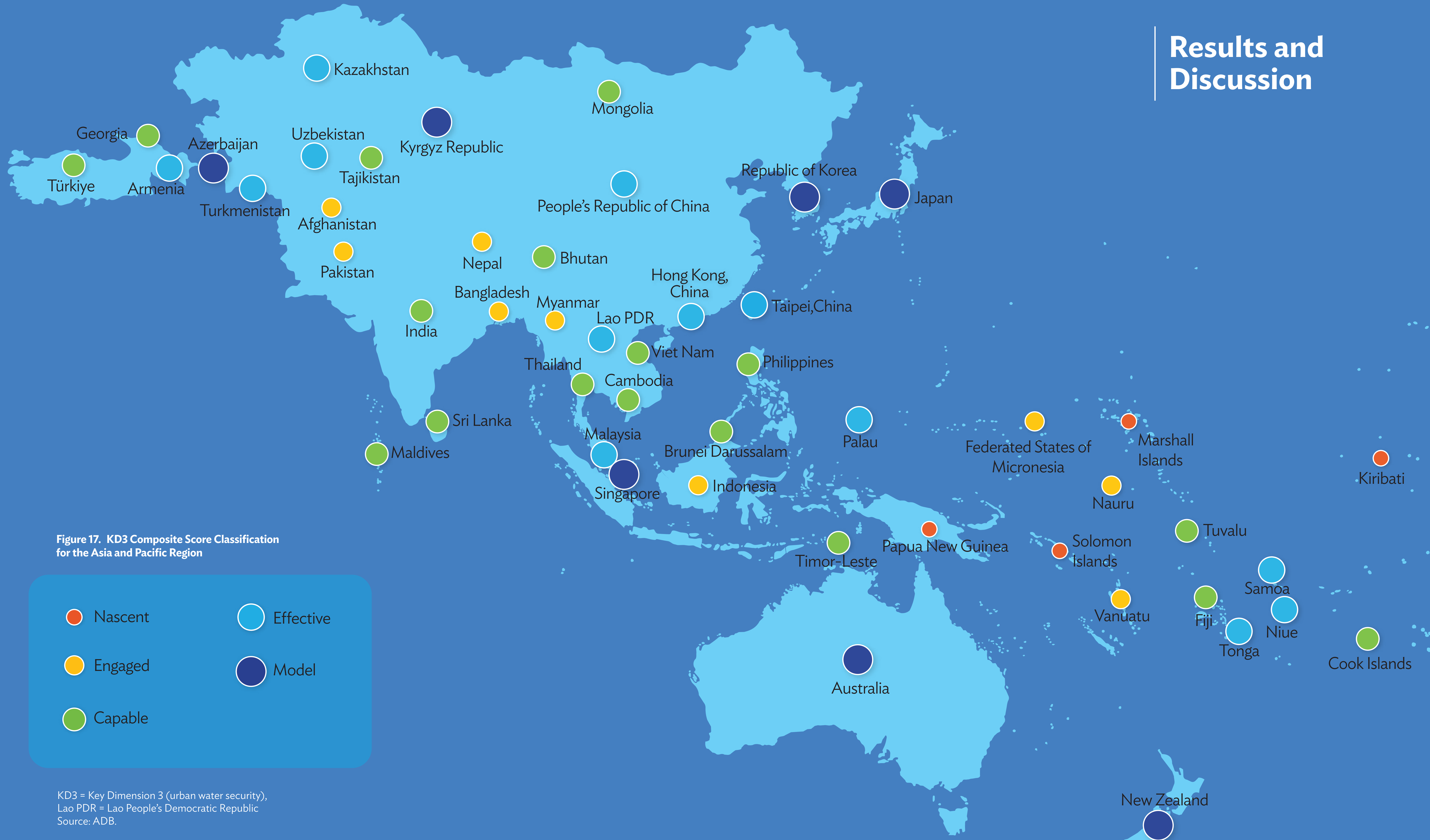
Each of the four KD3 indicators contributes to a total possible score of 12 points. This is scaled to a score out of 20. For countries with missing data in one or more indicators, the score is scaled from the maximum possible points (e.g., if one indicator is missing, the maximum becomes 11) then assigned a water security step (Table 12). KD3 scores are not calculated if fewer than three indicators are available.

Table 12. Narrative Description of the Steps and Corresponding KD3 Scores

Water Security Steps	KD3 Score (out of 20)	Description
Model	>18.5	Very high urban water security. Urban populations have access to inclusive, safely managed water and sanitation, low flood and storm impacts, and strong environmental performance.
Effective	17-18.5	High urban water security. Most people access at least basic services. Flood risks are low and environmental security is strong.
Capable	12.5-17	Moderate urban water security. Services are generally inclusive and basic, with manageable flood risks and environmental pressures. One indicator may score poorly.
Engaged	9-12.5	Low urban water security. Urban populations face challenges in service or access, and experience moderate to high flood impacts and environmental risks.
Nascent	0-9	Very low urban water security. Services are often inaccessible or unavailable. Flood impacts are high and environmental conditions are poor.

Source: ADB.

Figure 17. KD3 Composite Score Classification for the Asia and Pacific Region

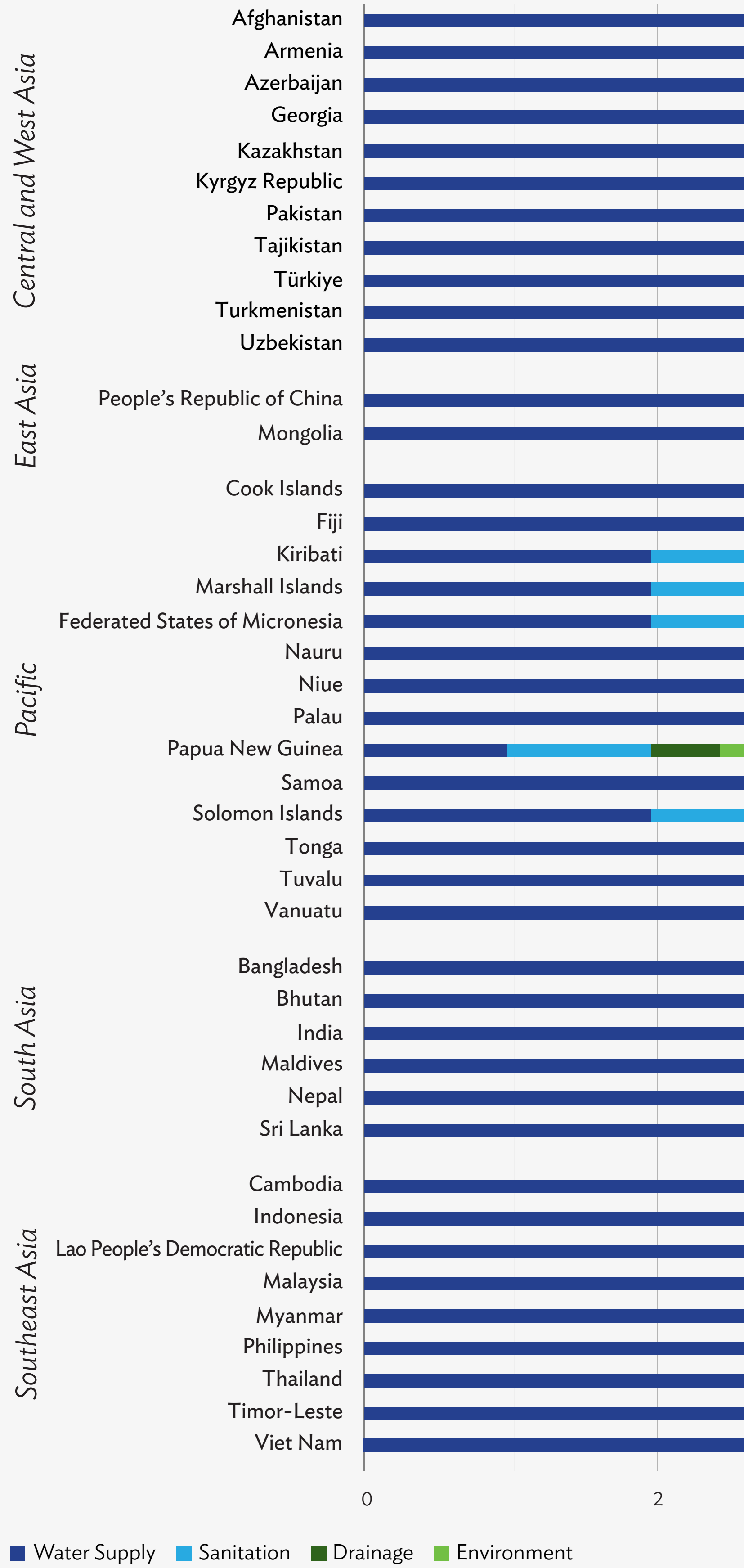


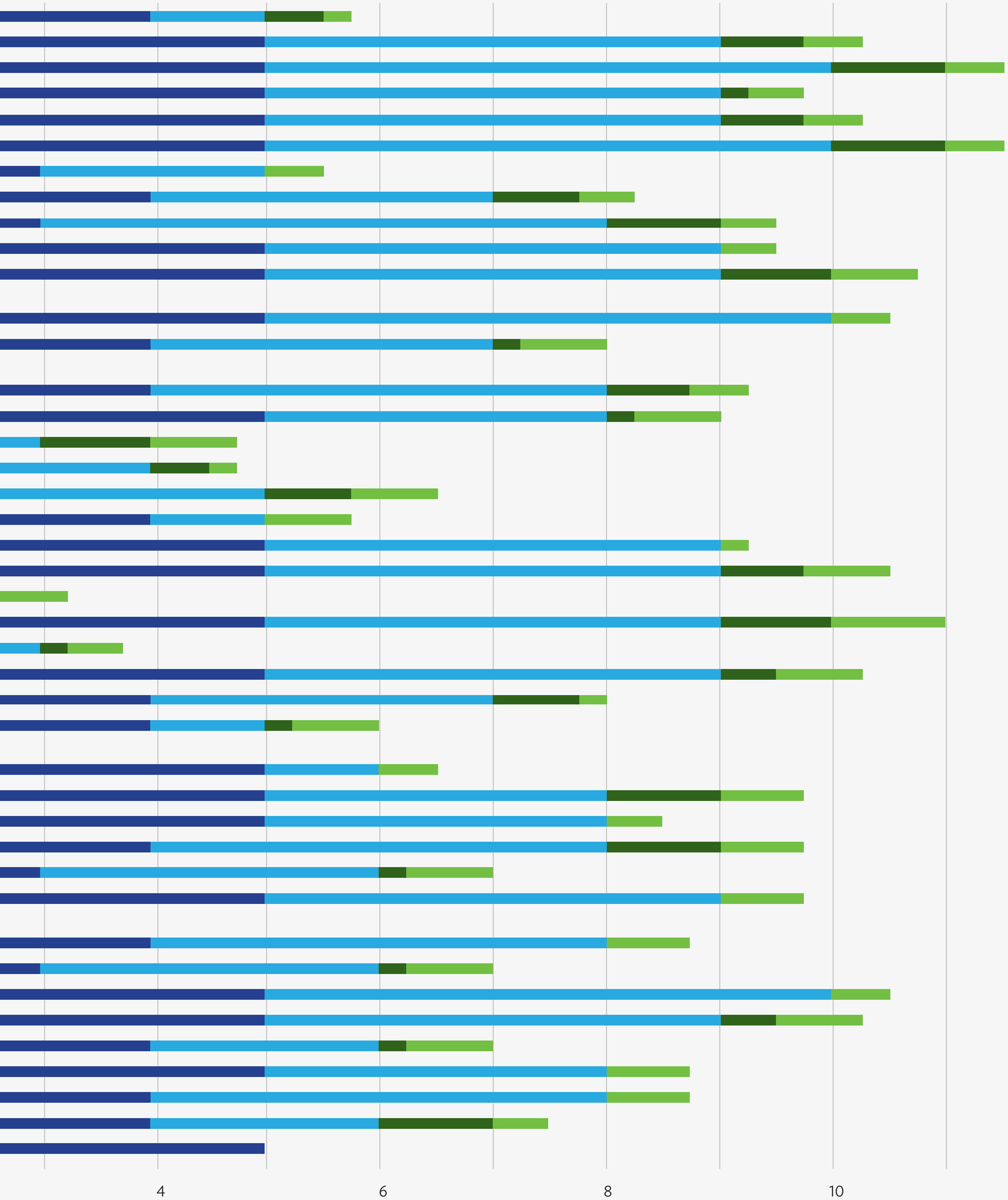
KD3 = Key Dimension 3 (urban water security), Lao PDR = Lao People's Democratic Republic
Source: ADB.

Urban water security is improving across Asia and the Pacific, but regional disparities remain. East Asia has the highest scores. Central and West Asia, South Asia, and Southeast Asia show moderate levels, while the Pacific records the lowest scores overall. Urban areas in countries such as Kiribati, the Marshall Islands, Solomon Islands, and Papua New Guinea remain among the most water insecure (Figure 18).

Urban Services Improvement Investment Program - Tranche 3 in Georgia (Photo by ADB).

Figure 18. Sum of Four Indicators to Obtain the Total Raw KD3 Scores 2025

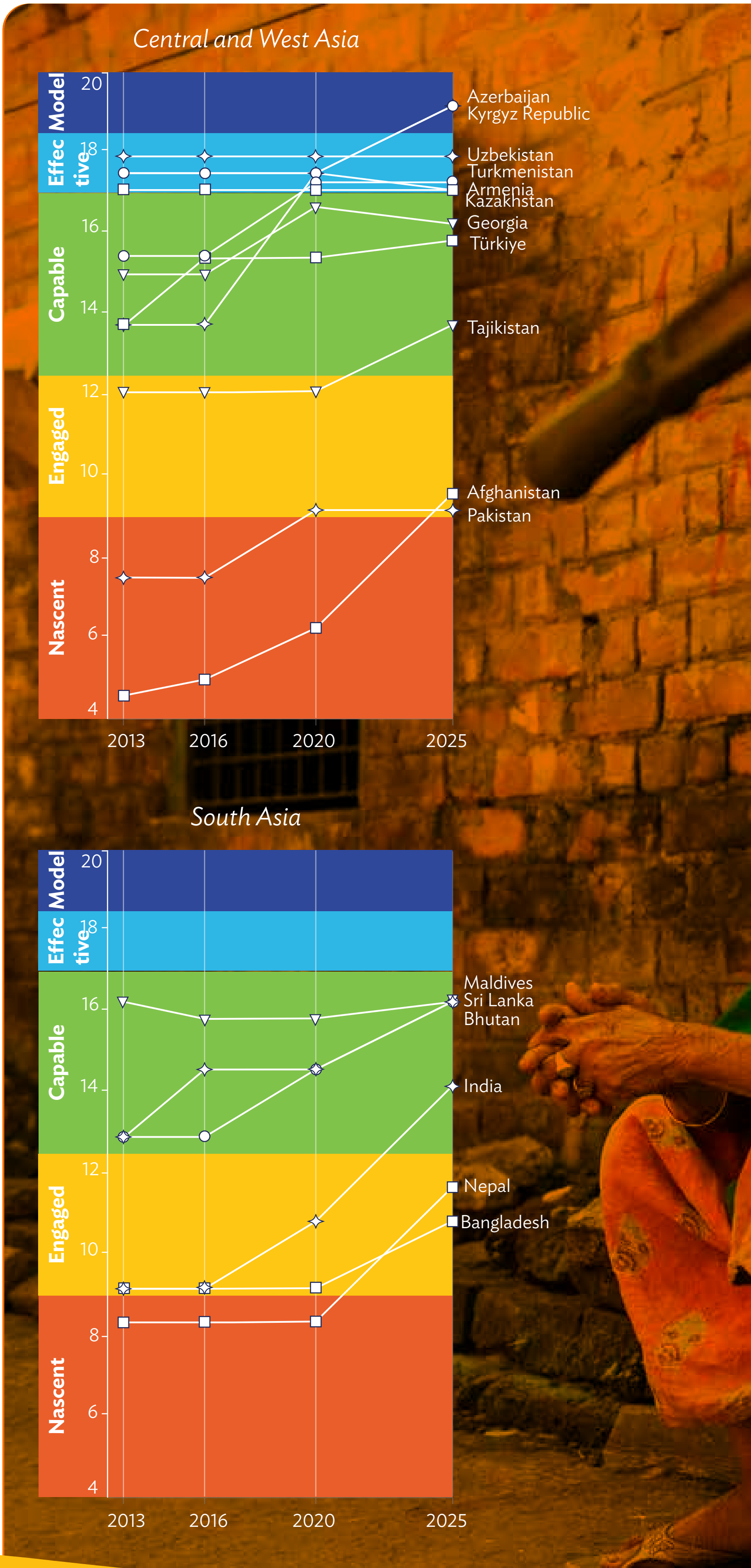




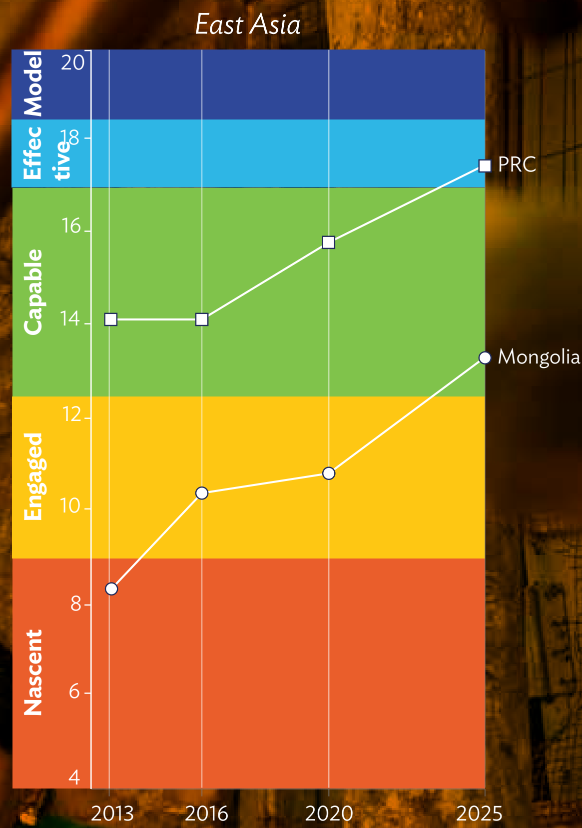
KD3 = Key Dimension 3 (urban water security).
Note: Missing drainage data for Nauru, Niue, and Turkmenistan. Scores for Drainage and Environment are out of 1.
Source: ADB.

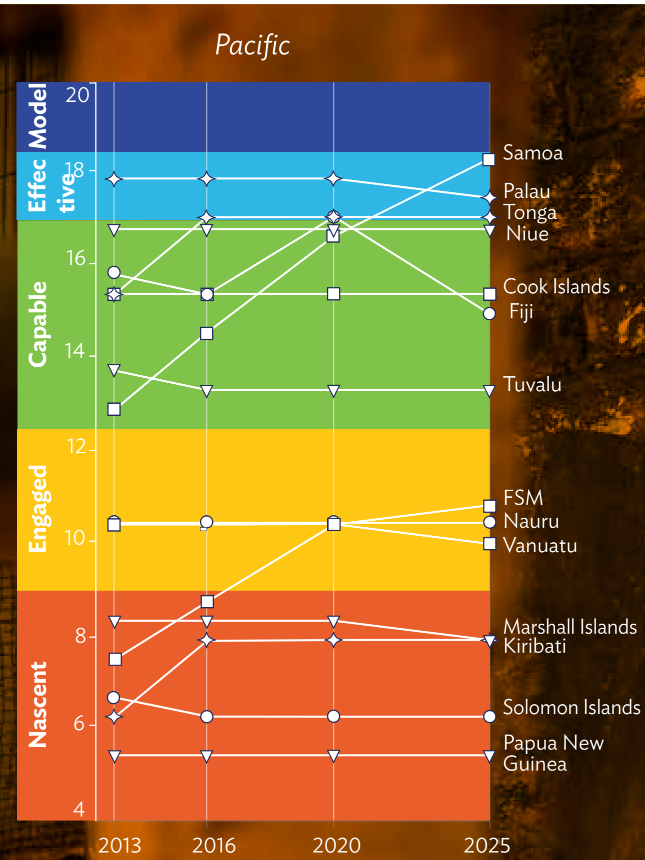
Urban water security has improved in most countries, though setbacks remain in specific regions. Over the past 12 years, many countries across Southeast Asia, South Asia, and parts of Central and West Asia have lifted their scores, showing that rapid progress is possible (Figure 19). Declines are less common but have occurred mainly in the Pacific, including Solomon Islands, Vanuatu, the Marshall Islands, Tuvalu, Palau, and Fiji, with Armenia the only other case. These declines often reflect aging infrastructure, reduced investment, and the impacts of droughts or extreme weather events on service reliability.

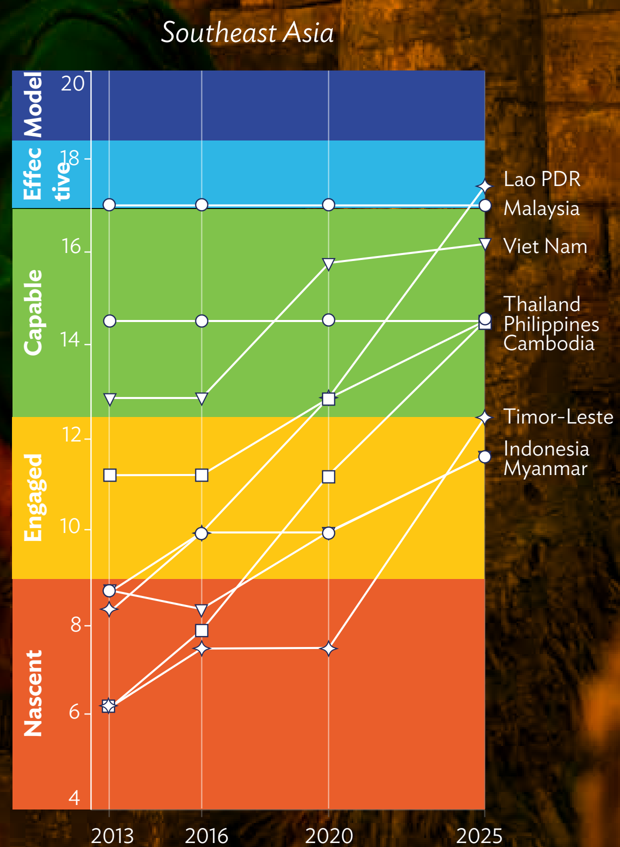
Figure 19. Trends in KD3 Scores (2013–2025)



PRC = People's Republic of China,
KD3 = Key Dimension 3 (urban water security),
Lao PDR = Lao People's Democratic Republic,
FSM = Federated States of Micronesia.
Source: ADB.







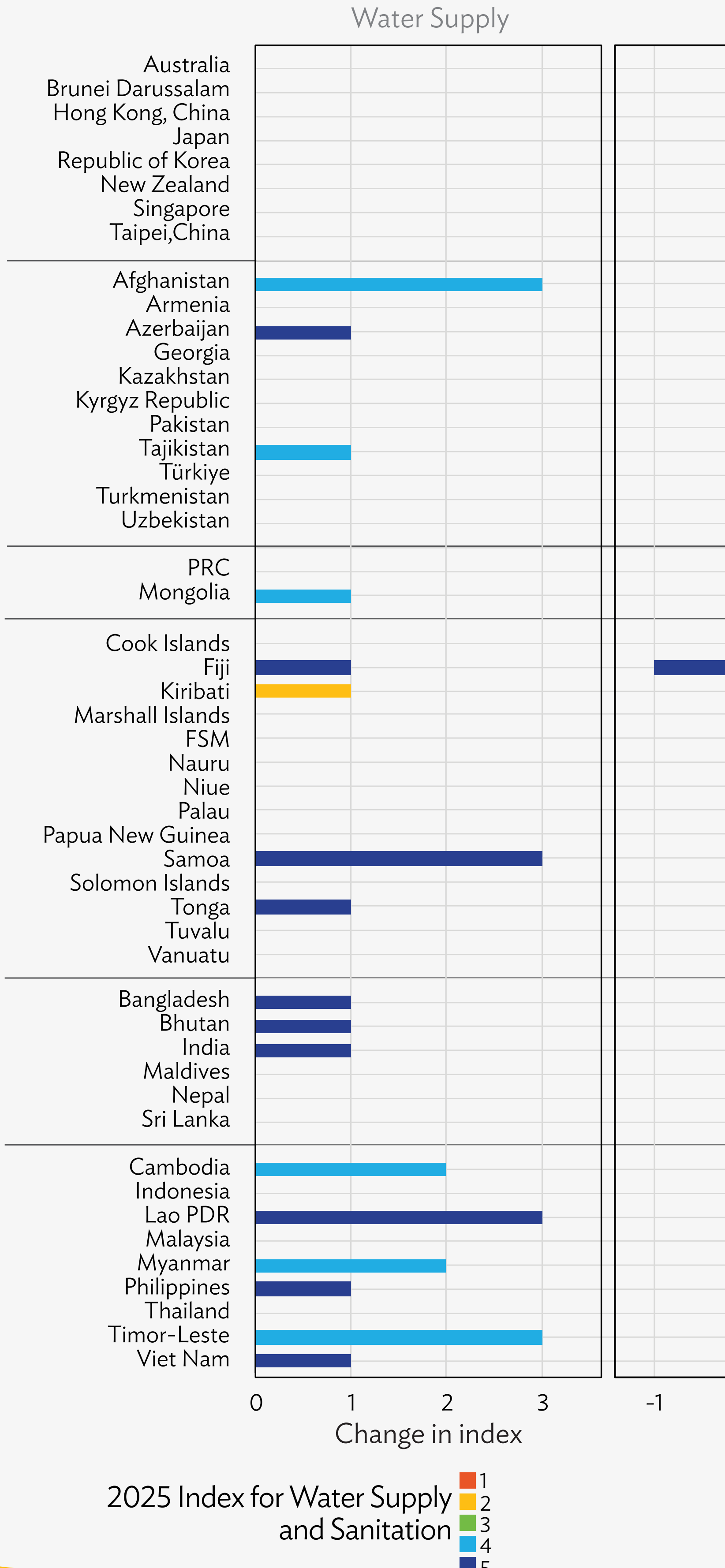
National Water Security Steps

- **Model**
- **Effective**
- **Capable**
- **Engaged**
- **Nascent**

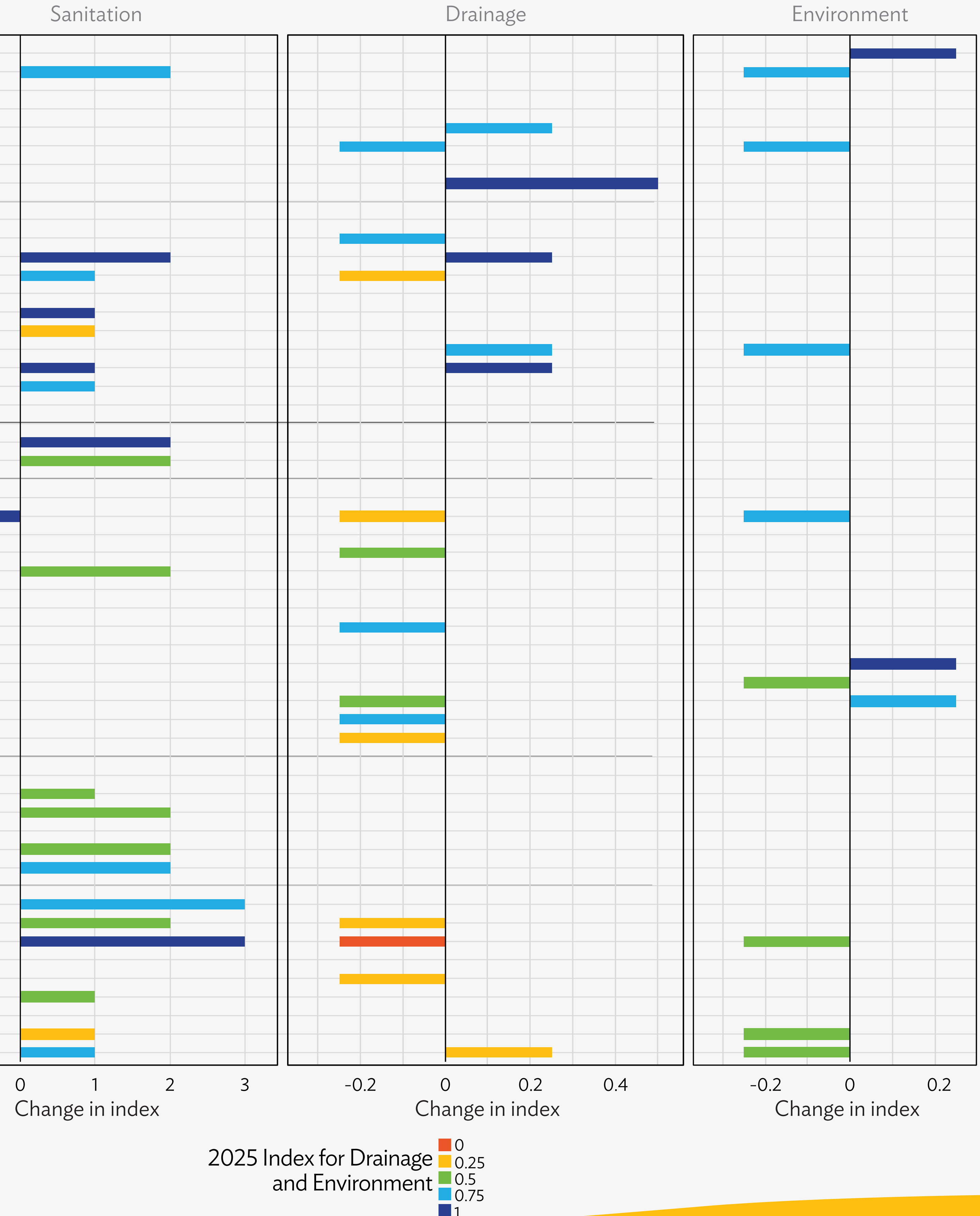
Elderly woman waits near a community handpump at the Behala slum area in Kolkata, India (Photo by ADB).

Many economies have managed to improve multiple aspects of urban water security in parallel, but progress is not always even across indicators. Even the Lao PDR, the economy with the most KD3 improvements, did not increase in all indicators and even declined in drainage (Figure 20).

Figure 20. Changes in KD3 Indicator Values (2013–2025)

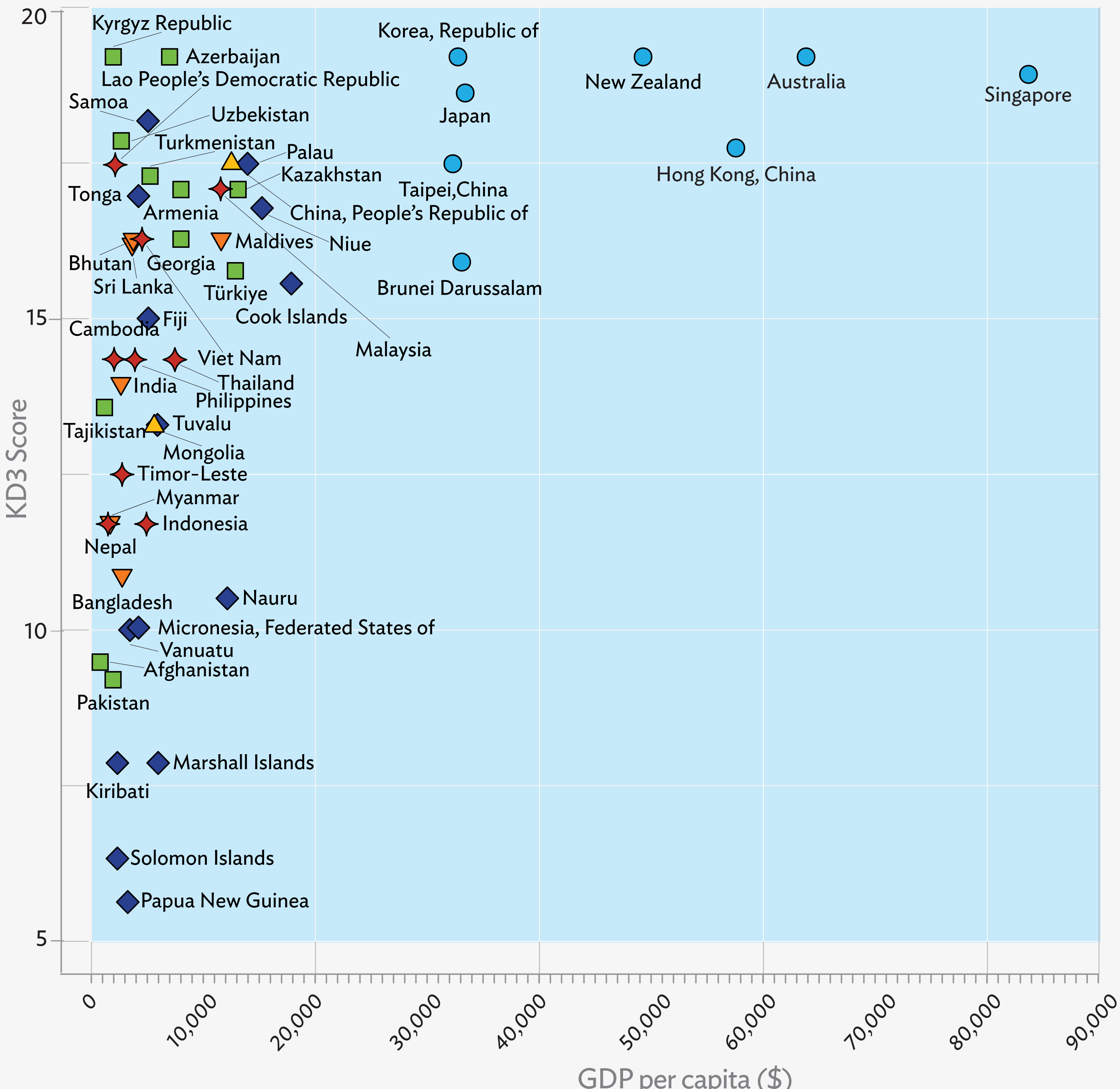


PRC = People's Republic of China,
KD3 = Key Dimension 3 (urban water security),
Lao PDR = Lao People's Democratic Republic,
FSM = Federated States of Micronesia.
Source: ADB.


Sanitation
Drainage
Environment
0
1
2
3
Change in index
-0.2
0
0.2
0.4
Change in index
-0.2
0
0.2
Change in index
2025 Index for Drainage and Environment
0
0.25
0.5
0.75
1

While higher GDP generally supports better water security, it is not the only factor shaping outcomes. A comparison of KD3 scores with GDP per capita shows that some lower-income countries are achieving high levels of urban water security (Figure 21). Within the $5,000–$10,000 income range, scores vary widely, from 7.9 to 19.2 out of 20. For example, Tonga has a relatively low GDP per capita but scores 17.1, while Nauru has two and a half times the income yet scores 10.5. These differences highlight the role of effective policy, planning, and institutional capacity alongside financial and environmental conditions.

Figure 21. GDP per Capita vs. Total Urban Water Score by Economy and Region



- Advanced Economies
- Central and West Asia
- East Asia
- Pacific
- South Asia
- Southeast Asia

GDP = gross domestic product.
Source: ADB.

Resident of Poti enjoys the benefits of easy access to clean water (Photo by ADB).

Trends Across Indicators

Water supply has improved or remained stable in all countries, particularly in Southeast Asia. The Lao PDR and Timor-Leste increased their scores by 3, reflecting strategic national action such as expanding piped water networks, improving treatment capacity, and strengthening utility management. In the Pacific, performance remained stagnant across most of the region, where small island nations face delivery challenges linked to environmental constraints (such as limited fresh water availability) and high infrastructure costs. Samoa improved sharply (3 points out of 5), though the result may reflect data uncertainty rather than confirmed infrastructure upgrades.

Sanitation services have strengthened in most regions, but progress in the Pacific has been limited. East, South, and Southeast Asia each recorded multiple countries with score increases of two or more, and none experienced declines. By contrast, the Pacific performed poorly. Only the Federated States of Micronesia improved, while Fiji was the only country across AWDO to record a decline in urban sanitation. Fiji's decline may reflect very low tariffs, which limit the utility's ability to raise funds for sustainable service expansion.

Drainage scores declined in 12 economies, including Indonesia, Myanmar, Kiribati, Vanuatu, and Tuvalu, largely due to more frequent and intense storms overwhelming systems. Six economies improved: Azerbaijan, Taipei,China, Singapore, the Republic of Korea, Thailand, and Georgia. Taipei,China recorded the most notable improvement, the result of sustained investment in flood control, stormwater networks, and climate-resilient urban design.

Environmental water security has seen little change across the region. Most economies scored between 0.5 and 0.75 out of 1, indicating partial compliance with environmental flow requirements but insufficient protection of ecosystems, particularly in urban areas. Score changes were small, within ±0.25. Australia and Samoa achieved the highest scores, reflecting stronger environmental water management and enforcement. At the other end, Afghanistan, Niue, Tuvalu, and the Marshall Islands recorded the lowest scores, driven by weak management systems and limited enforcement of environmental standards.

Central and West Asia

Water supply scores in Central and West Asia were largely stable, with some notable gains. Most countries in the region, including Armenia, Georgia, Kazakhstan, the Kyrgyz Republic, Turkmenistan, and Uzbekistan, maintained a score of 5 from 2013, while Azerbaijan advanced from 4 to 5. Tajikistan improved its water supply score from 3 to 4 from 2020 to 2025, following a notable increase in Dushanbe's water tariff. Pakistan, however, remained at lower levels due to aging infrastructure and persistent service gaps.

Sanitation services continued to improve across the region. Türkiye advanced from 4 to 5, reaching access to safely managed urban sanitation. Georgia, Turkmenistan, and Azerbaijan also improved, moving from 3 to either 4 or 5, reflecting major expansions in sewerage networks and treatment facilities. Pakistan increased from 1 to 2, signaling progress but from a very low base.

Drainage performance varied. Türkiye improved drainage through Smart City investments (Switzerland Global Enterprise 2021). Azerbaijan's Baku White City project supported infrastructure gains (Tourish 2011). Armenia's decline is tied to increased storms and infrastructure investment delays caused by conflict (Center for Preventive Action 2025). Georgia's 2015 Tbilisi flood exposed critical weaknesses (BBC News 2015). Pakistan's drainage score remained the lowest possible due to poor planning, limited investment, and land conversion (Ghafoor 2025).

Only **Tajikistan** saw a change in the environment score, dropping by 0.25, reflecting reduced environmental flow protection and weaker enforcement of urban water quality standards.

East Asia

East Asia showed high or improving results across water supply and sanitation. The PRC improved by two points in sanitation through massive infrastructure investment, national reforms like the Toilet Revolution, and strengthened monitoring (Zhou et al. 2022). Mongolia improved in both water supply and sanitation.

The PRC's drainage score remains low but is improving due to the Sponge City Project, launched in 2015. This national initiative aims to ensure 80% of urban areas absorb 70% of rainfall by 2030. Investments have expanded pipeline length and separated sewerage and stormwater systems (Zhang 2022; Urban Governance for Health and Well-being 2024).

Environment Index scores remained unchanged.

West Bengal Drinking Water Sector Improvement Project in India (Photo by ADB).

Pacific

Water supply in most Pacific countries has remained stagnant, reflecting deep structural challenges. Disaster impacts, growing urban populations, and decades of underinvestment in WASH systems have limited progress (UNESCAP 2023; UNICEF 2023). In the Marshall Islands, high exposure to climate change and natural hazards continues to disrupt services (OCHA 2022). In Nauru, long-term neglect of water infrastructure has left systems fragile and prone to failure (Nauru Department of Commerce 2022). Fiji, Kiribati, and Tonga recorded modest increases of 1 point, while Samoa achieved the largest improvement in the region, rising by 3 points.

Sanitation performance has remained largely stable, although several countries have seen notable changes. The Federated States of Micronesia improved from 1 to 3, reflecting gains in coverage and service quality. By contrast, Vanuatu remained at 1 but declined sharply in its underlying score, driven by the growth of informal settlements in Port Vila and Luganville, as well as infrastructure damage from earthquakes and saltwater intrusion (Rousso et al. 2024; The Guardian 2024). These shifts highlight the urgency of building climate-resilient sanitation systems, especially given the region's reliance on on-site dry and water-based facilities. Strengthening inclusive policy frameworks, particularly for people with disabilities, also remains a priority (Bose et al. 2024). Research in Vanuatu points to opportunities to improve outcomes through stronger civil society engagement, addressing ministry understaffing, and elevating hygiene in policy and planning. Fiji's sanitation score also declined, falling by 1 point. This may reflect very low tariffs and structural constraints, as the Water Authority of Fiji (WAF) does not retain revenues from water delivery, limiting its capacity for sustainable service expansion despite low costs, highlighting that tariff adjustments alone are insufficient without structural reforms to strengthen WAF's financial autonomy.

Drainage scores declined in six Pacific countries (Fiji, the Marshall Islands, Palau, Tonga, Tuvalu, and Vanuatu). This reflects rising storm and coastal flooding risk driven by sea-level rise (WMO 2024; NASA JPL 2024). Seawalls have been widely deployed, but they are costly and require constant upgrades. More sustainable options like land reclamation are possible but expensive and ecologically risky (Fruean and Dingwall 2025).

Samoa and **Tonga** improved their environment score by 0.25, reflecting stronger coastal and watershed protection measures, including mangrove restoration projects and integrated catchment management plans that also support climate resilience. **Fiji** and **Solomon Islands** declined by 0.25, mainly due to increased pressure on natural water sources from urban expansion, logging-related sedimentation, and climate-related events such as tropical cyclones that damaged riparian zones and water catchments.

South Asia

South Asian countries recorded steady improvements in water supply and sanitation, with one exception. All countries in the region increased their scores, apart from Maldives, which remained stable. India, Bhutan, and Bangladesh each improved their water supply score by one point, while others saw no change. India made the most progress in sanitation, moving from 1 to 3. This shift is largely attributed to the Swachh Bharat Mission, launched in 2014, which focused on eliminating open defecation through large-scale toilet construction and behavior change campaigns (Pritam 2023; Bose et al. 2024). The Atal Mission for Rejuvenation and Urban Transformation, launched in 2015, ensures adequate sewerage networks.

Drainage in South Asia has seen little change between 2013 and 2025. Most countries recorded no change in their drainage scores over the period. Maldives maintained a score of 1 throughout, while Bhutan also scored 1; however, Bhutan's result reflects missing EM-DAT data on the number of people affected, creating a mismatch between the score and actual conditions on the ground. In contrast, Bangladesh, India, and Sri Lanka continued to score 0, indicating minimal or no progress in drainage infrastructure over the past decade.

There was no change in the environment score across South Asia.

Box 5.

Building Urban Water Security Through Youth Leadership

Water security remains a pressing challenge in many cities in the Asia and Pacific region, with 453 million people lacking access to safely managed drinking water and 766 million without safe sanitation in 2022, highlighting the urgency for more inclusive and sustainable solutions to accelerate transformation in urban water security. With 60% of the world's youth population, the region holds an untapped potential for accelerating transformative change. Yet, they are often excluded from the decision processes, with limited access to technical capacity, resources, and platforms.

The Water as Leverage program applied the principle of inclusion from start to finish throughout the project cycle. It created a social inclusion strategy for youth, women, and vulnerable communities, including identifying barriers, tailoring actions, capacity strengthening, and monitoring through inclusion parameters. In Chennai, India, the City of 1,000 Tanks initiative meaningfully engaged with youth and children through ideation sessions, training programs, and workshops. It also implemented a Water Balance Pilot project, a model for citywide sustainable water management and nature-based solutions that also builds capacity and raises stakeholders' awareness, including youth.

This example demonstrates that youth can make meaningful contributions to urban water security with the right supporting environment. Mainstreaming youth engagement requires dedicated targets and indicators, supported by policy mandates from governments and donors, along with access to resources, funding, and platforms to foster innovations. Youth need sustained capacity building through education, peer learning, and training tailored to urban water issues. Moreover, youth can contribute through research, data collection, and technology development.

Meaningful youth engagement strengthens project relevance, community engagement, sustainability, and accelerates the transformation in urban water security. Governments and decision-makers must engage youth in regulations, policies, strategies, and investment agendas by setting clear mandates, establishing advisory roles, integrating youth indicators into monitoring systems, and ensuring resources for youth-led actions.

Source: Accyntyacakti R. Prakasita (Cyntya), WASH Officer, UNICEF, Indonesia.

Author of this box:
Accyntyacakti R. Prakasita
Cyntya currently works as a WASH Officer at UNICEF Indonesia and holds a Master's in Water Science and Management from Utrecht University. Her work focuses on urban water security, water safety, water governance, and climate-resilient services.

Biology class at the Madrasah Aliyah Negeri (MAN) Yogyakarta III School (Photo by ADB).

Southeast Asia

Most Southeast Asian countries strengthened urban water security, with some making significant gains. Timor-Leste and the Lao PDR rose by 3 points in water supply, supported by international investment, national prioritization, expanded piped coverage, better utility performance, and, in the case of the Lao PDR, an increase in Vientiane's water tariff. Cambodia and Myanmar each improved by 2 points through upgrades and expanded supply networks. Indonesia and the Philippines also increased by 1 point, reflecting broader access to "at least basic" services.

Sanitation coverage also advanced, with the strongest progress in Cambodia and the Lao PDR. Both countries improved by 3 points, driven by fiscal decentralization, subnational administrative reform (OCHA 2024), and external investment in sanitation (AFD 2022). Indonesia, the Philippines, Timor-Leste, and Viet Nam also recorded improvements in sanitation scores.

Drainage results were mixed. Viet Nam's drainage score rose from 0 to 0.25, supported by upgrades in Ho Chi Minh City and climate-resilient urban projects, including smart city initiatives (VietnamPlus 2025; Tuổi Trẻ News 2020). Cambodia and Thailand improved their drainage without altering the score. Thailand improved, aided by the National Water Resources Management Strategies (2015–2026) that focused on boosting drainage capacity (Office of the National Water Resources 2025). Cambodia's flood protection efforts, supported by Japan (2018–2021), helped improve drainage infrastructure (Kort 2022). In contrast, **Indonesia's drainage declined due to rapid urbanization** and groundwater overextraction in Jakarta.

The Lao PDR, Timor-Leste, and Viet Nam recorded a 0.25-point decline in the environment score, largely due to increased urban pollution loads and reduced wastewater treatment coverage in fast-growing cities, where infrastructure expansion has not kept pace with population growth.

Findings and Conclusion

Urban water security has improved across most of Asia and the Pacific. Nearly all economies have raised their scores since 2013, with the most progress in East and Southeast Asia. Stronger water supply and sanitation systems were the main drivers. These gains reflect national reforms, targeted investments, and international support. In India, the Swachh Bharat Mission significantly reduced open defecation. Cambodia's progress followed decentralization and external financing. Yet sanitation continues to lag water supply in many places. In 2021, only five countries reported to have at least **75% of the funding needed for urban sanitation** (GLAAS, WHO, and UNICEF 2023). The lower performance in sanitation is not unexpected, as these services are often managed by different agencies or under-resourced local governments.

Several low- and middle-income countries such as Bhutan, Timor-Leste, and Viet Nam delivered strong results. These examples demonstrate that high GDP is not a prerequisite for water security. Committed governance, external support, and policy prioritization can drive significant progress, even in resource-constrained settings. At the same time, economies with higher-income levels, like Brunei Darussalam and Turkmenistan, but weak water management institutions often failed to sustain improvements.

In several countries, tariff increases have helped strengthen urban water security, particularly when additional revenues were directed toward operations and maintenance. These cases show that well-designed tariff reforms can improve both service coverage and quality.

Where tariff increases are necessary to finance improvements, governments must weigh financial sustainability against the risk of excluding vulnerable households. If tariffs are raised to cover operating costs, but service quality does not improve, it can leave a country struggling to balance financial recovery and inclusive service expansion. This dynamic can expose a deeper divide between countries that can deliver reliable, inclusive services and those locked in cycles of poor maintenance.

Drainage scores show mixed results, with declines in many vulnerable areas. Several countries saw reduced scores due to climate change, with sea-level rise and more intense storms, which overwhelmed existing infrastructure. Yet others made notable progress by investing in climate-resilient systems, including smart city initiatives, sponge city projects, and national drainage strategies. These examples show that targeted infrastructure planning, backed by strong governance, can yield measurable improvements even in the face of growing risks.

Six Pacific countries saw overall urban water security decline. These drops were most often due to drainage. In some cases, rising water costs outpaced income growth; in others, stagnant infrastructure investment left cities exposed to floods and storms. These results reinforce the need for coordinated, cross-sector approaches to water management.

Improving urban water security requires integrated, forward-looking investment. Rapid population growth, increasing climate risks, and limited fiscal space constrain progress in many countries. Sanitation and drainage often receive less attention and funding, despite their essential roles (WHO and UNICEF 2023). Energy costs are another growing concern. In many countries, energy is a major and rising component of water service provision (Kenway 2014; Ngarava 2021). Investing in **energy-efficient supply systems, water reuse, decentralized infrastructure,** and stormwater or rainwater harvesting can reduce long-term costs and improve service resilience. Drainage upgrades, in particular, are crucial to reduce future flood risks.

Performance statistics must better reflect the diversity of urban conditions. A limitation of this analysis is the treatment of urban areas as uniform. In reality, **informal settlements, peri-urban districts, and small towns often have very different service levels** from the city core, like the disparities observed between rural and peri-urban areas in KD1. Many national datasets and definitions of "urban" exclude informal areas, leading to underestimates of water insecurity. Improving the clarity and inclusiveness of these definitions would enhance both the accuracy of AWDO analysis and its relevance for SDG monitoring (Allan et al. 2018).

Countries could prioritize integrated support for urban water security. This includes investment in **climate-resilient services,** especially in places where water supply scores are falling and data gaps are large. Affordability must be considered carefully in the future AWDO score where appropriate policies and regulations should balance water tariff and people's affordability for sustainable services. For the Pacific in particular, support should focus on improving the reliability of basic services and building local capacity to monitor performance and plan for future needs. These actions will help countries meet rising challenges and strengthen the foundation for long-term water security.

Box 6.

Gender-Responsive Investment Can Improve Urban Water Security in Informal Settlements

By 2030, around 2 billion people are expected to live in informal urban settlements. Many of these communities lack safe and equitable water, especially for women and girls who carry the main responsibility for household water collection and management.

In Viet Nam's fast-growing secondary cities, the Secondary Cities Development Project improved urban water security for more than 476,000 people, about half of them women and girls. The project upgraded water supply networks, drainage systems, and flood protection in cities like Buon Ma Thuot and Lao Cai. These improvements ensured poor and women-headed households gained inclusive and reliable piped water access.

A strong Gender Action Plan was central to the project's success. It delivered 94% of its planned actions, with local women's unions leading outreach and hygiene education. Women made up 65% of community awareness facilitators, helping households adopt safer water and sanitation practices.

By placing women at the center of planning, service delivery, and education, the project reduced the unpaid burden of water-related work, improved family health, and strengthened resilience to flooding and waterborne risks. This example highlights how gender-responsive approaches can expand access and improve outcomes for the most vulnerable.

Source: ADB. 2022. Secondary Cities Development Project Completion Report.

Phan Thi Hoai and her family enjoying the benefits of clean water provided by Binh Duong Water Supply Sewerage Environment Company Limited (BIWASE) (Photo by ADB).

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Old and new buildings line the banks of Bangkok's Mae Nam Chao Phraya. This river remains the capital's most important waterway (Photo by ADB).

Key Dimension 4:

ENVIRONMENTAL WATER SECURITY

Key Dimension in Brief

KD4 in AWDO 2025 assesses environmental water security across Asia and the Pacific by measuring both the condition of aquatic ecosystems and the governance systems in place to protect them. **The Key Dimension combines two indicators:** the Catchment and Aquatic System Condition Index (CASCI), which measures ecological pressures and health, and the Environmental Governance Index (EGI), which assesses the effectiveness of national environmental policies and regulations.

Each indicator should be interpreted separately when reviewing results. While higher scores in the EGI and CASCI may be related, an improvement in one does not offset a decline in the other. Assessing both measures together provides a more complete picture of a country's performance and helps identify targeted actions to strengthen environmental water security.

Residents of Tuvalu enjoying the sea (Photo by ADB).

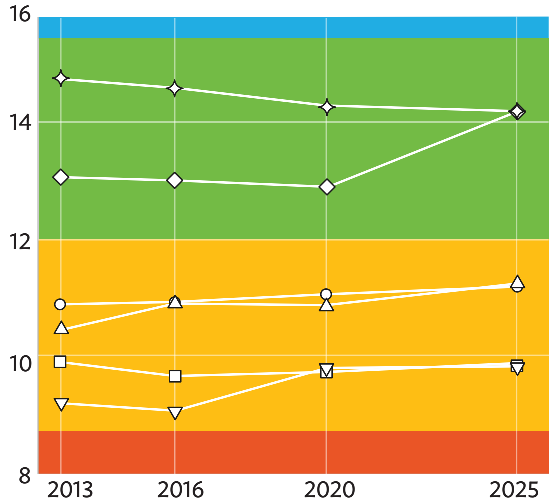
Indicators included in KD4:

Catchment and Aquatic System Condition Index (CASCI)

Environmental Governance Index (EGI)

Results

Figure 22. KD4 Regional Scores (2013–2025)



Source: ADB.

Southeast Asia shows a clear downward trend in CASCI, driven by increased hydrological alteration, groundwater depletion, loss of riparian vegetation, and reduced river connectivity. These pressures are increasing even in countries with improved governance scores. Without stronger action, this region is likely to see continued declines in water security and ecosystem resilience.

Largest gains (≥3 points) were recorded in Tonga, the Cook Islands, and Niue, where relatively small populations and targeted ecosystem protection measures supported significant improvements in environmental flows, water quality, and biodiversity health. **Moderate gains (1-2.9 points) were achieved in countries such as Kazakhstan, Papua New Guinea, and Palau,** reflecting improvements in fresh water ecosystem management and monitoring, albeit from a low baseline.

Table 13. Top Performers on KD4

Country	Tonga	Cook Islands	Niue
KD4 gain (2013–2025)	+5.5	+4.5	+4.4

Refer to the Pacific Regional Study for more details on AWDO data for the Pacific.
Source: ADB.

Smallest gains (0.1-0.9 points) were observed in 14 countries, such as Malaysia and Nepal, alongside advanced economies where systems are already advanced. Seven countries recorded stagnant KD4 scores (no change since 2013), reflecting persistent challenges in advancing environmental water security. **Declines were recorded in almost half of the assessed countries**, with the largest drops in the Federated States of Micronesia, Nauru, and Viet Nam, driven by intensified development pressures, weak enforcement of environmental safeguards, and exposure to climate extremes.

KD4 scores in Central and West Asia were mixed, with ecological decline from overextraction, land degradation, and pollution offsetting governance improvements. Kazakhstan showed the strongest gains, driven by better nitrogen use efficiency and wastewater treatment, but the results highlight that only a systems approach can protect aquatic ecosystems and sustain wider benefits.

In East Asia, the PRC and Mongolia stabilized EGI through better nitrogen management and protected areas. Rapid development, intensive land use, and high population density continue to drive ecological decline, underscoring the need for scaled-up restoration and integration of green infrastructure into future growth.

Most South Asian countries improved or maintained KD4 scores, with governance gains in nitrogen management offsetting some ecological pressures, though Bhutan declined due to reduced nitrogen efficiency and riparian tree loss. Despite progress, the region remains under intense pressure from population density and plastic pollution, making waste management, pollution control, and riparian restoration critical priorities.

Several Pacific island nations with high ecological value, such as Fiji and Solomon Islands, remain vulnerable to rapid ecological decline if development expands without adequate protection.

Findings and Recommendations

While the regional average KD4 score has remained relatively stable since 2013, this masks important subregional differences and rising risks in some areas.

1.

At first glance, the regional average KD4 score looks stable, **but this hides different realities across subregions.** Some countries in East and Southeast Asia made progress, while others in South Asia and the Pacific saw little improvement or even rising risks. In effect, the gains and setbacks balance each other out, creating the appearance of stability at the regional level.

2.

The findings show that development pathways must avoid repeating patterns where short-term infrastructure gains come at the cost of long-term water security. Rivers, wetlands, and groundwater systems are central to clean water supply, flood regulation, and ecosystem health. Infrastructure that disrupts flow regimes, degrades catchments, or fragments river systems can permanently damage these services.

3.

Environmental water security can only be protected through infrastructure that works with, rather than against, natural systems. This includes protecting riparian zones, maintaining flow variability, safeguarding connectivity, and using nature-based solutions. By embedding these ecological principles into development, countries can strengthen their KD4 performance while supporting inclusive, climate-resilient growth.

Introduction

KD4 definition: *The environmental water security indicator assesses the health of rivers, wetlands and groundwater systems and measures progress on restoring aquatic ecosystems to health on a national and regional scale.*

Healthy ecosystems are fundamental to water security. Over the past 30 years, there has been growing recognition of the essential role that rivers, wetlands, and catchments play in supporting human water needs (Vörösmarty et al. 2021). These ecosystems filter water, buffer against floods, help manage sediment, increase the life and effectiveness of infrastructure, and sustain fisheries and other food sources. The value of these services is estimated in the trillions of dollars globally (Costanza et al. 2014, Vörösmarty et al. 2021).

Human activities are degrading aquatic ecosystems across Asia and the Pacific. Rapid development has brought major investments in dams, irrigation networks, and urban water infrastructure. Many of these have improved access to water for people and the economy. These changes are captured in KDs 1 to 3. If well-managed, development can be beneficial and done in conjunction with ecosystem protection. However, such infrastructure often harms river health and creates new environmental and socioeconomic risks (Stewart-Koster and Bunn 2016, Vörösmarty et al. 2010). In some places, environmental degradation alone now poses a major threat to water security.

Integrating human water security and ecosystem protection is one of today's biggest water challenges. Meeting water needs while protecting the natural systems that provide clean, reliable water is critical for sustainable development. It also supports long-term economic and social goals. Without healthy aquatic ecosystems, water security cannot be achieved or maintained (Vörösmarty et al. 2021).

KD4 assesses the condition of aquatic ecosystems and the governance structures that support them. It outlines a regionwide method for evaluating pressures on rivers and fresh water systems across the Asia and Pacific region. The assessment also looks at how well countries are managing these ecosystems through laws, policies, and monitoring efforts.

Aquatic ecosystem health reflects the ability of fresh water systems to function over time. The concept helps measure whether rivers and wetlands can maintain biodiversity, recover from stress, and continue to support human needs (Norris and Thoms 1999). Landscape changes such as deforestation, agriculture, or urbanization affect water flow, sediment levels, and habitat structure. These changes influence the health of fish, plants, and other aquatic life (Hynes 1975, Allan 2004).

Understanding river conditions helps target effective water governance. By tracking changes in ecosystem health, decision-makers can identify emerging risks and take action to prevent long-term damage. Protecting ecosystem services is not just an environmental concern. It is a foundation for lasting water security in the Asia and Pacific region.

Methodology

The KD4 methodology remains largely unchanged from AWDO 2020 (Figure 23). It combines two indicators that assess both the condition of aquatic ecosystems and the governance in place to protect them: CASCI and EGI.

Each indicator is made up of multiple component sub-indicators that use publicly available data and global hydrological or nutrient models. These provide a regional picture of pressures on rivers and wetlands, including flow alteration, water quality, and ecosystem fragmentation, as well as the distribution of governance-related risks. CASCI and EGI are each scored out of 10, and their combined score forms the KD4 score out of 20. The workflow in Figure 23 shows how these indicators combine.

Catchment and Aquatic System Condition Index

CASCI measures pressures on and the condition of rivers and catchments using standardized global datasets. Given the size and diversity of ADB's member economies, using consistent and spatially distributed data is essential (Kuehne et al. 2023). CASCI includes three pressure indicators and two condition indicators:

- **Pressures:** riparian tree cover change, hydrological alteration, groundwater depletion
- **States**: nitrogen load, riverine connectivity

Time-series data are available for all five indicators in the 2025 assessment. However, for several Pacific countries, expert judgment supplemented limited data availability. No backcasting was possible where past assessments relied on different experts or methods.

Environmental Governance Index

The EGI focuses on governance outcomes rather than inputs. Governance quality is difficult to measure consistently over time. Instead, the EGI draws on the Yale Environmental Performance Index (EPI), which provides outcome-based indicators. Three EPI sub-indicators were selected:

- Wastewater treatment
- Terrestrial protected areas
- Sustainable nitrogen management index (SNMI)

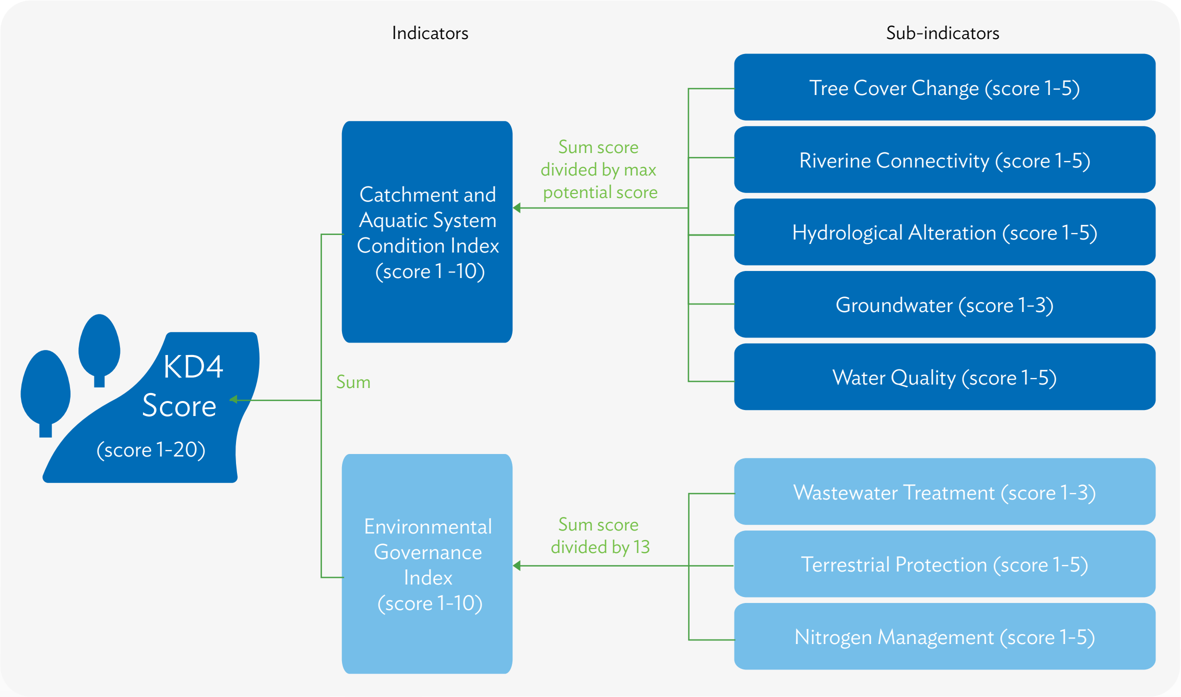
Countries that lack data for a given sub-indicator receive the minimum score, encouraging stronger reporting systems. The EGI complements CASCI by highlighting national environmental performance on ecosystem health.

Narrative Indicators

Two additional datasets, plastic pollution export and sediment export, were reviewed in 2025 as narrative indicators. Although these do not yet allow full country coverage or backcasting, they offer useful context for understanding river health alongside KD4, CASCI, and EGI scores.

Measuring saline level of the water at Mulia, Narail, Bangladesh (Photo by ADB).

Figure 23. Methodology for KD4



KD4 = Key Dimension 4 (environmental water security).
Note: Both the Catchment and Aquatic System Condition Index and Environmental Governance Index indicators are scaled and scored out of 10, then summed to make the overall KD4 index out of 20.
Note that groundwater and wastewater treatment are scored out of 3.
Source: ADB.

Fishers in Tonle Sap river (Photo by ADB).

The KD4 index is scored out of 20 and combines outcomes from both the CASCI and the EGI. To help interpret results, five steps categorize country performance, ranging from strong environmental governance and low ecological pressure to severe environmental risks and weak governance (14). These steps support consistent regional comparisons and help identify areas needing attention.

Table 14. Narrative Description of the Steps and Corresponding KD4 Scores

Water Security Steps	KD4 Score (out of 20)	Description
Model	>19.2	Very strong environmental governance and very low pressure on aquatic ecosystems
Effective	15.6-19.2	Moderate to good governance outcomes and limited pressures on aquatic ecosystems
Capable	12-15.6	Moderate governance or ecological outcomes, or strong performance in one and poor in the other
Engaged	8.6-12	Moderate to poor governance outcomes and high pressure on aquatic ecosystems
Nascent	<8.6	Poor governance outcomes and severe ecological pressures

Source: ADB.

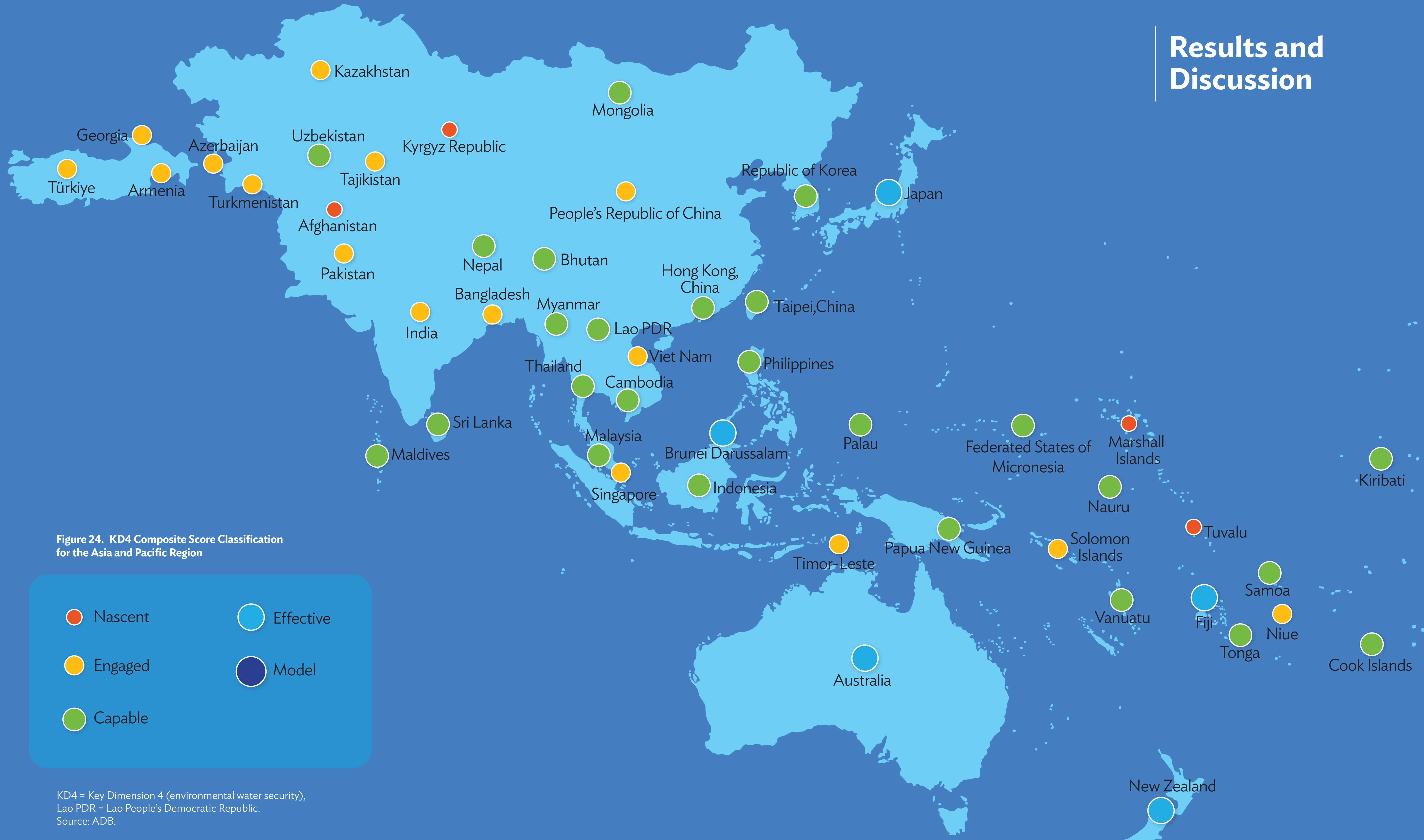


Figure 24. KD4 Composite Score Classification for the Asia and Pacific Region

KD4 = Key Dimension 4 (environmental water security), Lao PDR = Lao People's Democratic Republic.
Source: ADB.

Five economies scored above 15.6, placing them in the *Effective* step for environmental water security (Figure 24). These include Australia, New Zealand, Fiji, Brunei Darussalam, and Japan. While most advanced economies are in this category, several non-advanced economies also achieved *Effective* status. Most countries were rated either *Engaged* or *Capable*, with four countries from Central and West Asia and the Pacific rated as *Nascent*: Afghanistan, the Kyrgyz Republic, the Marshall Islands, and Tuvalu.

Half of all economies assessed, 25 in total, were classified as *Capable*, with scores between 12 and 15.6. This group spanned all regions and included countries with moderate environmental governance and ecological pressures.

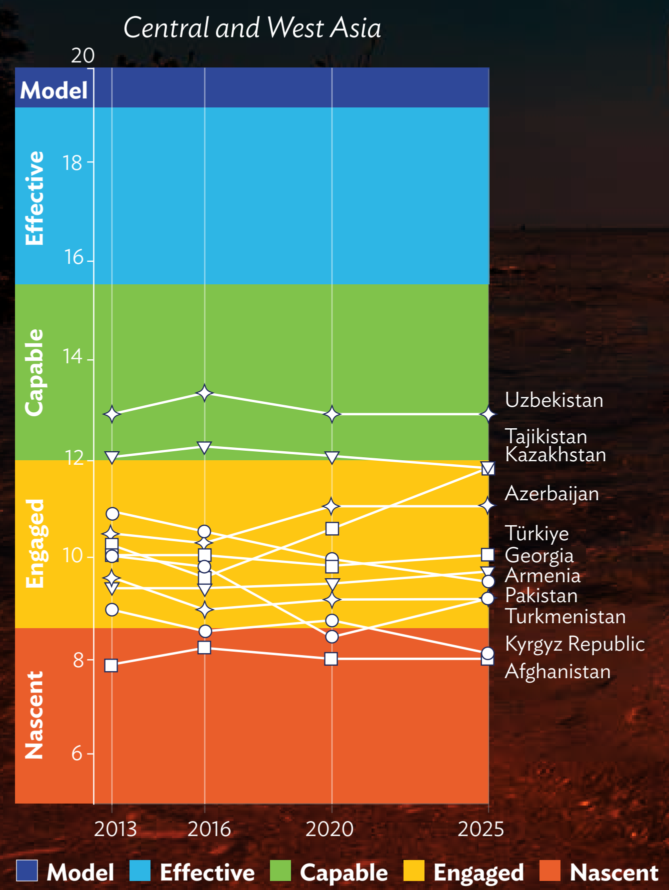
In some countries, CASCI and EGI scores were relatively balanced, however, in many countries it was not. In particular, five Pacific island countries, Vanuatu, the Federated States of Micronesia, the Cook Islands, Niue, and Solomon Islands, showed a concerning pattern. These countries scored relatively high on CASCI but low on EGI. This mismatch highlights ecosystems that remain in relatively good condition but lack the governance structures needed to sustain them.

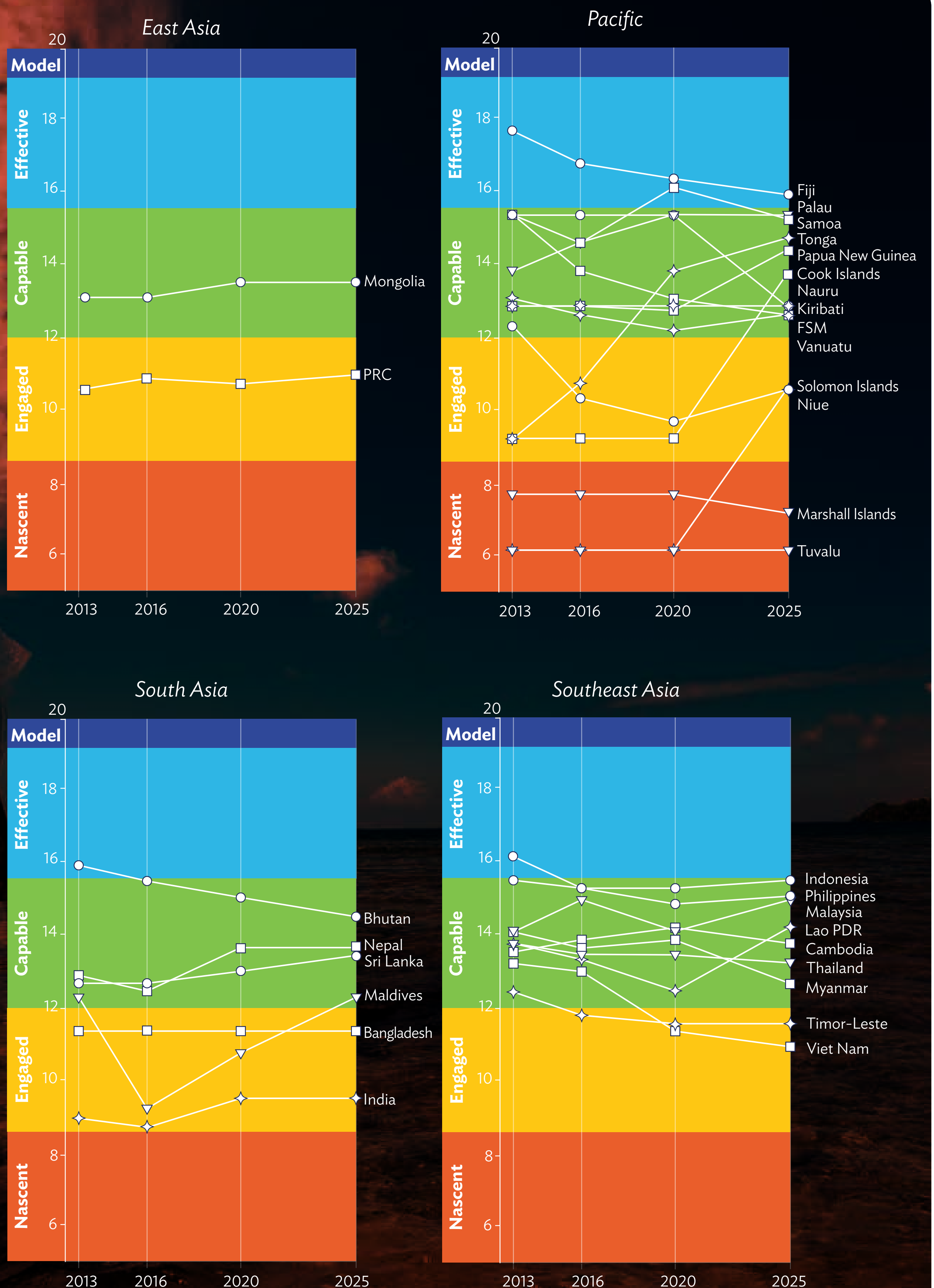
Each indicator should be interpreted separately when reviewing results. While higher scores in the EGI and CASCI may be related, an improvement in one does not offset a decline in the other. Assessing both measures together provides a more complete picture of a country's performance and helps identify targeted actions to strengthen environmental water security.

Changes in KD4 were mainly driven by increases in EGI or decreases in CASCI. However, most countries showed only moderate changes in their KD4 score between 2013 and 2025. Since the 2013 assessment, there have been substantial updates to the underlying data used in the component sub-indicators. Despite these updates, changes in the overall KD4 index were not always observed. In some cases, the shifts in underlying data were not large enough to move the score into a new quintile, based on the 2016 thresholds used to define the 1–5 scoring bands.

Twenty-nine countries experienced an absolute change of more than 0.5 units in their KD4 index between 2013 and 2025 (Figure 25). Fifteen countries showed increasing trends, while fourteen showed declines. All regions were represented among these changes.

Figure 25. Trends in KD4 Scores (2013–2025)





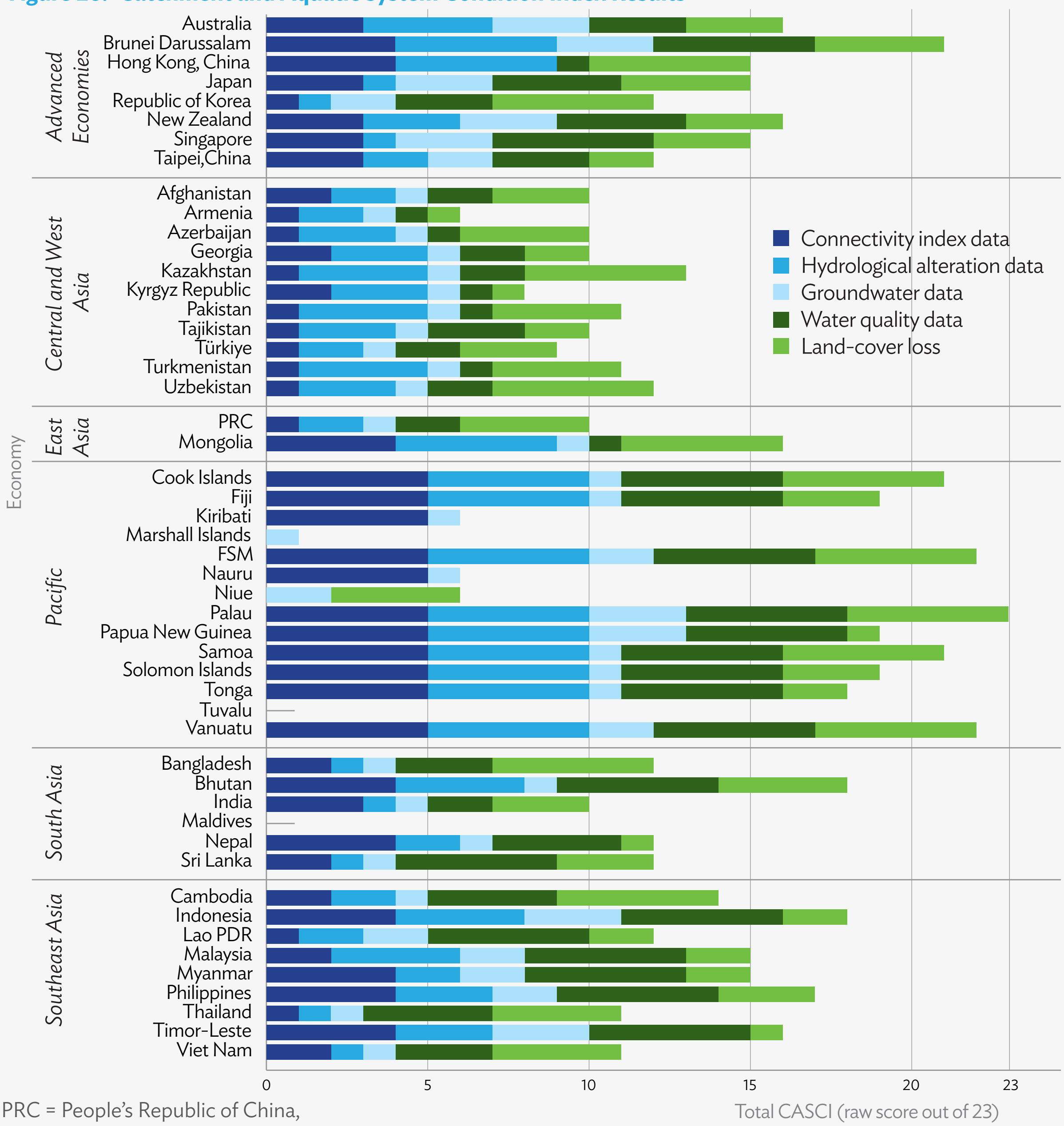
PRC = People's Republic of China, KD4 = Key Dimension 4 (environmental water security), Lao PDR = Lao People's Democratic Republic, FSM = Federated States of Micronesia.
Source: ADB.

Overall CASCI Results

The 2025 CASCI results are broadly consistent with previous AWDO assessments (Figure 26). They generally reflect patterns related to development level and population density. The highest CASCI scores were found in island nations, including Brunei Darussalam, the Cook Islands, Fiji, the Federated States of Micronesia, Palau, Samoa, as well as Vanuatu. These economies tended to have lower pressures on catchments and relatively intact ecosystems.

In contrast, economies with lower CASCI scores were often located in Central and West Asia. Examples include Armenia, the Kyrgyz Republic, and Türkiye. These economies recorded low values across multiple CASCI component sub-indicators, reflecting higher ecological pressures and more altered catchment conditions.

Figure 26. Catchment and Aquatic System Condition Index Results



PRC = People's Republic of China,
Lao PDR = Lao People's Democratic Republic, FSM = Federated States of Micronesia.
Source: ADB.

Almost half of the economies assessed (23 in total) showed very little change in CASCI between 2013 and 2025, with a change of less than ±0.25 out of 20. Only three economies recorded an increase in CASCI over this period: Japan, Palau, and Singapore. Palau improved due to better trends in groundwater. Singapore saw improvements in both groundwater and riparian tree cover. In economies with already high scores, such stability reflects sustained environmental water security. However, in economies with low or mid-range scores, it signals a lack of progress in restoring or improving water-related ecosystems.

Most economies that experienced a significant decline in CASCI, defined as more than 0.5 units, **were in Southeast Asia.** However, several advanced economies also recorded small declines. For example, New Zealand's CASCI declined due to rising nitrogen loads and increased loss of riparian tree cover. Fiji's decline was mainly driven by worsening groundwater conditions and riparian tree loss compared to 2013. In Southeast Asia, the Lao PDR experienced a decline in riverine connectivity, which was the main factor lowering its CASCI score. Armenia's CASCI dropped due to increased riparian tree cover loss. In the Kyrgyz Republic, the decline was linked to both higher nitrogen loads and reduced groundwater availability.

Box 7.

Empowering Women to Protect Forests and Water in Mongolia

Healthy forests are vital for securing clean water, sustaining fresh water ecosystems, and protecting fragile catchments. In Mongolia, the Sustainable Forest Management to Improve Livelihood of Local Communities Project showed how community-led forest management, informed by local hydrological assessments, can reduce climate risks, protect river flows, and improve environmental water security.

The project worked in five rural districts, where 141 forest user group members were trained in forest planning and sustainable management, including practices to protect riparian zones and prevent sediment runoff into streams. Women made up 55% of participants. Another 185 cooperative members, nearly half of them women, gained technical and business skills to process timber and non-timber forest products, reducing pressure on ecologically sensitive headwater areas. Local women led most of the new community forest enterprises, making up 70% of new small business operators.

Their leadership extended beyond economic activities. Women played key roles in managing forest fire risks, protecting riparian areas, and monitoring water sources. By placing women at the center of forest and water governance, the project improved livelihoods, supported gender equality, and helped safeguard critical water sources, sustain seasonal flows, and enhance the resilience of fresh water ecosystems.

This example shows that empowering women in local resource management strengthens both ecosystems and community water security.

Source: Independent Evaluation Department. 2019. Project Validation Report: PVR-2542. ADB.

The Southeast Gobi Urban and Border Town Development Project improves water supply and sanitation services in the booming mining and border towns of Omnogovi and Dornogovi provinces Southeast Gobi (Photo by ADB)

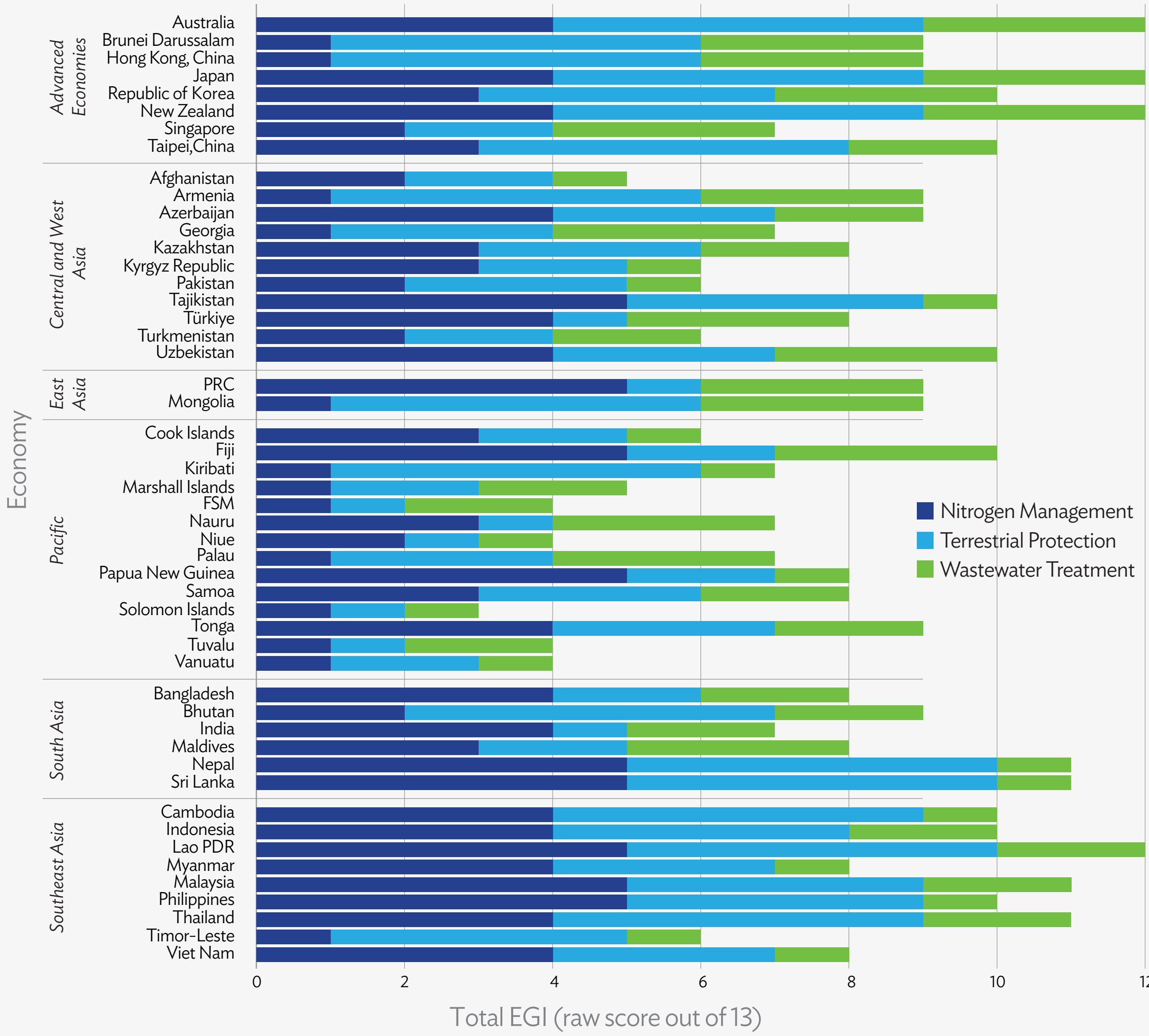
Overall EGI Results

The EGI results generally followed a development pattern (Figure 27), **where economies with stronger economies and institutions tended to score higher.** Advanced economies such as Australia, Japan, and New Zealand, recorded the highest overall EGI scores. The Lao PDR also ranked among the top performers. Its high EGI score reflected a significant increase in terrestrial protected areas between 2020 and 2025.

In contrast, **several small island nations had the lowest EGI scores.** This group included the Federated States of Micronesia, Niue, Solomon Islands, Tuvalu, and Vanuatu. Despite having relatively high CASCI scores, these economies lacked strong environmental governance frameworks. This mismatch points to a need for greater investment in governance capacity to protect remaining ecosystem health.

Most economies in the region either maintained or improved their EGI between 2013 and 2025. However, six economies showed a decline over this period. These were New Zealand, Bhutan, Armenia, Myanmar, Viet Nam, and the Federated States of Micronesia. The largest decline occurred in the Federated States of Micronesia, driven by reduced efficiency in nitrogen management. New Zealand also declined for the same reason.

Figure 27. Environmental Governance Index Scores



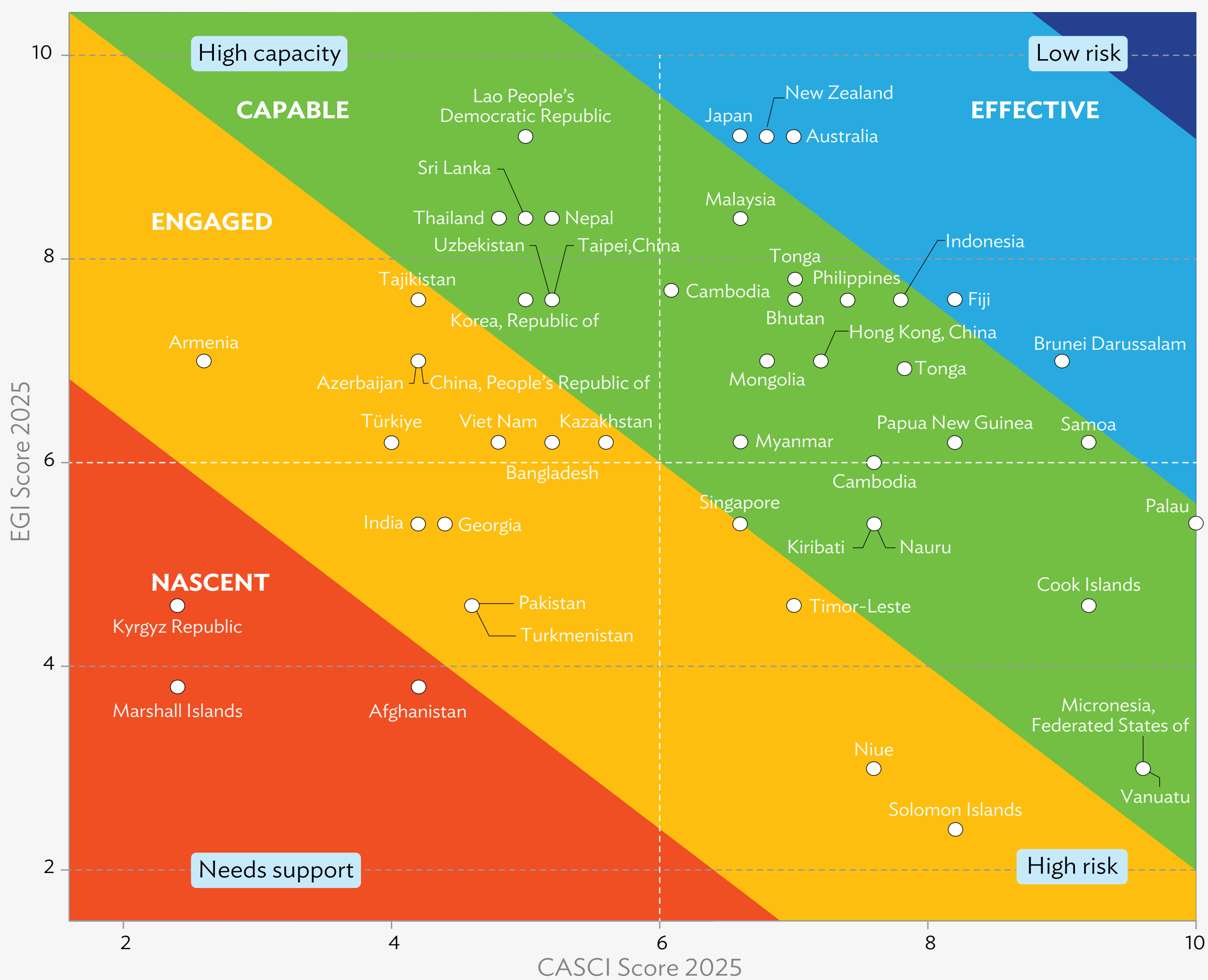
PRC = People's Republic of China, Lao PDR = Lao People's Democratic Republic, FSM = Federated States of Micornesia.
Source: ADB.

In contrast, **17 economies improved their EGI between 2013 and 2025.** These economies came from all regions of the Asia and Pacific. Improvements were mainly due to better nitrogen management and expanded terrestrial protected areas.

Key Dimension 4 Risk Framework

To assess recent pressures on environmental water security, a risk-based framework was applied using the CASCI and EGI. The risk-based framework helps identify which economies need urgent ecological restoration, stronger governance, or both to safeguard environmental water security. Figure 28 shows each country's CASCI and EGI scores. The top left quadrant includes *high capacity* economies, with strong governance but more degraded ecosystems. These economies may have the institutional tools needed to support recovery if implemented effectively. *Low risk* economies appear in the top right quadrant, generally showing strong scores across all indicators, though those with declining KD4 should be monitored. Those in the bottom left quadrant have low CASCI and EGI scores and are categorized as *needs support*, facing both ecological and governance pressures. The bottom right quadrant includes *high-risk* economies, which have relatively healthy ecosystems but weak governance. Without stronger institutions, these economies may struggle to maintain environmental water security.

Figure 28. Risk Map Showing Catchment and Aquatic System Condition Index and Environmental Governance Index Scores



CASCI = Catchment and Aquatic System Condition Index , EGI = Environmental Governance Index.
Note: Several Pacific countries are missing from this chart as they did not have a complete dataset.
Source: ADB.

An economy is considered *high risk* if it has a high CASCI but low EGI. **These economies often lack adequate protection and pollution management.** For example, in Solomon Islands, CASCI declined from a very high baseline, while the EGI has remained extremely low. This highlights the importance of examining individual sub-indicators to fully understand national trends. Strengthening governance remains a priority for *high risk* economies to support long-term ecosystem resilience.

Three economies experienced large shifts in KD4 index and quadrant category between 2013 and 2025. Viet Nam moved from *low risk* to near the border of *high capacity* and *needs support*. Continued declines in CASCI and EGI could place it firmly in the *needs support* category. In contrast, Papua New Guinea shifted from *high risk* to *low risk* through improved nitrogen management. Kazakhstan moved from *needs support* to *high capacity*, driven by better nitrogen use and wastewater treatment.

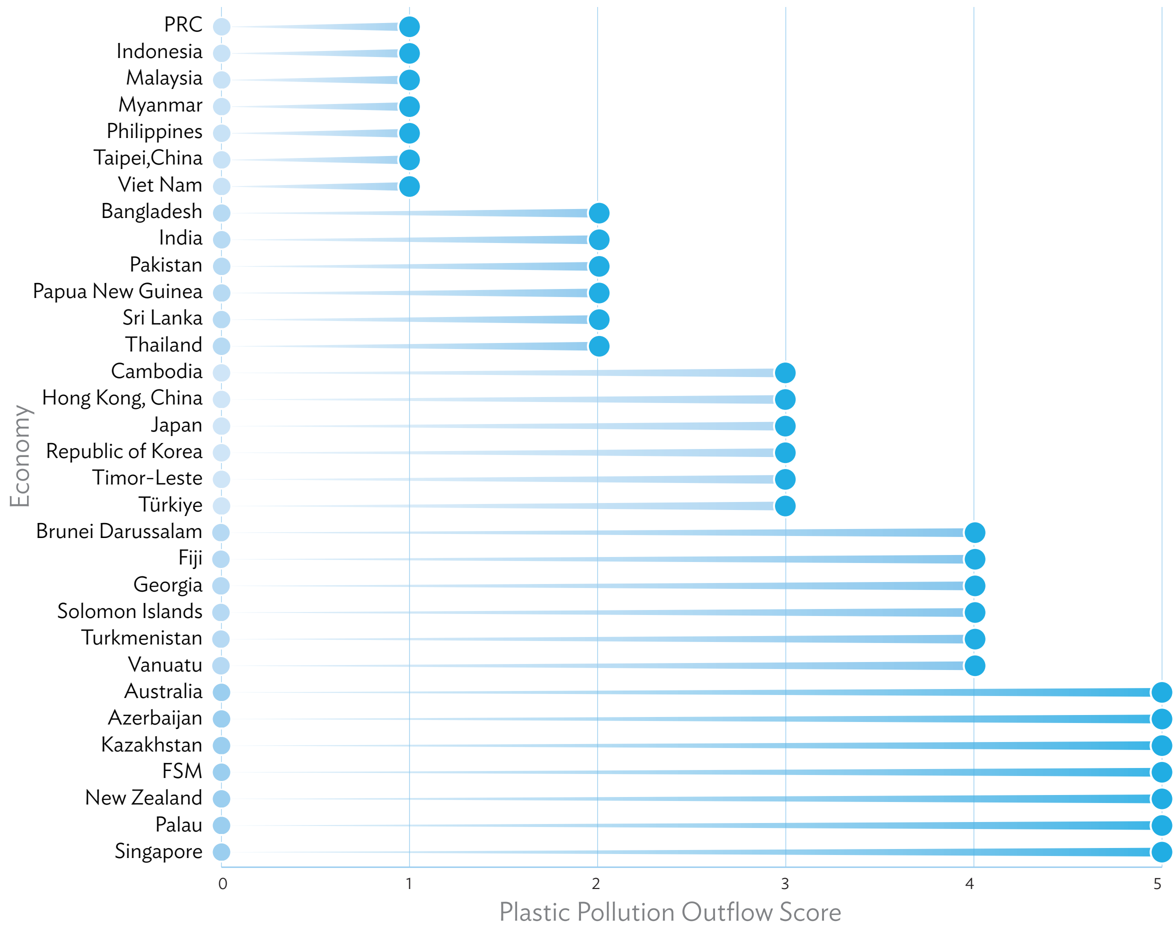
Narrative Indicators

Plastic Pollution

The 2025 assessment introduced a new indicator: **plastic mass release at river outflows,** measured in tons per year. Data was available for 32 member economies. The highest total outflows were observed in the PRC, Indonesia, Malaysia, Myanmar, the Philippines, Taipei,China, and Viet Nam. These economies received the lowest score (1) for this indicator (Figure 29). This is especially concerning as several also recorded lower KD4 scores. For example, the PRC already faces significant ecological pressure, and high plastic outflows may further strain aquatic systems.

Economies with the lowest plastic pollution outflows included Singapore, Palau, New Zealand, the Federated States of Micronesia, Kazakhstan, Azerbaijan, and Australia. These

Figure 29. Scores for Plastic Pollution Narrative Indicator



PRC = People Republic of China, FSM = Federated States of Micronesia.
Source: ADB.

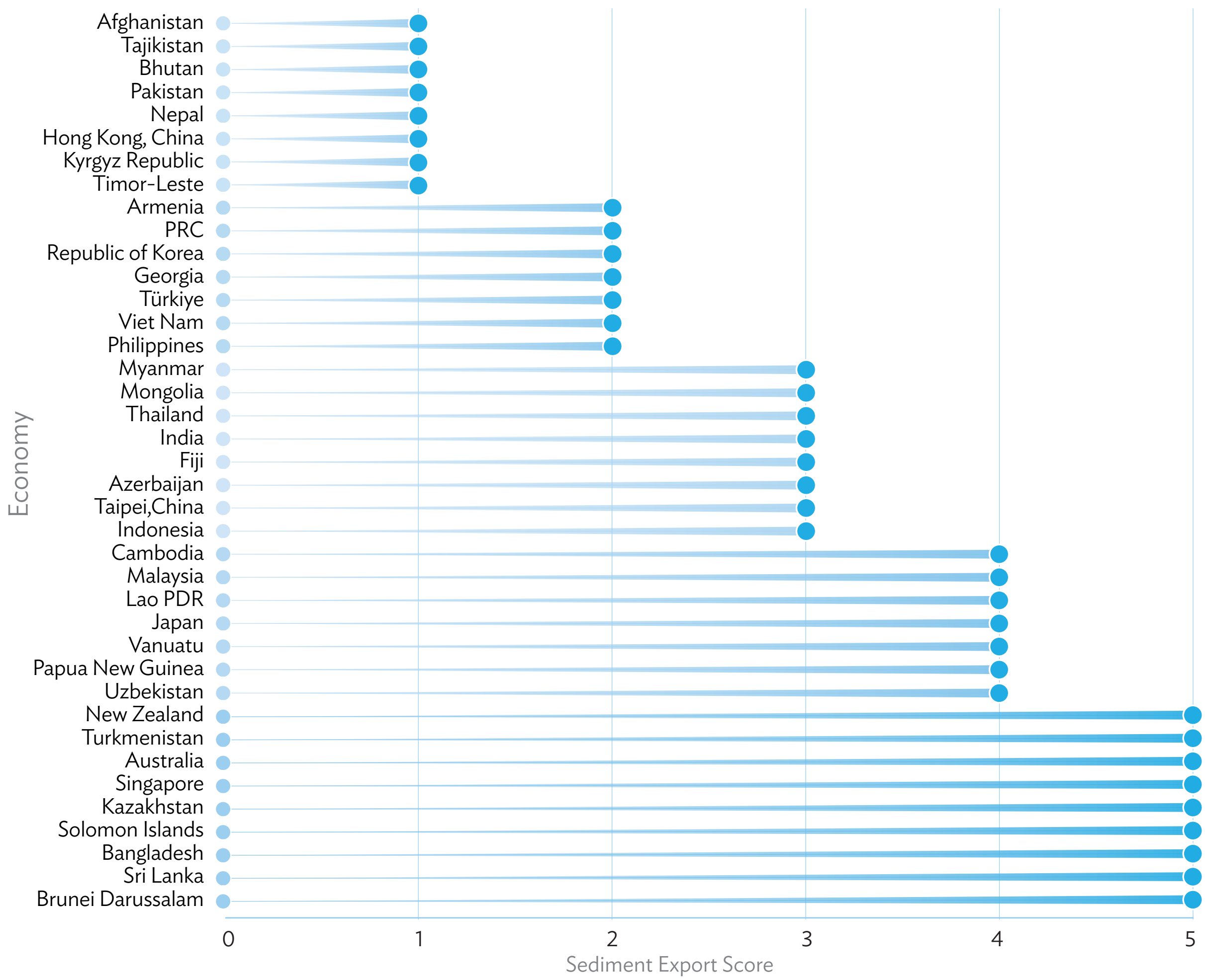
economies tended to have moderate to high KD4 scores, suggesting that strong environmental governance and catchment conditions may help limit plastic pollution reaching rivers and coasts.

Sediment Export

Sediment supply is vital for maintaining natural river processes. However, excessive sediment export can damage aquatic ecosystems and reduce the lifespan of infrastructure, which may require significant investment in dredging and maintenance. This is especially true when linked to land-use change or upstream infrastructure such as dams. Further, this indicator does not consider where the sediment was generated, perhaps in an upstream transboundary river. For this assessment, economies were ranked by total average sediment export per pixel (tons per hectare per year). While high sediment export was assumed to have negative impacts, low sediment flows can also disrupt river functions. This indicator should therefore be interpreted alongside other information, such as land-cover change and catchment modification.

Economies with the highest average sediment export included Afghanistan; Tajikistan; Bhutan; Pakistan; Nepal; Hong Kong, China; the Kyrgyz Republic; and Timor-Leste (Figure 30). This pattern raises concern for the Kyrgyz Republic and Afghanistan, which also had some of the lowest CASCI scores. High sediment loads, combined with weak governance (low EGI), place these economies at greater risk. Without effective regulation or catchment management systems, rising sediment pressure may lead to further ecosystem degradation (Suárez-Castro et al. 2021).

Figure 30. Scores for Sediment Export Narrative Indicator



PRC = People's Republic of China , Lao PDR = Lao People's Democratic Republic.
Note: Economies without available data for this indicator are not shown.
Source: ADB.

Across the Regions

Central and West Asia

Almost all countries in Central and West Asia recorded stable or declining CASCI scores, largely due to persistent pressures from water overextraction, land degradation, and pollution from agriculture and industry (Table 15). In contrast, EGI scores were stable or improving in most countries, except for Armenia. As a result, overall KD4 trends across the region were mixed, with governance gains often counterbalanced by continued ecological decline.

Kazakhstan had the largest increase in KD4. This improvement was driven by better governance, including higher nitrogen use efficiency and improved wastewater treatment. While hydrological riverine connectivity declined, reductions in nitrogen loads helped maintain a steady CASCI score.

The results from this region highlight the complexity of managing aquatic ecosystem health. Changes in CASCI and EGI can result from different drivers, and no single policy or action guarantees improved outcomes. Effective development strategies must address multiple sources of ecological pressure. A systems approach is needed to protect aquatic ecosystems and sustain the broader economic and social benefits they provide.

The beneficiary of the CAREC regional road project funded by the Asian Development Bank in her greenhouse (Photo by ADB).

Table 15. KD4 Indicator Scores by Year in Central and West Asia (2013–2025)

	2013		2016		2020		2025	
Country	CASCI	EGI	CASCI	EGI	CASCI	EGI	CASCI	EGI
Afghanistan	4.8	3.0	4.4	3.8	4.2	3.8	4.2	3.8
Armenia	3.2	7.6	2.8	7.6	3.0	7.0	2.6	7.0
Azerbaijan	4.4	6.2	4.2	6.2	4.2	7.0	4.2	7.0
Georgia	4.8	4.6	4.8	4.6	4.2	5.4	4.4	5.4
Kazakhstan	5.6	4.6	5.0	4.6	5.2	5.4	5.6	6.2
Kyrgyz Republic	4.4	4.6	4.0	4.6	4.2	4.6	3.4	4.6
Pakistan	5.0	4.6	4.4	4.6	4.6	4.6	4.6	4.6
Tajikistan	4.4	7.6	4.6	7.6	4.4	7.6	4.2	7.6
Türkiye	4.0	6.2	4.0	6.2	3.6	6.2	4.0	6.2
Turkmenistan	5.4	4.6	5.2	4.6	4.6	3.8	4.6	4.6
Uzbekistan	5.2	7.6	5.6	7.6	5.2	7.6	5.2	7.6

CASCI = Catchment and Aquatic System Condition Index , EGI = Environmental Governance Index,
KD4 = Key Dimension 4 (environmental water security).
Source: ADB.

East Asia

All countries in East Asia showed declining CASCI scores but stable or improving EGI (Table 16). Most changes were small across the sub-indicators, making it difficult to identify strong regional trends.

The PRC improved its nitrogen management efficiency, while Mongolia expanded its terrestrial protected areas. These improvements in governance helped stabilize EGI scores, even as ecosystem conditions declined.

The region faces mounting pressures from rapid development, intensive land use, and high population density. These factors have contributed to the observed declines in CASCI, particularly through impacts on water quality, connectivity, and catchment condition. Although the PRC has made large investments in ecological restoration, these efforts must be scaled up. Future development should integrate green infrastructure and nature-based solutions to reduce pressure on ecosystems and ensure that economic growth does not come at the cost of environmental water security (Vörösmarty et al. 2021).

Table 16. KD4 Indicator Scores by Year in East Asia (2013–2025)

	2013		2016		2020		2025	
Country	CASCI	EGI	CASCI	EGI	CASCI	EGI	CASCI	EGI
China, People's Republic of	4.4	6.2	4.8	6.2	4.6	6.2	4.2	7.0
Mongolia	7.0	6.2	7.0	6.2	6.8	7.0	6.8	7.0

CASCI = Catchment and Aquatic System Condition Index , EGI = Environmental Governance Index,
KD4 = Key Dimension 4 (environmental water security).
Source: ADB.

Pacific

Pacific countries often showed the greatest differences between CASCI and EGI scores. This includes the Federated States of Micronesia, Vanuatu, and Solomon Islands (Table 17). These countries had CASCI scores above 8, indicating relatively healthy catchments, but EGI scores below 4, reflecting weak environmental governance due to limited policy frameworks, incomplete regulations, and gaps in implementation capacity.

This mismatch is particularly concerning where CASCI scores are beginning to decline. In Table 17, **several Pacific countries show downward trends in ecosystem conditions.** For example, Fiji and Solomon Islands have experienced increased riparian tree cover loss and declining groundwater levels. These trends signal rising pressure on ecosystems that were previously in good condition.

Although many Pacific countries do not have the large river systems typically assessed under KD4, they still contain valuable fresh water ecosystems. **Weak governance creates a risk that these systems may degrade over time.** Strengthening environmental management as part of development planning offers a way to avoid the common pattern of ecological decline that often accompanies economic growth. Early investment in governance can help secure long-term environmental water security and protect development gains.

Table 17. KD4 Indicator Scores by Year in the Pacific (2013–2025)

	2013		2016		2020		2025	
Country	CASCI	EGI	CASCI	EGI	CASCI	EGI	CASCI	EGI
Cook Islands		4.6		4.6		4.6	9.2	4.6
Fiji	10.0	7.6	9.2	7.6	8.6	7.6	8.2	7.6
Kiribati	7.6	5.4	7.6	5.4	7.6	5.4	7.6	5.4
Marshall Islands		3.8		3.8		3.8	3.4	3.8
Micronesia, Federated States of	10.0	5.4	10.0	3.8	10.0	3.0	9.6	3.0
Nauru	10.0	5.4	10.0	5.4	10.0	5.4	7.6	5.4
Niue		3.0		3.0		3.0	7.6	3.0
Palau	8.4	5.4	9.2	5.4	10.0	5.4	10.0	5.4
Papua New Guinea	8.2	4.6	8.2	4.6	7.4	5.4	8.2	6.2
Samoa	10.0	5.4	10.0	4.6	10.0	6.2	9.2	6.2
Solomon Islands	10.0	2.4	8.0	2.4	7.4	2.4	8.2	2.4
Tonga		4.6		5.4		7.0	7.8	7.0
Tuvalu		3.0		3.0		3.0		3.0
Vanuatu	10.0	3.0	9.6	3.0	9.2	3.0	9.6	3.0

CASCI = Catchment and Aquatic System Condition Index , EGI = Environmental Governance Index,
KD4 = Key Dimension 4 (environmental water security).
Source: ADB.

South Asia

Most countries in South Asia were on a positive trajectory, with KD4 scores either increasing or remaining stable between 2013 and 2025 (Table 18). Bhutan was the only country in the region with a declining KD4 score. This decline was driven by reduced nitrogen management efficiency and increased riparian tree cover loss.

In countries that improved, the changes were generally modest. In Sri Lanka, reductions in nitrogen load and improved nitrogen management were caused by gains in efficient nitrogen use. This highlights how stronger governance through the EGI can support ecological improvements captured in CASCI. In India, the KD4 score increased despite a slight decline in CASCI caused by riparian tree loss. This was due to a rise in EGI, particularly from better nitrogen management. National flagship programs such as Atal Mission for Urban Rejuvenation and Urban Transformation 2.0 (AMRUT 2.0), Jal Jeevan Mission, the Swachh Bharat Mission, and Namami Gange have strong ecological improvement components alongside other ongoing reform initiatives in sewerage expansion, sewage treatment plant modernization, wastewater reuse, and fecal sludge management. These are expected to lead to significant improvements in the future.

South Asia started from a relatively low baseline for KD4, reflecting the intense pressure on ecosystems in one of the most densely populated parts of the world. South Asia's river systems are also heavily impacted by plastic pollution from mismanaged urban waste in densely populated catchments. Strengthening governance through improved waste management, enforcement of pollution controls, and restoration of riparian buffers can reduce plastic leakage into waterways, complementing ecosystem gains from better nitrogen management and vegetation protection.

Table 18. KD4 Indicator Scores by Year in South Asia (2013–2025)

	2013		2016		2020		2025	
Country	CASCI	EGI	CASCI	EGI	CASCI	EGI	CASCI	EGI
Bangladesh	5.2	6.2	5.2	6.2	5.2	6.2	5.2	6.2
Bhutan	8.2	7.6	7.8	7.6	7.4	7.6	7.6	7.0
India	4.4	4.6	4.2	4.6	4.2	5.4	4.2	5.4
Maldives		6.2		4.6		5.4		6.2
Nepal	5.2	7.6	4.8	7.6	5.2	8.4	5.2	8.4
Sri Lanka	5.0	7.6	5.0	7.6	4.6	8.4	5.0	8.4

CASCI = Catchment and Aquatic System Condition Index , EGI = Environmental Governance Index,
KD4 = Key Dimension 4 (environmental water security).
Source: ADB.

Southeast Asia

More than half of the countries in Southeast Asia showed a declining KD4 trend between 2013 and 2025 (Table 19). Cambodia, the Lao PDR, the Philippines, and Thailand all recorded notable CASCI decreases, reflecting a combination of worsening groundwater conditions, rising hydrological stress, reduced efficiency in nitrogen management, and increased alteration of river flows from infrastructure development. Viet Nam had the steepest decline, driven by reduced nitrogen management efficiency, falling groundwater levels, and greater hydrological alteration of surface flows.

Groundwater loss can reduce surface water availability and harm aquatic ecosystems, especially those dependent on groundwater flows (Kath et al. 2018). In Viet Nam, this is particularly concerning. The country already faces problems with groundwater salinization and contamination (Ha et al. 2022), which adds to the pressure on environmental water security.

Malaysia recorded the largest improvement in KD4 in the region. This increase was due to stronger performance in governance, particularly in nitrogen management and expansion of terrestrial protected areas. Although Malaysia's CASCI declined, it rose in its EGI. This contrast between Malaysia and Viet Nam highlights the critical role of fertilizer efficiency in protecting ecosystems and improving agricultural outcomes.

Table 19. KD4 Indicator Scores by Year in Southeast Asia (2013–2025)

	2013		2016		2020		2025	
Country	CASCI	EGI	CASCI	EGI	CASCI	EGI	CASCI	EGI
Cambodia	7.4	6.2	7.0	7.0	6.6	7.6	6.0	7.6
Indonesia	7.8	7.6	7.6	7.6	7.6	7.6	7.8	7.6
Lao PDR	6.0	7.6	5.6	7.6	4.8	7.6	5.0	9.2
Malaysia	7.2	7.0	6.6	8.4	5.6	8.4	6.6	8.4
Myanmar	7.2	7.0	6.8	7.0	7.0	7.0	6.6	6.2
Philippines	8.4	7.6	7.6	7.6	7.2	7.6	7.4	7.6
Thailand	6.0	7.6	5.0	8.4	5.0	8.4	4.8	8.4
Timor-Leste	7.8	4.6	7.2	4.6	7.0	4.6	7.0	4.6
Viet Nam	6.4	7.0	6.0	7.0	5.2	6.2	4.8	6.2

CASCI = Catchment and Aquatic System Condition Index , EGI = Environmental Governance Index,
KD4 = Key Dimension 4 (environmental water security), Lao PDR = Lao People's Democratic Republic.
Source: ADB.

Box 8.

Youth Leading Local Solutions for Water Security in the Philippines

Across Asia and the Pacific, water insecurity remains one of the most pressing challenges of our time, threatening human health, livelihoods, and ecosystems. Yet, one of the most underutilized resources in addressing this crisis is the power of young people. While youth are often on the front lines of water-related impacts, they are rarely given the opportunity or tools to shape solutions. However, examples from across the region show that when empowered, youth can become vital contributors to water governance, innovation, and community resilience. A powerful case study from the Philippines, Sto. Niño in Benguet, shows how young people are stepping up to protect and restore fragile water ecosystems through science, community engagement, and advocacy.

Sto. Niño is a legacy copper mine site located in Tublay, Benguet, approximately 300 kilometers north of Manila. The site was abandoned without proper rehabilitation, and surrounding communities continue to face environmental threats from heavy metal contamination, particularly high concentrations of copper in the tributary of the local River system. This pollution poses significant risks to human health, agriculture, and biodiversity.

To address this, Bioplus Mine.earth, in partnership with academic and research institutions, implemented a limestone-based passive treatment system at a known acid mine drainage site in Sitio Sto. Niño in 2022. The system harnesses a nature-based approach to neutralize acidic water and reduce heavy metal concentrations by increasing pH levels through limestone leaching.

A defining strength of this initiative is the active involvement of local youth. Through tailored training and capacity-building efforts, the youth have become essential to the project's success by monitoring water quality, using scientific instruments to track pH, conductivity, and metal levels, and facilitating real-time data sharing with research partners to monitor and evaluate project impact. Beyond technical roles, they also serve as trusted liaisons, ensuring community engagement remains culturally sensitive and transparent, particularly in conversations with elders and decision-makers.

This experience has sparked scientific curiosity and environmental awareness among the youth, while also deepening their sense of agency and connection to their local ecosystem. It shares how youth, when supported, can lead localized, impactful, and sustainable solutions to complex environmental challenges.

Source: Dimple Behal, Environmental and Urban Planner, UNOPS, India.

Author of this box: Dimple Behal
Dimple Behal is an Urban and Environmental Planner working at the intersection of urban development, climate resilience, and social equity. With experience across UN agencies and grassroots projects, she works on WASH, circular economy, combining research, advocacy, and storytelling to amplify marginalized voices and envision regenerative, inclusive futures.

A farmer is watering his field. La Union, the Philippines (Photo by ADB).

Conclusion and Findings

KD4 provides a regional picture of environmental water security across the Asia and Pacific region, combining data on ecosystem condition and governance. While some countries have made progress in improving environmental outcomes, many others face rising risks. These risks are not limited to countries with low incomes or limited data; they are emerging in diverse settings and reflect the growing tension between development pressures and ecosystem sustainability. As an example, expanding hydropower and irrigation schemes that alter river flows, rapid urban growth increasing stormwater runoff, or intensive agriculture contributing to nutrient pollution and habitat loss.

The risk-based framework used in this assessment offers a valuable tool for identifying vulnerability. It reveals where countries have relatively healthy aquatic ecosystems but seem to lack the governance systems needed to sustain them. This is particularly evident in parts of the **Pacific, where governance scores are relatively low, which may expose fragile ecosystems to future degradation.** Without timely intervention, these countries could experience sharp declines in ecosystem condition, even if pressures are currently low.

Infrastructure development remains a central challenge. **When poorly planned or implemented without ecological safeguards, infrastructure projects can severely degrade rivers, wetlands, and groundwater systems.** These changes often undermine the natural systems that provide clean water, regulate flows, and support livelihoods. The long-term costs of degraded ecosystems are substantial, not only in terms of water supply and quality, but also in increased disaster risk, reduced agricultural productivity, and harm to biodiversity. **In Viet Nam and the Philippines, for example, increased groundwater extraction and hydrological alteration have led to noticeable declines in aquatic ecosystem condition. Malaysia's experience shows that strengthened governance,** including better nitrogen management and expanded protected areas, does not always prevent ecological decline.

Across the region, KD4 scores have remained relatively stable over the past 12 years. However, this apparent stability hides important shifts in underlying trends. **Many countries have made modest improvements in governance, as captured by EGI, while ecological indicators measured by CASCI have declined slightly.** In most cases, these changes were not large enough to move the overall KD4 index across scoring thresholds. **Southeast Asia emerged as a region of particular concern,** with several countries showing consistent downward trends in CASCI. This suggests that without more ambitious action, continued environmental degradation is likely.

The results of this assessment underscore the need to embed ecological principles into infrastructure design and investment decisions. Development that fails to account for ecosystem health is unlikely to deliver lasting water security. Nature-based solutions and integrated catchment planning offer more resilient pathways forward, particularly in rapidly developing areas. Transboundary challenges remain especially urgent, as seen in the Mekong River Basin, where downstream impacts are increasingly shaped by upstream decisions. Strengthening regional cooperation will be essential for protecting shared water resources and ensuring that future development does not come at the cost of long-term sustainability.

To move forward, it is vital that governments continue to promote infrastructure that works with nature rather than against it. At the same time, **efforts to strengthen governance, particularly in countries with high ecological value but low institutional capacity, can help shift vulnerable countries out of the high-risk category.** Together, these approaches offer the clearest path toward securing environmental water security in the face of growing pressures.

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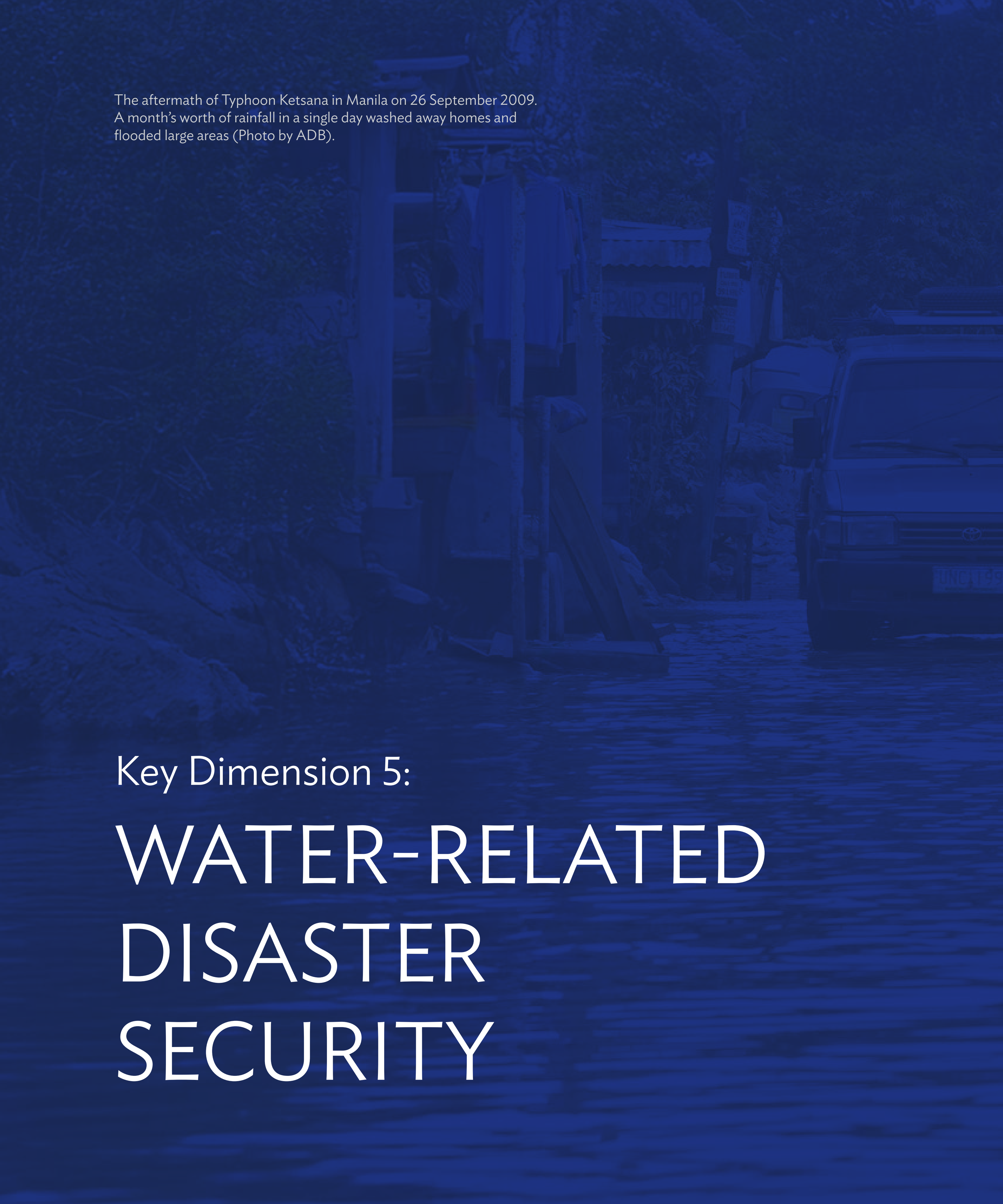
Mangroves growing along the beach of Tarawa, Kiribati (Photo by ADB).



The aftermath of Typhoon Ketsana in Manila on 26 September 2009. A month's worth of rainfall in a single day washed away homes and flooded large areas (Photo by ADB).

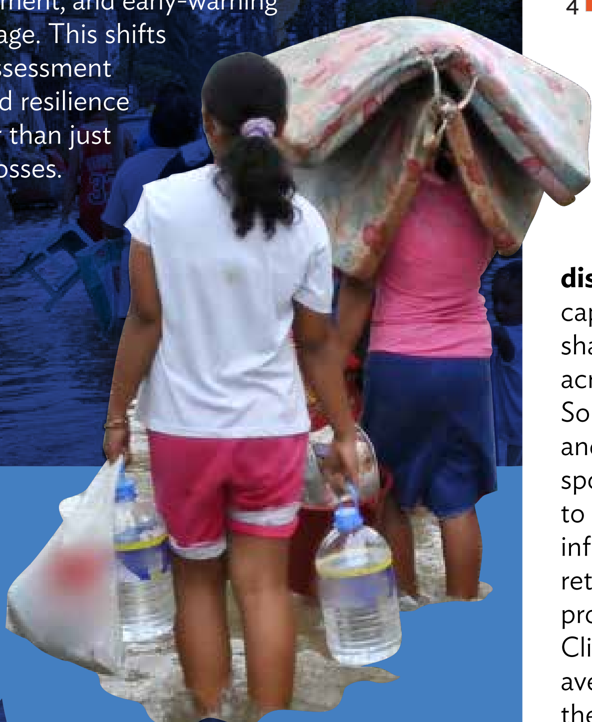
Key Dimension 5:

WATER-RELATED DISASTER SECURITY

Key Dimension in Brief

KD5 in AWDO 2025 assesses the capacity of countries to anticipate, absorb, adapt to, and recover from water-related disasters such as floods, droughts, and storms. It combines indicators on hazard exposure, vulnerability, and coping capacity to provide an overall score out of 20, reflecting both risk levels and resilience-building measures.

The 2025 update enhances the KD5 framework by introducing a forward-looking climate change multiplier to adjust historical exposure for future conditions, and adding indicators for social cohesion, infrastructure investment, and early-warning coverage. This shifts the assessment toward resilience rather than just past losses.



The aftermath of Typhoon Ketsana (Photo by ADB).

Indicators included in KD5:

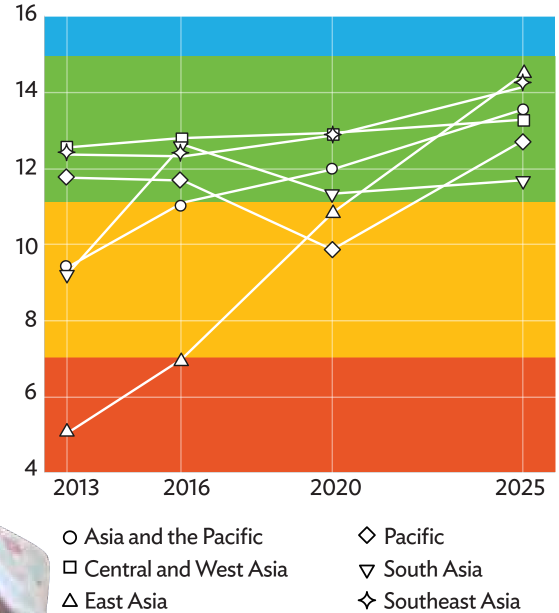
Drought Risk

Storm Risk

Flood Risk

Results

Figure 31. KD5 Regional Scores (2013–2025)



Source: ADB.

The results reveal widening gaps in disaster resilience across the region. While capacity has emerged as the dominant factor shaping KD5 scores, improvements are uneven across the region. East Asia and parts of Southeast Asia show steady gains, while Central and West Asia has stalled. South Asia sees sporadic progress, and the Pacific continues to fall behind. Thailand shows that even major infrastructure upgrades can see diminishing returns when climate-adjusted hazard projections cushion exposure reductions. Climate change is raising hazard exposure on average by 19%, with South Asia at 13% and the Pacific at 15%, increasing the urgency for forward-looking planning.

Table 20. Top Performers on KD5

Country	China, People's Republic of	Tajikistan	Thailand	Cambodia	Niue
KD5 gain (2013–2025)	+9.0	+7.4	+7.1	+5.1	+4.5

Source: ADB.

Five countries recorded the highest gains (≥4 points)—the PRC, Tajikistan, Thailand, Cambodia, and Niue. Gains in the PRC were driven by large-scale flood management infrastructure, strengthened emergency response systems, and urban drainage upgrades. Thailand advanced through enhanced early-warning coverage and targeted flood barrier investments, while Niue benefited from donor-supported coastal protection.

The PRC recorded the largest KD5 gain (+9.0 point increase from 2013), driven by extensive flood management infrastructure, sponge city investments, and advanced early-warning systems, which collectively reduced hazard exposure for hundreds of millions of people.

Moderate gains (1–3.9 points) were achieved by 19 countries. Many of these improvements came from integrated disaster risk management programs and investment in climate adaptation measures.

Smallest gains (0.1–0.9 points) were seen in 16 countries. These include advanced economies where further progress depends on governance and innovation, and small island developing states where geographic and structural constraints limit resilience-building. In the Pacific, four island nations recorded the smallest gains, reflecting persistent barriers despite targeted external support.

Declines were observed in 10 countries, most sharply in Tuvalu, which faces extremely high climate-related hazard exposure, limited protective infrastructure, and constrained institutional capacity. Significant setbacks were also seen in the Marshall Islands and Palau.

Findings and Recommendations

1. **The strongest predictor of resilience is not wealth or infrastructure, but social cohesion.** Countries with high levels of trust, inclusion, and community participation consistently perform better. Social cohesion magnifies the effectiveness of early-warning systems and infrastructure investments, helping to turn alerts into timely action. This makes it a powerful and often underutilized lever for disaster risk reduction.

2. **Progress is achievable if countries commit to five core priorities:** embedding disaster-risk finance into national budgets, expanding early-warning coverage to last-mile populations, investing in maintenance and modernization of existing infrastructure, strengthening social cohesion through inclusive disaster planning, and finalizing and funding NAPs. The tools and knowledge are now in place; the next challenge is to close the implementation gap before climate change locks in a more severe hazard baseline.

3. **Highest exposure is found in the Pacific, where small populations face disproportionately high risk.** The "island paradox" is particularly striking. Many Pacific island nations have moderate incomes but extremely high risk. Geographic isolation, limited land area, and institutional capacity constraints leave these states unable to scale up resilience, even with steady aid flows. National averages often mask much greater vulnerability in remote outer islands. Without regionally coordinated approaches and targeted support, these countries risk falling further behind as climate extremes intensify.

4. **Despite significant improvements, significant capacity gaps between countries, and the underutilization of social cohesion as a resilience driver, the data show that risk is reducible.** In 2025, no country scored the lowest KD5 water security step, but 34 million people still live in the engaged step. Raising all countries' capacity scores to the current regional 50th percentile would reduce this number to 150,000.

Introduction

KD5 definition: *The extent to which populations are protected from water-related disasters, reflecting their ability to withstand, manage and recover from water-related risks, including floods, drought and storms.*

Securing water-related disaster resilience is one of the most urgent challenges facing Asia and the Pacific. As climate risks accelerate, countries face growing threats from droughts, floods, and tropical cyclones. These hazards are becoming more intense due to rising temperatures, changing rainfall patterns, and unsustainable development. To manage these risks, countries need stronger policies, resilient infrastructure, and inclusive governance. Regional cooperation is also essential. Water-related disasters cross borders, so shared strategies and open information are critical to building long-term resilience.

Key Dimension 5 (KD5) measures water-related disaster security. It draws on the **United Nations Office for Disaster Risk Reduction risk framework** (UNDRR 2017), which defines disaster risk as the potential loss of life, injury, or damaged assets over a given period. KD5 captures this risk by combining data on hazard, exposure, vulnerability, and capacity. It focuses on three main types of water-related disasters: drought (climatological), floods and landslides (hydrological), and cyclones and storm surges (meteorological). Historical data from sources such as EM-DAT (Centre for Research on the Epidemiology of Disasters 2025) provide a transparent, comparable foundation for assessing past impacts and guiding future action.

The 2025 assessment expands KD5 by integrating climate projections, NAPs, infrastructure readiness, and social cohesion. This moves the framework beyond a historical review of disaster losses. It now offers a forward-looking tool to assess resilience. Climate projections help flag emerging hot spots that may not appear high-risk today from historical records and evidences. Adaptation plans show whether countries are turning awareness into real action. Infrastructure such as dams, levees, and drainage systems influences how hazards translate into impacts. Social cohesion, built through trust and local networks, often shapes community survival during extreme events.

By combining these lenses, KD5 identifies where risk is highest and why. It also highlights which interventions, such as policy reform, infrastructure investment, or community mobilization, could reduce losses most effectively. **Disaster risk is not caused by extreme events alone. It is shaped by development choices, inequality, and weak governance.** These deeper drivers are often overlooked. Although the SDGs mention resilience, disaster risk reduction has not always been central to development efforts.

KD5 2025 helps fill this gap. It blends empirical disaster data with insights into vulnerability, adaptive capacity, and climate governance. This approach reveals both the scale of risk and the level of preparedness. As climate extremes become more frequent and severe, KD5 offers a vital tool for guiding national priorities and regional strategies. It supports better decision-making to protect people, economies, and ecosystems across Asia and the Pacific.

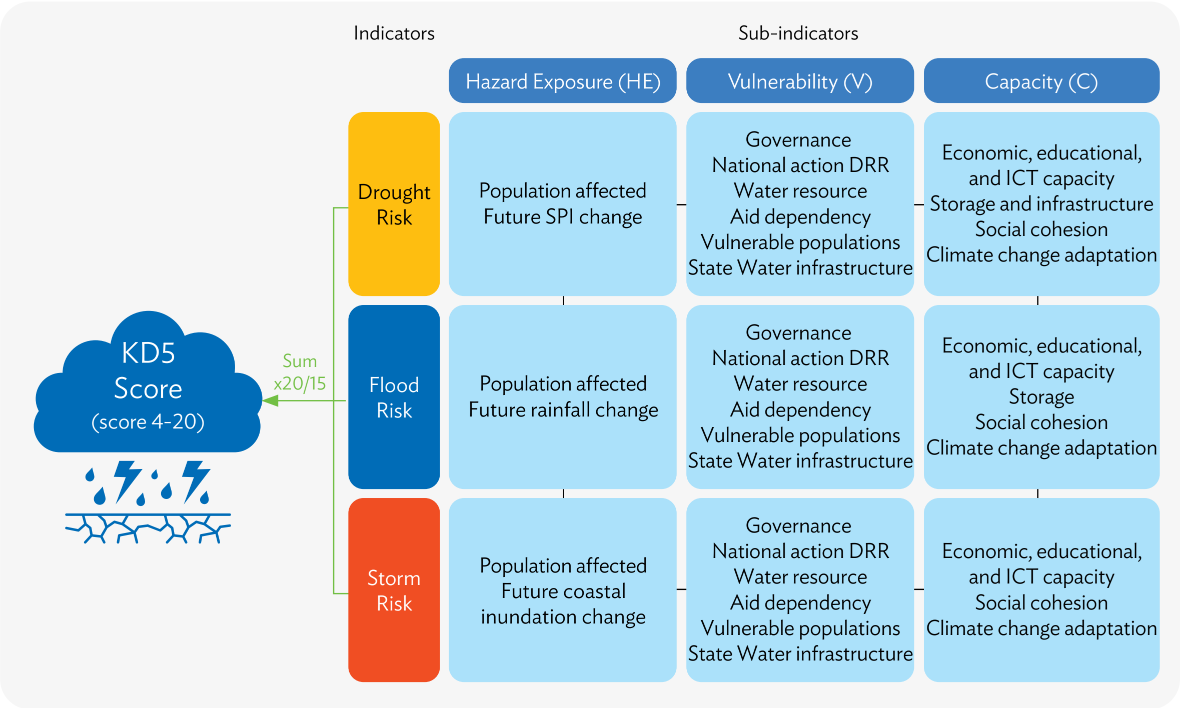
Methodology

Key Dimension 5 (KD5) assesses how well countries in Asia and the Pacific can manage risks from droughts, floods, and storms (Figure 32). The 2025 update builds on the 2020 framework, which defined disaster risk as a function of three factors: **hazard and exposure (HE)**, **vulnerability (V)**, and **capacity (C).** The same factors have been used to calculate risk:

$$Risk = (HE \times V \times (1 - C))^{1/3}$$

Subtracting capacity ensures that higher levels of preparedness reduce overall risk. Scores for the three types of water-related hazards, climatological, hydrological, and meteorological, are grouped into five bands and rescaled to produce a KD5 score ranging from 4 to 20. This approach maintains consistency with previous assessments while allowing more detailed comparisons.

Figure 32. Methodology for KD5



DRR = disaster risk reduction, ICT = information and communication technology,
KD5 = Key Dimension 5 (water-related disaster security), SPI = Standardized Precipitation Index.
Source: ADB.

Calculation Process

The KD5 calculation follows five steps:

1. Normalize source data to a common scale, including values per capita and per US dollar GDP, using min–max scaling to a 0 to 1 range.
2. Aggregate sub-indicators into composite scores using equal weights within each thematic group.
3. Apply the climate change multiplier to hazard and exposure values, then calculate the risk for each hazard type using the geometric mean.
4. Band the hazard-family risks into quintiles, sum the results, and rescale to produce a final KD5 score between 4 and 20.
5. Convert final scores into a five-tier classification ranging from *Nascent* (lowest performance) to *Model* (highest performance), aligning KD5 with the overall AWDO stepped rating system used across all KDs (Table 21).

Table 21. Narrative Description of the Steps and Corresponding KD5 Scores

Water Security Steps	KD5 Score (out of 20)	Description
Model	>19.2	Disaster risk reduction is fully integrated, sustained, and institutionalized.
Effective	15.2-19.2	Strong and consistent policy-level action to manage and reduce disaster risk.
Capable	11.2-15.2	Institutional frameworks are in place, with moderate progress in reducing risk.
Engaged	7.2-11.2	Some action taken, but progress is limited or not yet systematic.
Nascent	≤ 7.2	Little or no progress; disaster risk reduction is minimal or has regressed.

Source: ADB.

Methodological Improvements in 2025

For the first time, KD5 2025 includes climate change adjustment. This uses projections from Coupled Model Intercomparison Project Phase 6 (CMIP6) climate models to estimate how extreme rainfall, drought, and coastal flooding will evolve. Changes in rainfall inform expected increases in flood risk, while the Standardized Precipitation Index (SPI) estimates future drought severity. Coastal flooding risk is assessed through projected changes in inundation area. These projections are incorporated through a Climate Change Factor (CC-factor), which multiplies exposure values to reflect future hazard intensity. For example, the Ganges–Brahmaputra delta receives a multiplier above 1.3, while parts of temperate East Asia fall below 1.0. This transparent stress test helps identify emerging hot spots.

Social cohesion is also now part of the KD5 framework. A new index converts 15 indicators of health, equality, safety, freedom, and life satisfaction into a score from 0 to 1 (Solability, 2024). Countries with stronger social cohesion tend to respond better to disasters, reducing their vulnerability (Aldrich 2012).

Infrastructure investment is measured using two proxies. Gross fixed capital formation as a share of GDP and reservoir capacity per person. Together, these offer a snapshot of how well countries are investing in structural protection against water-related hazards.

NAPs or equivalent strategies are used to track how governments are preparing for climate change. As of May 2025, 17 developing countries in Asia and the Pacific have submitted their NAPs to the UNFCCC. Many other developing and advanced economies have developed similar strategies. KD5 assesses progress using eight criteria, including legislation, budgeting, implementation, and monitoring. Countries that translate planning into concrete action receive higher scores for governance capacity.

Large language models were used to estimate missing values in the KD5 dataset, which had around 10% of data gaps. These estimates were guided by historical trends and constrained by physical plausibility. Regional experts then reviewed and adjusted the model outputs as needed. Sensitivity testing confirmed that these values had a minimal effect on final KD5 scores, shifting results by less than 0.3 points on average. This approach helped ensure full regional coverage while maintaining transparency and reliability.

Results and Discussion

Overall

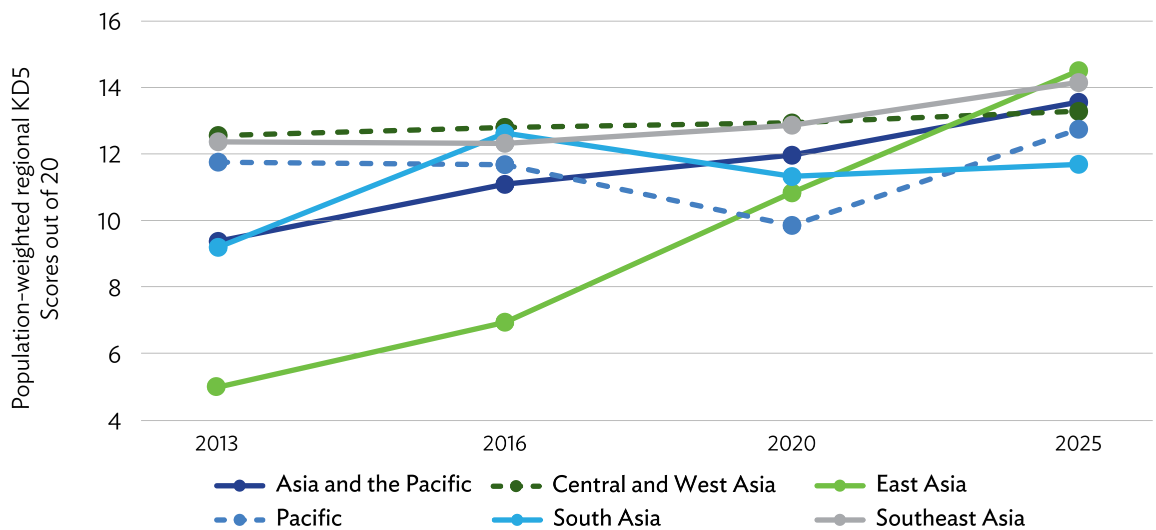
Water-related disaster security in Asia and the Pacific has followed an uneven path since 2013. Many countries have made steady improvements, as reflected in rising KD5 scores. These gains show growing investment in preparedness, infrastructure, and governance. However, progress is not uniform across the region.

Advanced economies continue to hold the most secure positions, but the gap is closing. In East Asia, large-scale investment in disaster protection has translated into stronger performance. Some Southeast Asian countries are also improving, converting economic growth into more coordinated risk management.

When interpreting the regional averages, it is important to understand that demographics play a key role in shaping the results. All regions, except Southeast Asia, include a single country that contains over 80% of the regional population; therefore, it is heavily weighted in the regional results. Further, Pacific nations often face worsening per capita exposure. As small island developing states, their vulnerability to storms and sea-level rise is growing, leading to declining KD5 scores despite efforts to improve resilience.

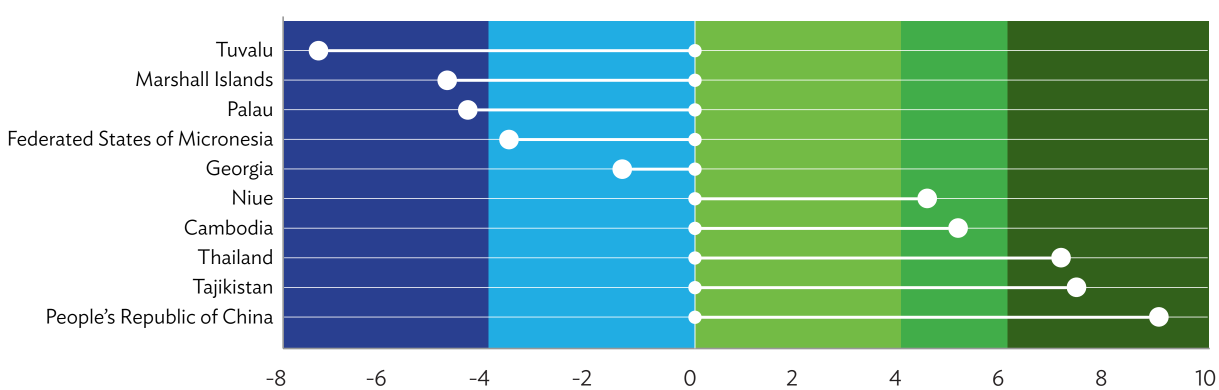
Figure 33 highlights these regional trends, showing where progress is taking root and where risks are rising.

Figure 33. Population-Weighted Regional KD5 Scores out of 20



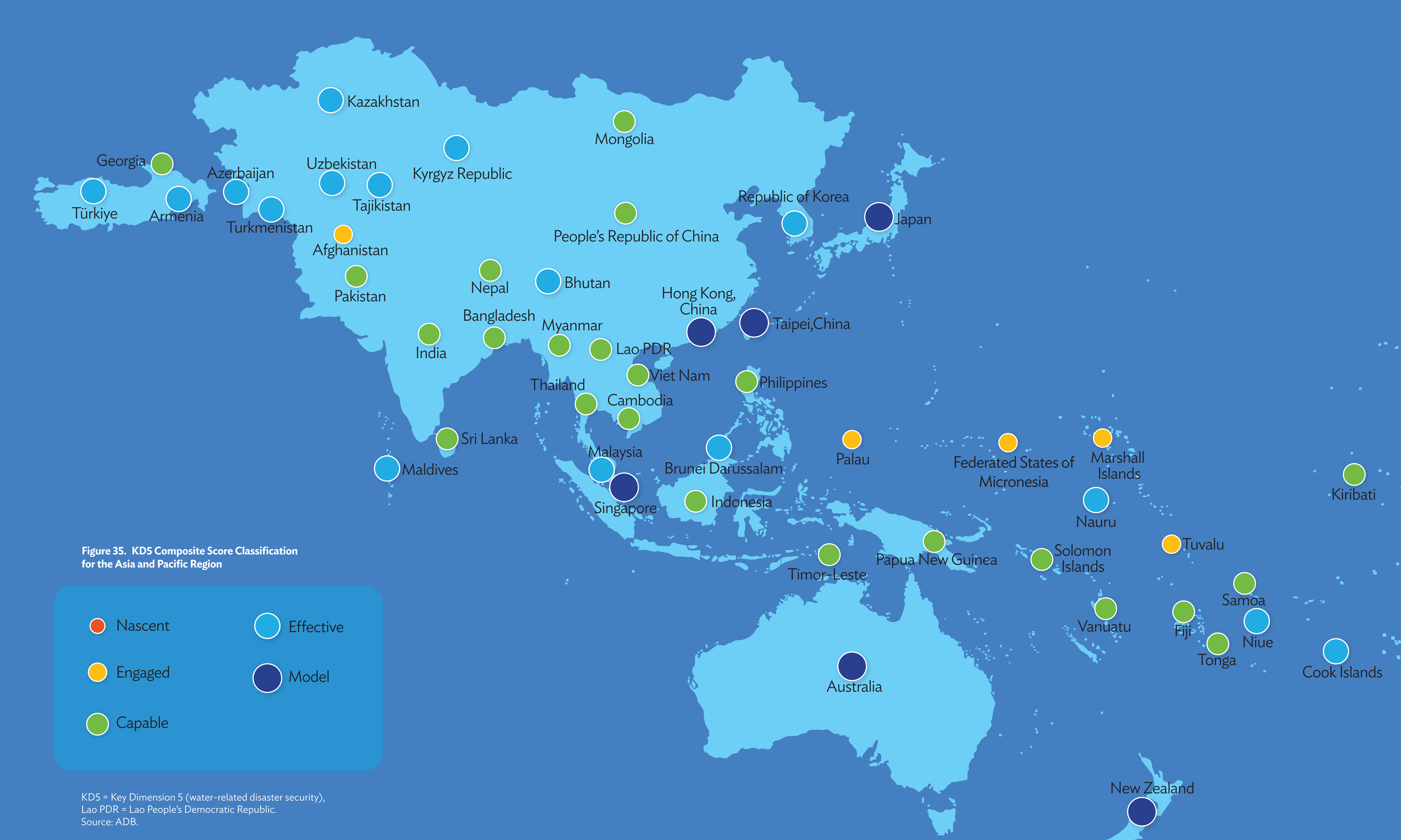
KD5 = Key Dimension 5 (water-related disaster security).
Source: ADB.

Figure 34. Top 5 and Bottom 5 Countries by KD5 Improvement (2013–2025)



Source: ADB.

Figure 35. KD5 Composite Score Classification for the Asia and Pacific Region



KD5 = Key Dimension 5 (water-related disaster security), Lao PDR = Lao People's Democratic Republic.
Source: ADB.

A clear divergence in disaster risk trajectories has emerged across the region. Economies in East and Southeast Asia, including the PRC, Thailand, and Cambodia, have made strong gains in KD5 scores. These improvements reflect consistent investment in infrastructure, climate adaptation, and disaster risk governance. In contrast, several Pacific island countries, such as Tuvalu, the Marshall Islands, Palau and the Federated States of Micronesia, have seen their scores decline or remain stagnant (Figure 34). These outcomes underscore the combined impact of national capacity, exposure to hazards, and differing development pathways across subregions.

In terms of hazard exposure, there are no dominant regional trends. However, **exposure to climatological hazards, particularly droughts, shows high variability.** In some countries, a single severe drought can heavily influence overall exposure statistics as they affect large portions of the population. In contrast, meteorological hazards such as storms tend to be more evenly distributed in intensity and frequency, resulting in lower variability across countries. Hydrological hazard exposure remains significant in several subregions but does not show a consistent upward or downward trend.

Box 9.

From Risk to Resilience: Youth at the Front Line

When the floodwaters covered one-third of Pakistan in 2022, many young people did not just lose their homes, but also their schools, connections, and hopes. Similarly, the 2013 Typhoon Haiyan in the Philippines and the 2002 drought in India did not just rob young people of food and water but also opportunities and dreams. Despite being among the most affected, young people are rarely at the decision-making tables when disaster plans are made. Young people are willing to contribute toward disaster resilience, but are often left waiting for permission, opportunity, training, and trust.

During the 2024 flood in Bangladesh, youth emerged as front line heroes, utilizing their skills to raise donations. Students at Dhaka University not only managed to send relief trucks and parcels to remote areas but also raised over BDT 52.3 million ($480,000) in just 4 days. They also played roles in rescue operations and comforting traumatized children. Learning from the devastating flood of 2024, Bangladesh is now strengthening future flood resilience through simulation exercises like the one held in a school in Gaibandha, which test the National Early Action Protocol across key phases of a disaster. These drills train communities, youth, and officials by rehearsing real-time response scenarios, shifting the focus from reactive aid to proactive resilience.

Integrating effective youth mainstreaming in disaster resilience projects will train youth and empower them to utilize their high level of creativity, passion, fearlessness, and tech savviness to lead awareness campaigns through storytelling, developing mobile apps for disaster education, early warning, and fundraising, using drones for flood-risk mapping, and supporting communities during crisis. Future water-related disaster risk policies will amplify their reach and effectiveness by identifying and including youth as project co-creators and leaders instead of labeling them as a “vulnerable” group.

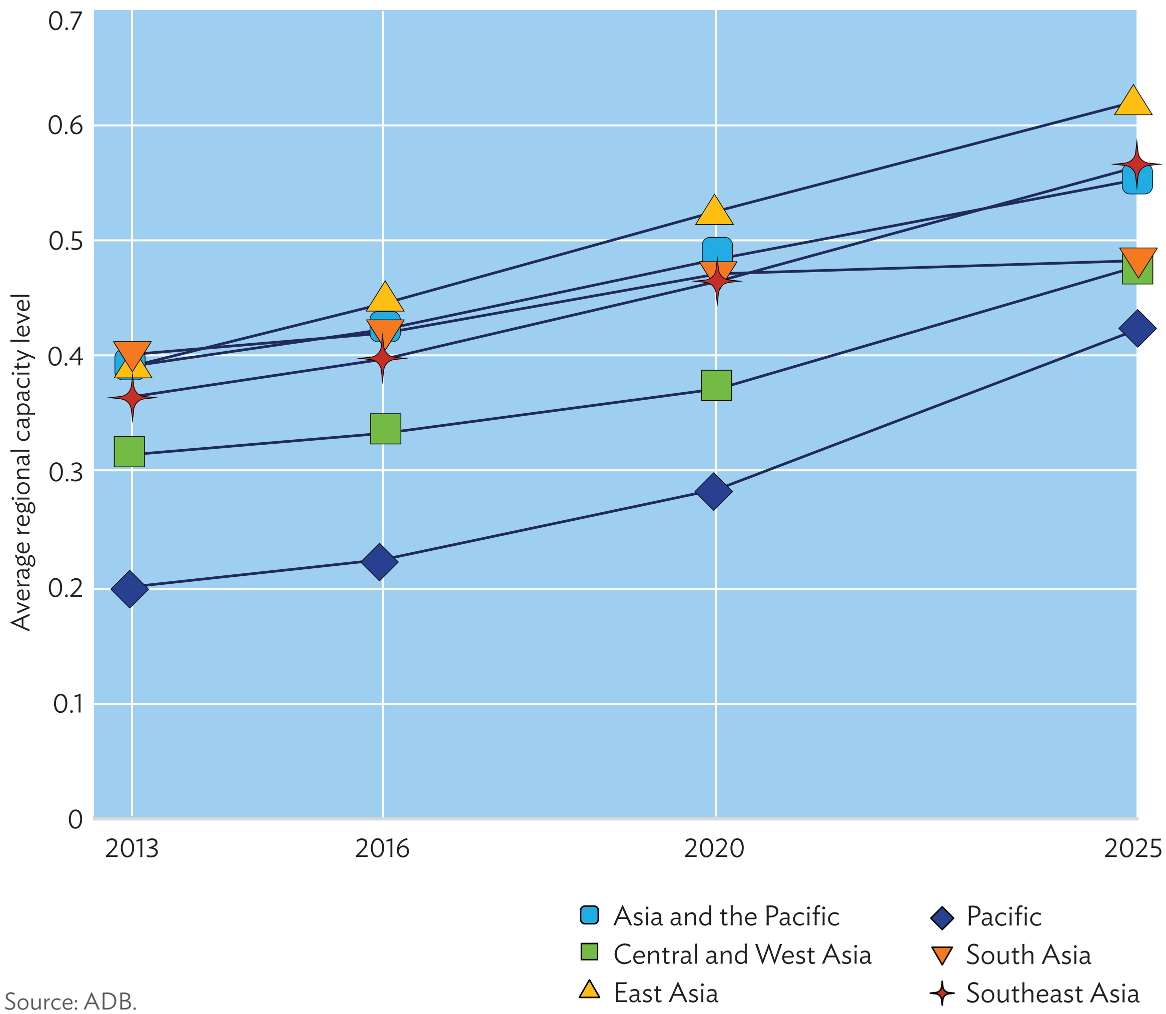
Source: Maha Sheikh, PhD researcher, University of Bern, Switzerland.

Author of this box: Maha Sheikh
Maha Sheikh is a civil engineer from Pakistan and a PhD researcher at the University of Bern, Switzerland. With prior experience in flood infrastructure planning, her PhD research focuses on cascading floods and the use of high-tech tools, such as drones, for improved flood risk management. She advocates for youth-led, community-driven water resilience solutions as the Young Author lead for AWDO 2025 Key Dimension 5.

Improvements in **vulnerability are modest and geographically patchy.** Incremental gains in income, literacy, and governance are evident in Southeast Asia and Central and West Asia, improving regional average vulnerability. Elsewhere, lingering poverty, unequal service access, and governance turbulence keep vulnerability high. These gains remain fragile. An economic slowdown or a loss of momentum in governance reform could quickly reverse them, especially in drought-prone inland areas.

Capacity shows the clearest upward trend, though progress is uneven across the region (Figure 36)**. East Asia has made strong advances by embedding risk considerations into fiscal policy and public infrastructure.** South Asia's progress is inconsistent, while gains in the Pacific remain limited. This reflects how geography and human resource constraints can slow progress, even when external funding is available. For example, **Cambodia, despite its lower-income level, has improved capacity through steady, budgeted risk spending.** In contrast, Palau, with a higher-income level, has seen flat results due to reliance on short-term, donor-led projects. The growing gap between regional leaders and others highlights that improvements depend not just on wealth but on sustained planning and financing.

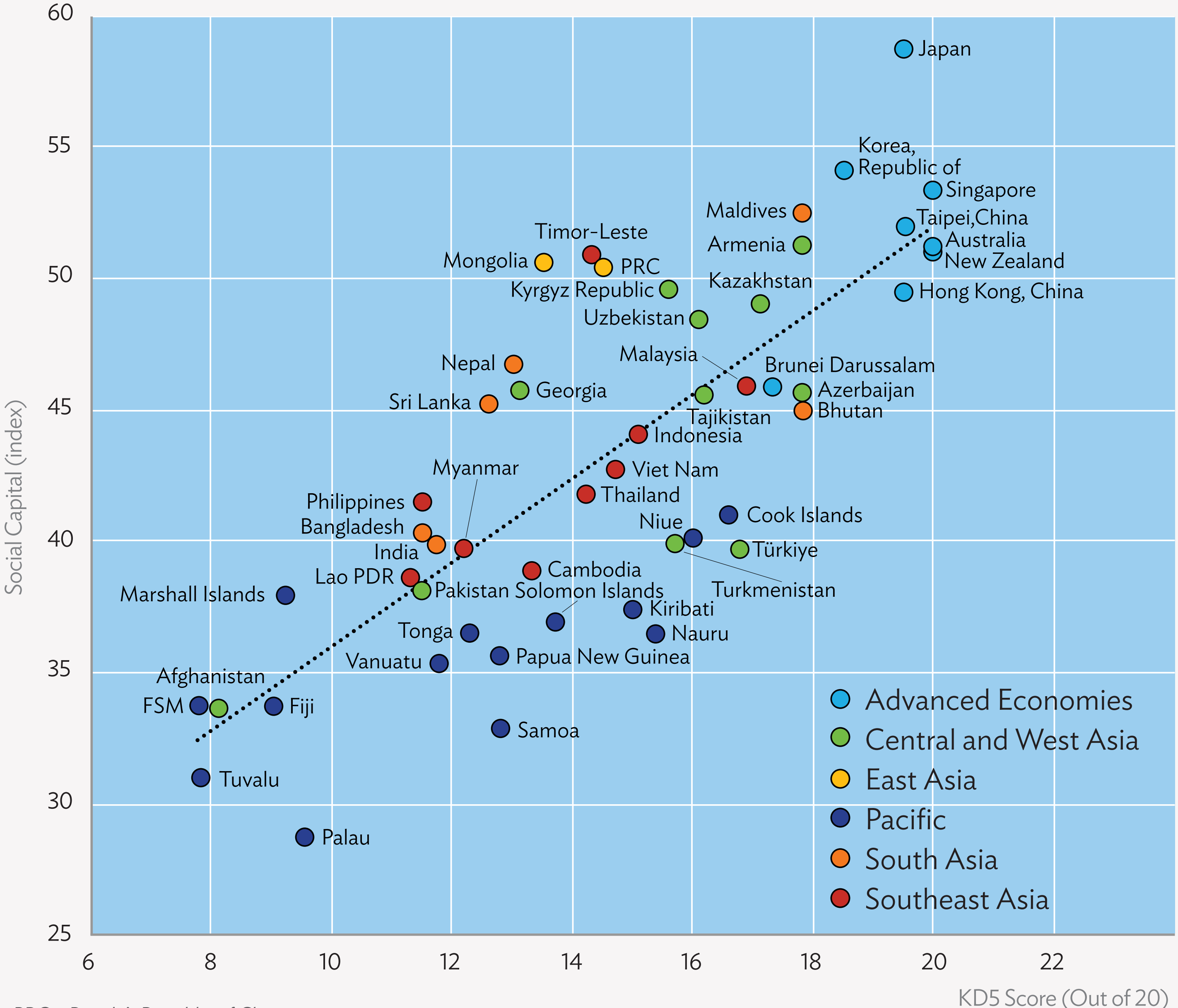
Figure 36. Development of Regional Capacity



Source: ADB.

Among all capacity metrics, social cohesion shows the strongest correlation with reduced KD5 risk (Figure 37) and displays very few outliers. High levels of trust, participation, and inclusion contribute significantly to disaster resilience. Income also aligns broadly with disaster security, but several notable exceptions highlight the limits of using economic indicators alone. Some Central Asian economies, such as Tajikistan and the Kyrgyz Republic, outperform their income level by pairing targeted infrastructure upgrades, like dam safety and retrofitting, with community outreach programs. In contrast, higher-income island nations in the Pacific often underperform. **Limited land area, scattered populations, and high transport costs place significant pressure on national budgets. This pattern, often referred to as the island paradox, highlights how geography and system complexity influence disaster outcomes.**

Figure 37. KD5 Score out of 20 vs. Social Capital



PRC = People's Republic of China,
KD5 = Key Dimension 5 (water-related disaster security), Lao PDR = Lao People's Democratic Republic,
FSM = Federated States of Micronesia.
Source: ADB.

A major addition to the scoring framework is the climate change adjustment factor applied to hazard and exposure. On average, this factor increases baseline exposure by 1.19. However, individual coefficients range from 0.9, where projections suggest stable or even declining hazard frequency to above 4 in coastal microstates. This multiplier can either raise or moderate exposure, helping to identify future hot spots before significant losses occur.

> **Among all capacity metrics, social cohesion shows the strongest correlation with reduced KD5 risk** and displays very few outliers. High levels of trust, participation, and inclusion contribute significantly to disaster resilience.

Countries that have converted NAPs into funded programs tend to offset the upward pressure. In contrast, those still at the planning stage often see their banding scores reduced.

Several national trajectories illustrate these broader regional trends without overshadowing the overall picture. **The PRC's consistent rise in KD5 scores shows how reduced hydrological exposure,** supported by major infrastructure, can boost disaster security. Yet even the PRC's trend begins to level off when future climate projections are considered. **Thailand's stagnant KD5 score between 2013 and 2016, followed by a substantial increase, highlights the setback caused by consecutive floods and a major 2016 drought.** The turnaround was made possible by infrastructure investment, such as Bangkok's 13.3 km flood-drain tunnel, and institutional reform through the creation of the Office of the National Water Resource.

Looking at specific hazards, river flood risk has shown the most visible response to infrastructure investment and land-use controls. **Several major river basins in East and Southeast Asia have improved**. For example, the Yangtze river basin in the PRC lowered its hydrological exposure score by 65% between 2013 and 2025 by releasing 9 billion cubic meters of capacity at the Three Gorges Dam and clearing thousands of buildings from the floodway. Meteorological risk remains persistent in the tropical belt, where warming ocean temperatures continue to intensify cyclones, even as early-warning systems improve.

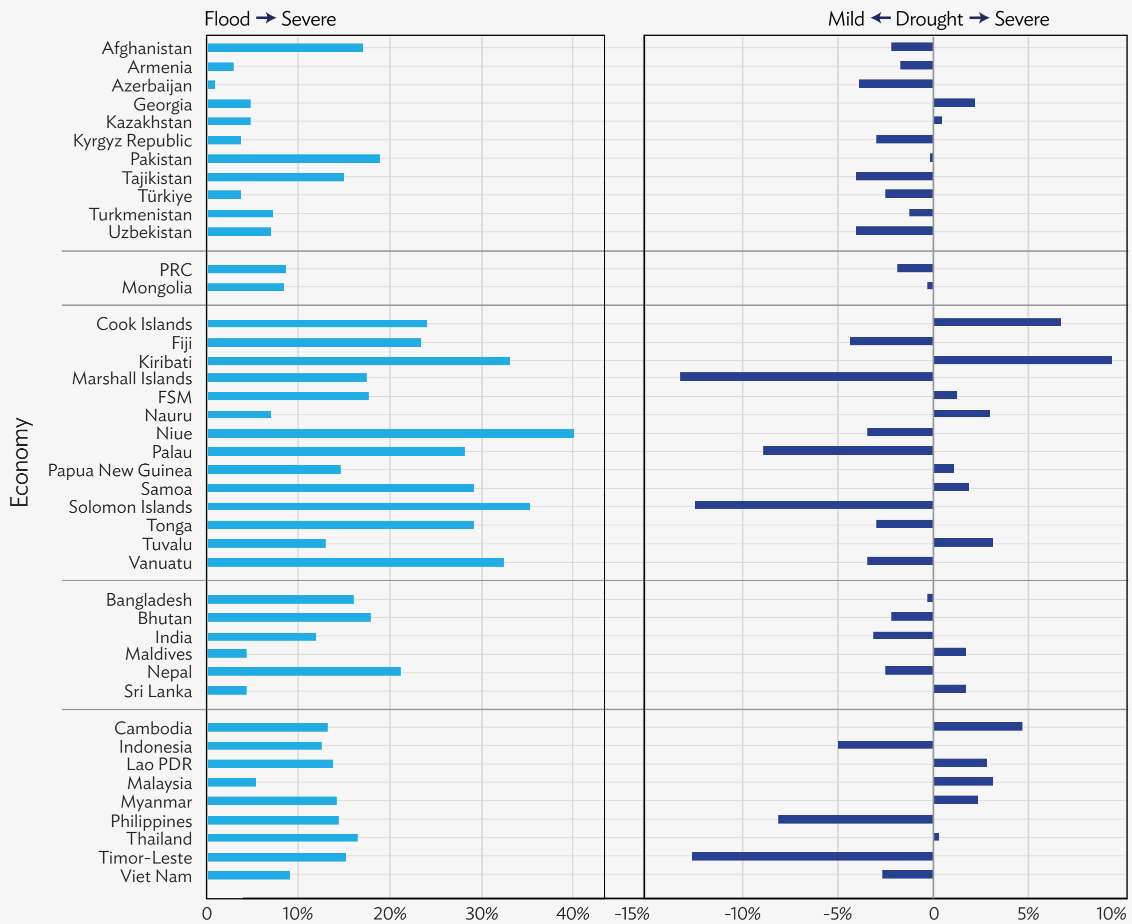
Drought risk presents a contrasting story. In monsoon-fed Southeast Asia, conditions have largely stabilized. In Central and West Asia, however, drought risk is rising as irrigation expansion fails to keep pace with increasing water losses. These patterns provide the foundation for the next sections, which take a closer look at trends by hazard type and highlight country-level case profiles across the region.

Box 10.

Forecasting Future Risk: Climate Signals and National Readiness

Extreme rainfall is projected to increase across all countries in Asia and the Pacific by the end of the century (2081–2100), consistent with trends reported in the Intergovernmental Panel on Climate Change Sixth Assessment Report. The once-in-25-year rainfall event is expected to become more intense, particularly in high-latitude areas and the equatorial Pacific. In contrast, Central and West Asia is projected to see smaller increases. **Short-term drought conditions**, measured using the 3-month Standardized Precipitation Index, **are expected to ease in two-thirds of countries**. The Marshall Islands shows the largest projected decrease in drought severity (13.2%). However, drought is expected to worsen in Kiribati and the Cook Islands. Compared to rainfall projections, uncertainty remains higher for drought outcomes. **Coastal flood risk is projected to rise across all 27 coastal countries** with available data. Brunei Darussalam stands out with a 317% increase in estimated flood-affected area, far above the regional average of 50%.

National adaptation plans play a critical role in managing these emerging risks. As of May 2025, 17 developing countries in the region have submitted their national adaptation plans to the United Nations Framework Convention on Climate Change. Most other countries, including advanced economies, have equivalent climate adaptation strategies in place. Only seven countries have yet to complete and make public a national plan. These documents often outline steps for disaster risk reduction and water resource management, signaling a country's readiness to adapt to future climate extremes.



PRC = People's Republic of China, Lao PDR = Lao People's Democratic Republic, FSM = Federated States of Micronesia.
Source: ADB.

Across the Regions

Central and West Asia

Central and West Asia's risk reduction has stagnated over the past decade, with average scores raising only marginally since 2013 and reaching 13.3 in 2025. While some countries made infrastructure gains, the region has struggled to sustain broad-based improvements. Progress is uneven, with vulnerability and capacity scores lagging in parts of the region, and hazard exposure, particularly from floods and droughts, remaining persistently high.

Behind this average lies increasing divergence. **Countries like Kazakhstan and the Caucasus states are steadily reducing risk, while Georgia and Afghanistan are moving in the opposite direction.** As a result, the regional mean remains flat despite very different national trajectories.

Geography provides some natural protection. Ten of the eleven countries are landlocked and receive little monsoon moisture. This keeps meteorological and hydrological exposure low by global standards. However, drought remains a major concern. Climatological exposure is double the global average and is the second highest among all regions. Even so, drought pressure is easing in parts of the Caucasus and Central Asia. Armenia, Azerbaijan, and the Kyrgyz Republic now show positive trends in SPI, leading to climate multipliers below 1.0 that reduce future hazard exposure. **In contrast, projected increases in extreme rainfall in Tajikistan and northern Pakistan point to rising flash flood risk.**

Vulnerability remains flat. Gains in literacy and health are balanced by governance challenges and gender equity gaps. **Capacity levels vary widely.** Oil-exporting countries have more resources for risk reduction, but progress is often uneven and sensitive to individual disaster events. The regional average climate-change multiplier is 1.21, slightly higher than the average for the Asia and Pacific region.

Tajikistan has shown the fastest improvement in the region, gaining over seven KD5 points since 2013. Much of this gain comes from the 2008 drought falling outside the ten-year exposure window: the overall hazard exposure dropped by over 80% during the 2013–2025 interval. Modest capacity improvements, including dam safety audits and the country's first national SMS alert tests in 2023 and 2024, have helped consolidate this progress. However, vulnerability remains high, and projected increases in summer rainfall could reverse some gains without improved flood protection.

Armenia and Azerbaijan have made steady progress and now rank in the safest third of countries assessed. Declining drought exposure and investments in digital hydrology and emergency response centers have supported this shift.

Kazakhstan and Uzbekistan show flat scores. Investment in infrastructure has helped prevent new risks, but long-term gains are limited by persistent governance challenges. In Azerbaijan, drought intensity is easing, but stalled adaptation planning and neutral rainfall trends have delayed progress in capacity.

Pakistan remains a concern. While early-warning systems and emergency financing have improved, rapid urban growth and development in floodplains continue to increase exposure. **Afghanistan remains the region's lowest performer. Declining security and governance since 2020 have erased earlier capacity gains,** leaving the country highly exposed and poorly equipped to respond.

To sustain progress, countries must complete pending adaptation plans, particularly in Uzbekistan, Azerbaijan, and the Kyrgyz Republic, and guide urban growth away from high-risk flood zones. A brief window of reduced drought stress provides an opportunity to prepare for the next wave of climate-related risks, including flash flooding in the highlands.

East Asia

East Asia remains one of the strongest performers in the KD5 assessment (Figure 38). **Between 2013 and 2025, the average KD5 scores rose by 9.0 points. This reflects progress on all three components**: lower hazard exposure, reduced vulnerability, and increased capacity. **These gains are closely linked to deliberate investments in flood control, river basin planning, and social protection systems that translate early warnings into rapid action.** These measures helped offset rising typhoon intensity and rainfall extremes, keeping the region's overall risk trend on a downward path, even after climate projections were applied.

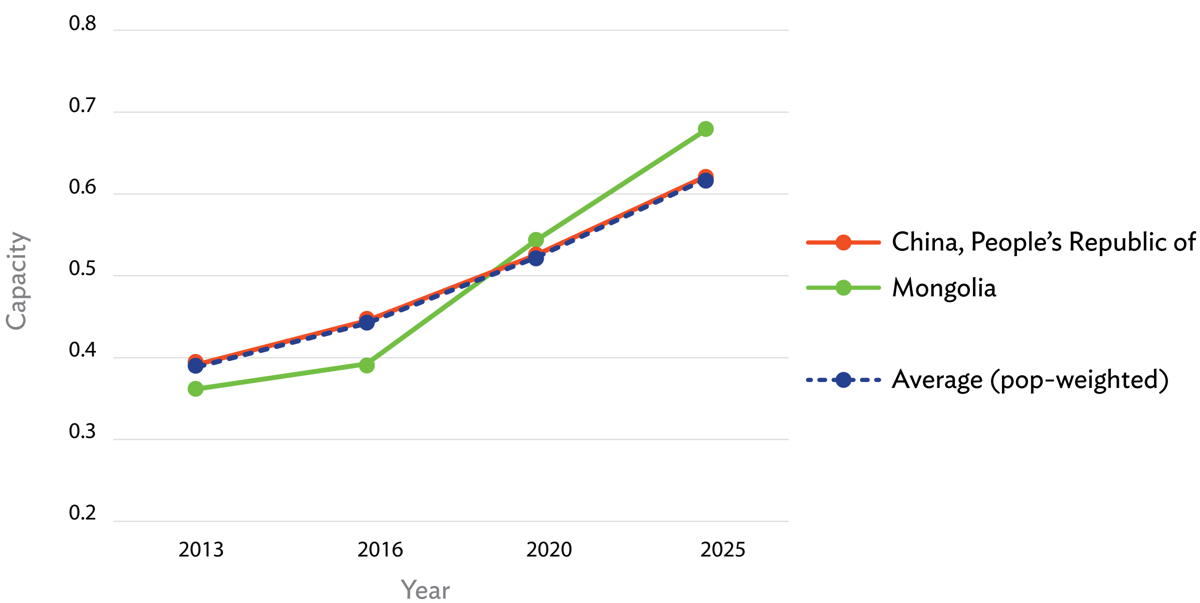
The PRC drives much of this improvement. Home to three-quarters of the subregion's population, **the PRC improved its KD5 score by 9.0 points, the largest gain recorded by any country in the assessment.** Key capacity investments include a nationwide high-density rainfall radar system, river basin flood zoning, and a tenfold expansion of community emergency teams. As a result, its capacity sub-index rose from 0.39 in 2013 to 0.62 in 2025. However, its large geographic area also leaves it exposed to a wide range of climate pressures. When the climate-change multiplier is applied, the national KD5 score falls by one full step, showing that even major capacity gains cannot fully offset future hazard increases.

Mongolia's experience highlights how time-series trends can be shaped by the rolling exposure window. Its score rose significantly between 2013 and 2016, when the major 2000–2002 drought dropped out of the ten-year dataset. **By 2025, a new drought event enters the assessment, nudging the score back down despite real gains in pasture management, drought insurance pilots, and early-warning systems.** This example shows how the shifting exposure window can mask or exaggerate progress.

The average climate-change multiplier across East Asia is 1.26, the highest sub-region. Coastal and deltaic areas show the highest increases, while temperate inland regions are closer to 1.03. These multipliers reduce net KD5 gains by about one-third, but the region's strong capacity and lower vulnerability help maintain a positive trend.

Looking forward, East Asia's challenge will shift from construction to maintenance. Sustaining and modernizing existing systems under a changing climate is now the priority. Further progress will depend on investments in nature-based solutions, regional flood forecasting, and continued efforts to strengthen social cohesion.

Figure 38. Development of KD5 Score Out of 20 for East Asian Economies



Source: ADB.

Pacific

When not weighted by population, the Pacific remains the lowest-performing region in every KD5 cycle from 2013 to 2025 when measured by the average across national scores. **It is the only region to show a net decline in water-related disaster security over the 12-year period. Meteorological hazards dominate, particularly cyclones and storm surges.** Drought also plays a major role, especially on low-lying atolls where shallow groundwater lenses are vulnerable to rain shortfalls. As several Pacific nations, particularly smaller islands and atolls, do not have large river systems, hydrological exposure in the region is reduced. Four of the five lowest-scoring countries in 2025, Palau, the Marshall Islands, the Federated States of Micronesia, and Tuvalu, are Pacific island states. Their rankings highlight the structural vulnerability of climate-driven extremes.

Between 2013 and 2020, the Pacific's composite KD5 score declined steadily, tracking a rise in reported cyclone and flood impacts. **This trend slowed after 2020, thanks mostly to gains in Papua New Guinea. Raising its capacity score by 60%.** Initiatives such as community shelter expansion, cyclone-resistant school retrofits, and a new national emergency operations center all contributed. However, because its score remained below the regional average, this improvement did not lift the Pacific average. Papua New Guinea's score rose from 11.7 in 2013 to 12.8 in 2025.

Fiji shows a mixed trend. Relocation of Vunidogoloa village and expansion of cyclone insurance have helped improve capacity scores. However, repeated flooding in the Rewa Delta and rising cyclone losses have held the overall KD5 score flat. In contrast, Palau, the Marshall Islands, the Federated States of Micronesia, and Tuvalu all declined between 2013 and 2025, with score drops ranging from 3.6 to 7.3 points. **Tuvalu's case is emblematic of the region: persistent exposure and limited administrative capacity continue to drag down performance, even with moderate levels of national income.**

Outside Papua New Guinea, exposure continues to rise while capacity and vulnerability remain unchanged. Hazard exposure from drought and storms has increased in Kiribati, the Marshall Islands, the Federated States of Micronesia, Palau, and Tuvalu . Most of these countries have not kept pace. Capacity scores have barely changed since 2013, and vulnerability remains high. **The island paradox is clear. Even with small gains in income, island states struggle to reduce risk. Coastal concentration of assets and gaps in technical expertise hinder effective disaster preparation and response.**

Climate change is raising the stakes further. This reflects projected increases in cyclone intensity, prolonged droughts, and rising seas that magnify flood risk. Since most global hazard models do not resolve islands smaller than 50 square kilometers (km^2), the true scale of risk is likely underestimated. Atoll-specific studies suggest coastal flood frequency could triple by mid-century.

Policy responses are lagging these growing threats. **Only five Pacific island countries completed NAPs.** Even where plans exist, implementation is slow. **By early 2025, fewer than half of planned adaptation actions had secured financing, according to UNFCCC submissions.** Without robust adaptation pipelines, most countries will see rising KD5 scores in future cycles as cyclone and drought records lengthen.

Reversing the Pacific's trajectory will require a coordinated regional effort. Priorities include expanding early-warning coverage, investing in nature-based coastal protection, and scaling sovereign risk financing tailored to micro-state economies. In this region, where population size and geographic isolation limit national options, regional pooling of resources and expertise will be critical to avoiding another rise in composite risk.

Box 11.

Disaster Security in Small Island States: Hidden Risks Behind National Scores

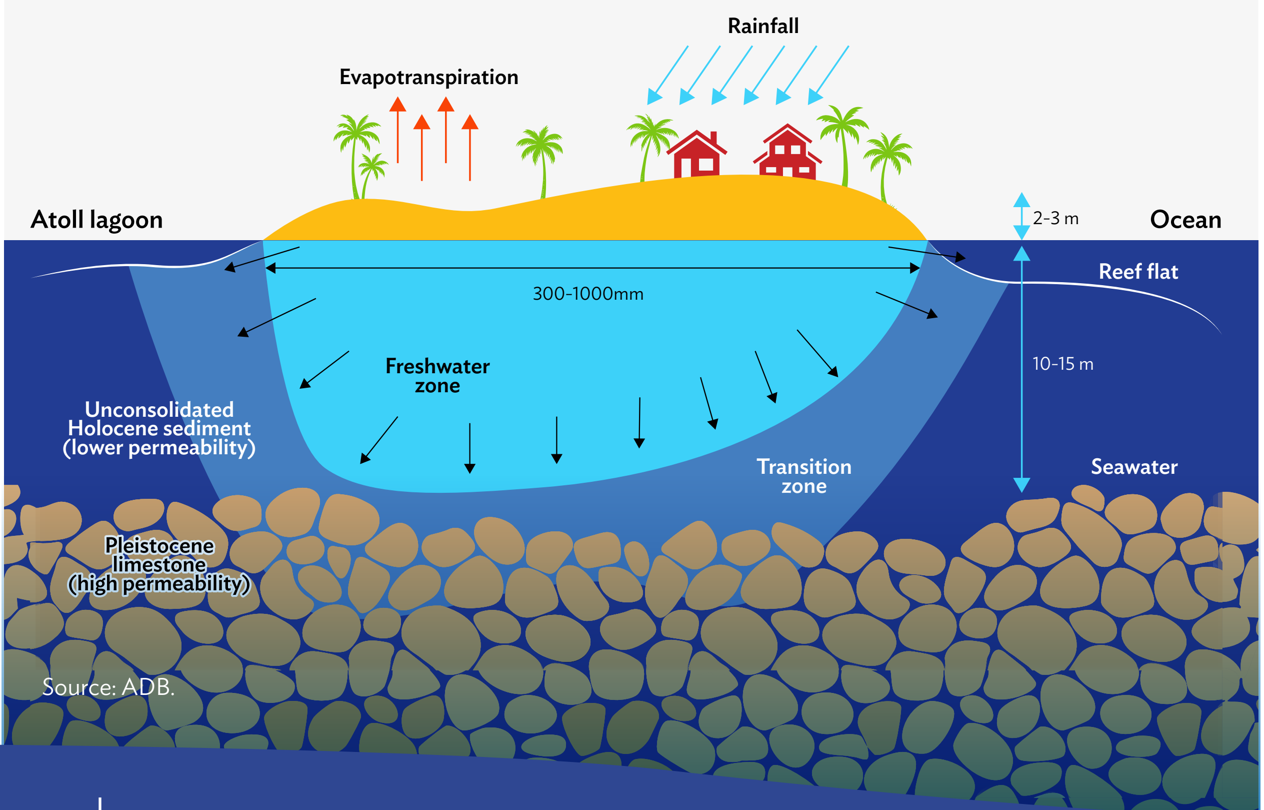
The Key Dimension 5 (KD5) score of Palau fell from 13.9 in 2013 to 9.5 in 2025, a sharp decline that reflects the rising disaster risk faced by many small island developing states (SIDS). Similar trends appear in the Marshall Islands (14.0 to 9.2), the Federated States of Micronesia (11.4 to 7.8), and Tuvalu (15.0 to 7.8). While broader regional averages show modest shifts, many small island states are experiencing substantial increases in hazard exposure, especially from storms and droughts. Hydrological exposure remains limited in most islands, except in places like Fiji where terrain amplifies flood risk.

Capacity, by contrast, has often stagnated or declined. Many SIDS reflect the "island paradox:" relatively prosperous economies that remain highly vulnerable to shocks. Small land areas, limited infrastructure, and institutional constraints make it difficult to scale up risk reduction, even where income levels are moderately high.

Subnational risks are often far more severe than national averages suggest. Maldives, for example, includes 186 inhabited islands, nearly all of which sit below 5 meters above sea level. More than 140 islands have fewer than 1,000 residents and population densities above 1,000 people per square kilometer. While the national KD5 score has stayed stable due to improvements in adaptive capacity, many outer islands remain highly exposed. Thin fresh water lenses, common across the atolls, are vulnerable to both drought and salinity intrusion.

Similar vulnerabilities exist across the Pacific. In Tuvalu, around 11,000 people are spread over nine low-lying atolls. Kiribati's 33 reef islands are scattered over 3.5 million square kilometers of ocean, while the Marshall Islands and the Federated States of Micronesia comprise dozens to hundreds of small, isolated islands. Many of these have limited communication, transport, and emergency services.

National KD5 scores may understate the risks in these fragmented geographies. Addressing disaster security in SIDS requires sub-national assessments, decentralized investment and regionally coordinated mechanisms to protect vulnerable outer-island populations.



Source: ADB.

South Asia

South Asia remains the most at-risk region in the KD5 assessment. Between 2013 and 2025, the gap between its average score and the regional median has widened. The main driver is rising hazard exposure, particularly from floods and droughts. South Asia adds around 6% to the regional hazard-exposure index even as global exposure levels decline. Population and asset concentration in floodplains and arid margins mean that localized weather events often result in large-scale impacts. Between 2020 and 2024, EM-DAT recorded two consecutive weak monsoons on the Deccan Plateau and a record-breaking Brahmaputra flood season. This one event alone accounted for nearly a third of the ten-year exposure total, even before climate multipliers were applied.

Capacity gains have slowed. From 2020 to 2025, the subregion's composite capacity score rose by less than one point, with most improvements coming from Bhutan and Sri Lanka. This stalled progress in infrastructure and economic indicators. **Community involvement needs to be improved in South Asia, to strengthen the trust and participation needed to turn alerts into action**. Vulnerability remains high. While literacy and life expectancy are improving, ongoing governance challenges continue to weigh down risk reduction efforts.

Hydrological hazards dominate the subregion. Four of the five countries with the highest hydrological exposure in Asia are in South Asia. With 93% of the Ganges–Brahmaputra–Meghna catchment located upstream of Bangladesh, it faces major flood risk in a densely populated delta. Urban expansion along rivers has worsened the situation. Impermeable surfaces increase runoff and compound the threat. Drought is also spreading westward. Remote sensing shows a 4% decline in soil moisture across semi-arid districts since 2016, even where rainfall appears stable.

Climate change is amplifying baseline hazards. South Asia has a regional average climate change factor of 1.13. Deltaic lowlands in Bangladesh and the lower Indus show multipliers above 1.3 due to sea-level rise and increasing cyclone-driven storm surges.

Some existing risks are growing. In the Hindu Kush Himalaya (HKH), glacial retreat is forming larger moraine-dammed lakes. International Centre for Integrated Mountain Development fieldwork in 2024 identified 25 potentially dangerous lakes in Bhutan and Nepal, double the number recorded in 2013. These lakes pose a growing threat of glacial lake outburst floods (GLOFs), which could sharply raise the hydrological exposure of most countries in South Asia in a single event.

Bangladesh remains a paradox. Major investment in cyclone shelters and community-based early-warning systems has cut windstorm mortality by more than 90% since the 1990s. However, its KD5 score remains high due to persistent flood exposure. While basin management talks with India and Nepal have improved data sharing, there is still no joint flood forecasting system. As a result, Bangladesh continues to face high residual risk.

Despite the overall challenges, there are signs of progress. Sri Lanka's KD5 score increased from 9.0 in 2013 to 12.6 in 2025, driven by dam rehabilitation and an expanded rain-gauge network. **Bhutan has improved social capacity by reaching 95% of students with school-based disaster education**. In Nepal, rising remittances have not yet translated into lower risk. Capital investment remains flat, and gains in social cohesion have stalled.

Sustained progress in South Asia will depend on integrated investment. Flood resilience requires predictive hydrology, early action finance, and cross-border coordination. Drought resilience depends on modern irrigation systems and stronger groundwater regulation. With the climate multiplier already raising baseline risk, the window for action is closing. Whether South Asia can bend its risk curve before the next assessment will depend on planning that cuts across sectors and borders.

Southeast Asia

Southeast Asia now ranks just behind East Asia on the KD5 scores. Since 2013, the region has steadily reduced risk. The most significant progress came between 2020 and 2025, when capacity gains outpaced modest increases in exposure. Indonesia, which accounts for around 40% of the regional population, anchors the middle of the distribution. Its scale tends to obscure faster progress in smaller neighboring countries. The region's risk profile is shaped by hydrological and meteorological hazards. Climatological risk is comparatively low, with episodic floods and storms interrupted by more localized droughts.

Indonesia holds a moderate KD5 score. A decade of incremental upgrades, including river-basin zoning and the INATEWS tsunami early-warning network, has helped increase capacity above the regional median. However, EM-DAT records show persistent exposure along Java's river corridors and in the cyclone-prone east. The country's climate-change multiplier is close to the regional average at 1.19, signaling neither strong upward nor downward pressure on baseline risk.

Cambodia has made the second-largest KD5 improvement in Southeast Asia. It has shown uninterrupted progress across all four assessment cycles from 2013 to 2025. Between 2020 and 2025 alone, its composite score rose by more than two points. Half of this gain came from a reduction in recorded hazard events, and the other half from improved capacity. Early-warning coverage now reaches more than 80% of districts through mobile services. Local disaster committees receive consistent funding via the Commune/Sangkat Fund. However, projected future risk remains high. Coastal flooding and fluvial inundation multipliers above 1.78 suggest that without sustained adaptation investment, recent gains could be at risk.

Viet Nam shows similar progress, though on a more moderate scale. Exposure has declined slightly as flood dike construction nears completion and mangrove restoration reduces storm surge impacts. By 2025, 94% of the 3,200 km Mekong and Red River dike network meets the 1-in-30-year standard, up from 81% in 2018. Preparedness has also improved with the launch of a nationwide multi-hazard early-warning app. Still, Viet Nam's climate-change multiplier of 1.22, driven by projected sea-level rise in its two major deltas, tempers the overall gains.

Thailand's KD5 score remained relatively flat prior to 2016, reflecting the lingering effects of earlier disasters, including back-to-back floods and droughts. Since 2016, however, the country has made steady and increasingly strong progress, culminating in its most substantial gain between 2020 and 2025. This recent improvement is driven largely by a decline in recorded hazard events, even though capacity slightly decreased. Meanwhile, climate projections indicate rising risks, particularly from meteorological and hydrological hazards, with multipliers of 1.49 and 1.16, respectively. Infrastructure measures such as Bangkok's drainage tunnels and the Chao Phraya master plan help manage these growing threats.

The Lao PDR remains one of the region's most at-risk countries. It has the fourth-highest hydrological exposure in mainland Asia, after Bangladesh, Mongolia, and Pakistan. Seasonal floods along the Mekong and its poorly monitored tributaries continue to drive risk. At the same time, limited insurance coverage and low digital connectivity keep capacity scores low. Without a major shift in basin-wide flood management and social protection, the Lao PDR is likely to remain on a high-risk trajectory.

The subregion's average climate-change multiplier is 1.19. Cambodia and Viet Nam's coastal lowlands exceed 1.2, while the Lao PDR and northern Myanmar's are closer to 1.05. This variation reflects divergent future pathways. **Countries that reduce exposure and build capacity quickly may still increase their KD5 scores. But the window is closing, especially in delta regions where sea-level rise is accelerating.**

Sustaining progress will depend on expanding early-warning systems, protecting coasts from rising seas, and ensuring that economic growth supports inclusive and climate-resilient social protection.

Box 12.

Empowering Women to Strengthen Disaster Resilience and Water Security

Climate-related disasters like floods, typhoons, and droughts often disrupt water supply systems, increasing the unpaid care burden on women and exposing communities to greater health risks. In the Philippines, the KALAHI-CIDSS National Community-Driven Development Project shows how gender-responsive approaches can build water security and disaster resilience.

Implemented in over 14,000 villages, the project supported the construction of safe water systems, communal taps, and resilient WASH facilities, particularly in poor and disaster-prone areas. Women played a central role in project design and delivery, making up 60% of local committees. They helped plan, build, and manage water infrastructure, as well as lead local emergency response plans.

By putting women at the center of decision-making, KALAHI-CIDSS strengthened both resilience and access to clean water. The project highlights how inclusive, community-led planning can reduce disaster impacts and protect vulnerable populations.

Source: Asian Development Bank. 2020. KALAHI-CIDSS Project Completion Report.

A woman is driving a passenger boat on Ninh Kieu Wharf, Can Tho River (Photo by ADB).

Conclusion and Findings

The 2025 assessment of KD5 shows that **water-related disaster security is improving across Asia and the Pacific, but progress is uneven. Capacity is the strongest driver of KD5 performance,** yet its growth remains inconsistent. Some countries have made clear advances, while others face mounting risks without matching improvements in preparedness.

The PRC leads in overall KD5 gains, driven by investment in infrastructure and early-warning systems. Yet even this success is tempered by rising climate pressure. Once future projections are applied, its KD5 score drops by a full step, underscoring the growing influence of climate-adjusted risk.

Pakistan has improved its early-warning systems and disaster financing, but continued urban encroachment on floodplains is pushing hazard exposure higher. Without land-use reform, these gains remain vulnerable.

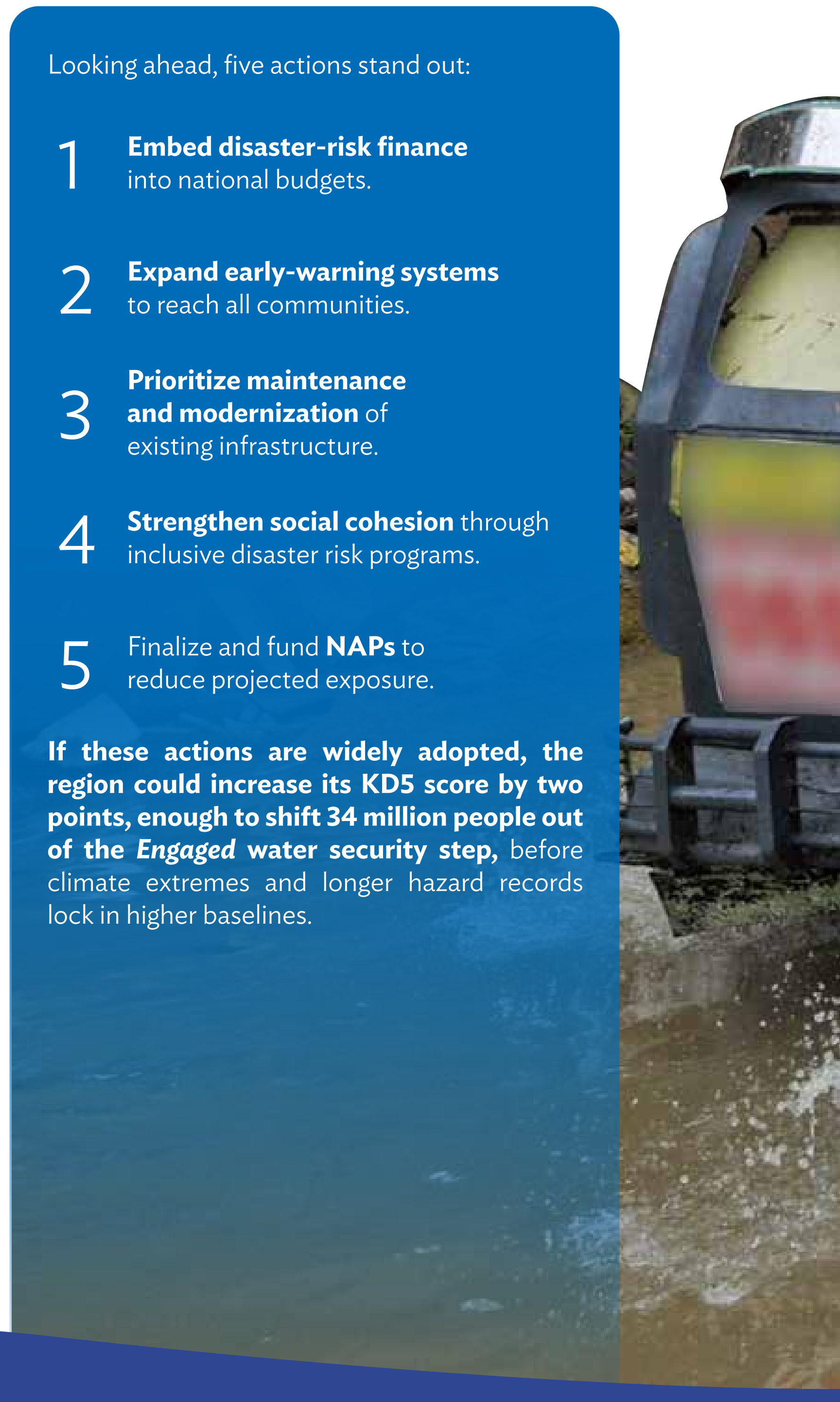
Cambodia has steadily raised its KD5 score through consistent local investment in preparedness. Mobile alerts and funded community disaster committees have built resilience from the ground up, even as climate risks rise.

Thailand's disaster resilience has improved sharply in recent years, driven by major infrastructure investments. However, aging systems and limited maintenance now pose challenges, as climate risks intensify. Rising projections for rainfall and coastal flooding underline the need for continued adaptation and system upgrades.

SIDS face the clearest structural challenges. **The "island paradox" remains stark: moderate national income coexists with high risk, due to geographic isolation, small land areas, and gaps in technical expertise.** National KD5 scores often hide much greater vulnerability in outer islands.

Social cohesion has the strongest correlation with lower disaster risk. Countries with high levels of trust, inclusion, and local participation consistently perform better. Social capital helps translate alerts into action and strengthens recovery, even in low-capacity settings.

Climate change continues to shift the hazard baseline. The regional average multiplier is 1.19. Coastal storms will have the largest increase in hazard exposure, while droughts see the only slight reduction in future hazard exposure. These shifts highlight the urgency of forward-looking adaptation.



Looking ahead, five actions stand out:

1. **Embed disaster-risk finance** into national budgets.
2. **Expand early-warning systems** to reach all communities.
3. **Prioritize maintenance and modernization** of existing infrastructure.
4. **Strengthen social cohesion** through inclusive disaster risk programs.
5. Finalize and fund **NAPs** to reduce projected exposure.

If these actions are widely adopted, the region could increase its KD5 score by two points, enough to shift 34 million people out of the *Engaged* water security step, before climate extremes and longer hazard records lock in higher baselines.

The aftermath of
Typhoon Ketsana
(Photo by ADB).

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In this study, the APHRODITE Monsoon Asia Precipitation Dataset [V1101] and Middle East Precipitation Dataset [V1101] (http://www.chikyu.ac.jp/precip/,) provided by the APHRODITE team, were used. This dataset is implemented in the CMIP5 analysis tool, which operates under the Global Environmental Data Integration and Analysis System Platform Project (Grant Number JPMX0721453504) subsidized by the Ministry of Education, Culture, Sports, Science and Technology of Japan.

3 THEMATIC DEEP DIVES

Men of the village building cottages by the beach in Nauru (Photo by ADB).

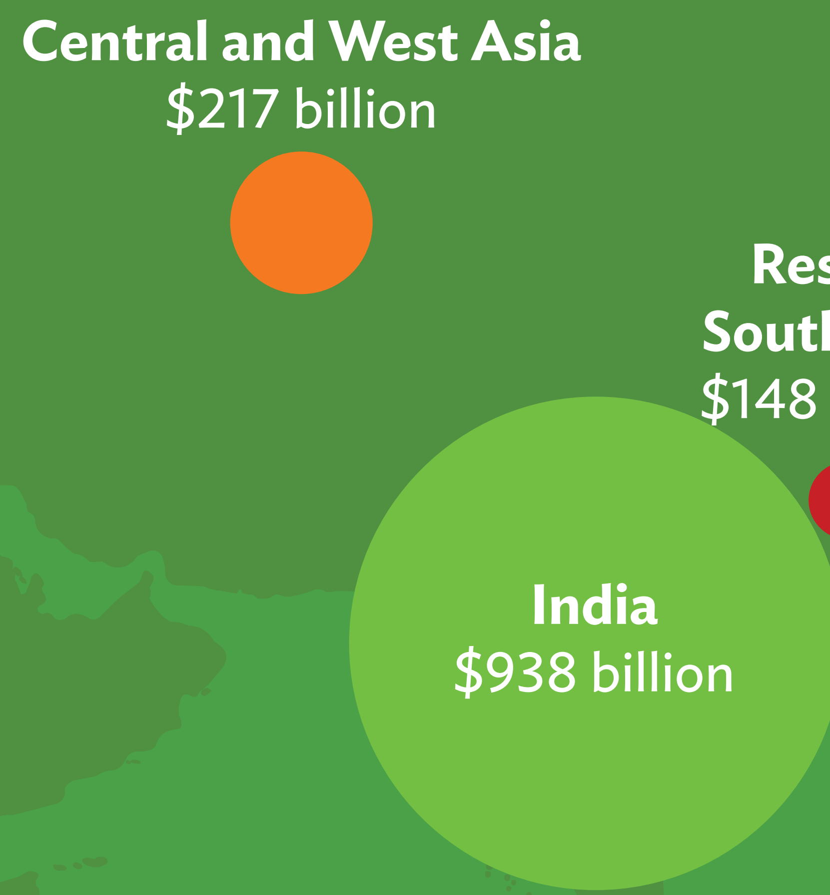
Water Investment Needs in Asia and the Pacific

Summary

The Asia and Pacific region faces a defining challenge: the urgent need to bridge a persistent and widening gap in water investment. To meet the rapidly growing WASH requirements from 2025 to 2040, the region must mobilize an estimated $4 trillion, equivalent to roughly $250 billion per year (Figure 39). However, current annual investment is only around $100 billion, less than 40% of what is necessary, leaving a yearly shortfall of over $150 billion. This deficit significantly undermines water security, disrupts social and economic progress, and threatens attainment of the SDGs in a region already marked by acute disparities in water access and quality.

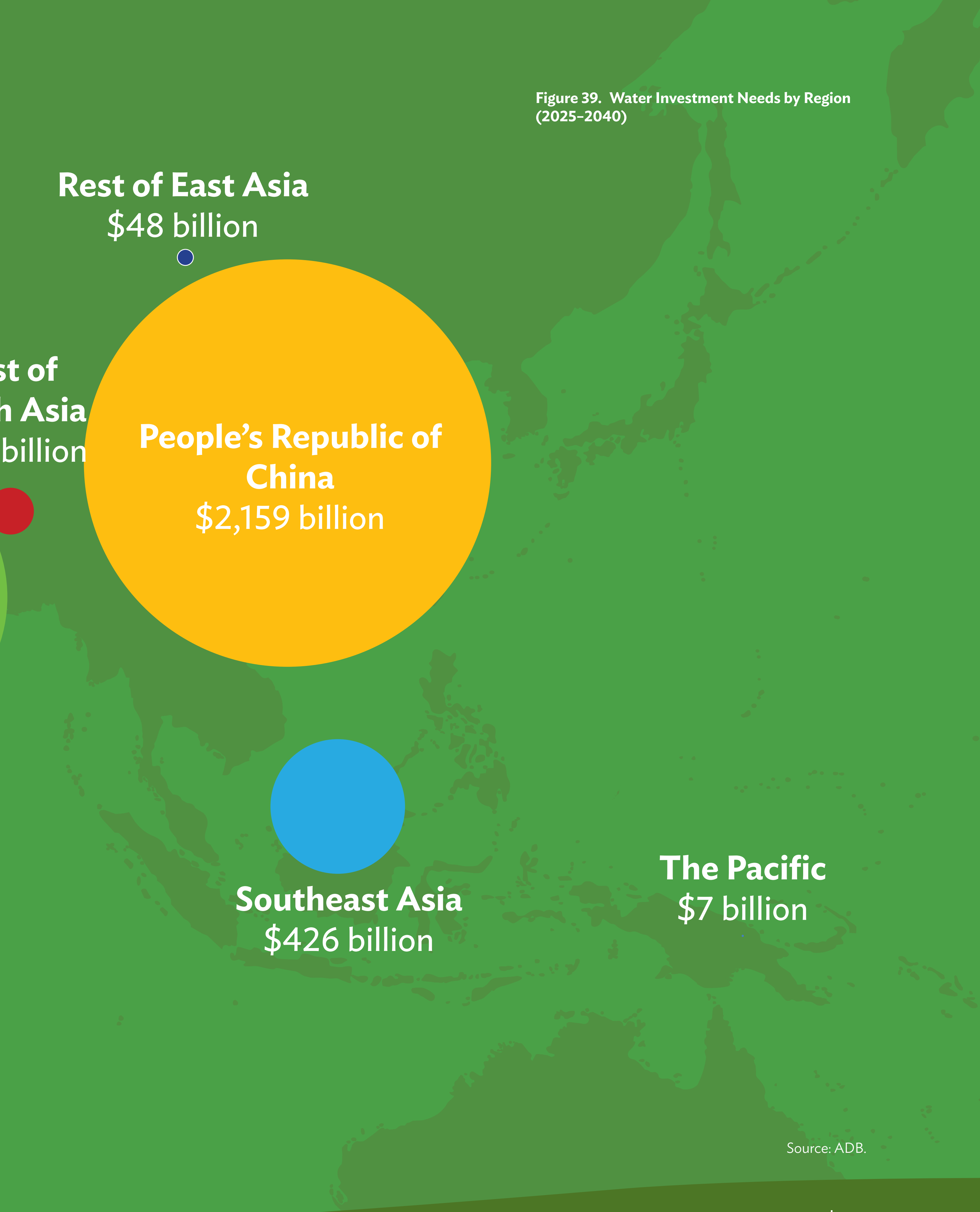
The analysis in this chapter highlights an acute need for more innovation and application to scale investment. This needs to be both responsive to local needs and sensitive to local context. For example, financing arrangements need to account for distributional equity, recognizing the importance of sustainable and inclusive service delivery and resilience across a highly diverse region.

Several examples of innovation and progress have been described in other chapters. This chapter highlights that the traditional reliance on concessional and commercial finance must be supplemented by a greater focus on operational efficiency. Areas of focus should include loss and leakage reduction, improved tariff collection, and a targeted emphasis on cost recovery. Progress in these areas supports the development of a virtuous cycle, where improved efficiencies unlock access to additional finance. However, to advance at scale, there is a policy-facing requirement to identify systemic inefficiencies and introduce incentives to address them, including encouraging private sector participation where appropriate.



MDBs contributed just $19.6 billion to water infrastructure, globally in 2024, a small share of the total need. Even limited resources can have a substantial impact when used strategically to reduce investment risks, improve long-term service performance, and attract additional commercial finance.

Figure 39. Water Investment Needs by Region (2025–2040)



Source: ADB.

Introduction

Achieving water security across Asia and the Pacific requires sustained and large-scale investment. Water supply, sanitation, and hygiene (WASH) services underpin public health, economic growth, and resilience to climate and disaster risks. Yet, many economies in the region continue to face major financing shortfalls. This chapter responds to a critical need: to better understand the scale of investment required to meet regional water goals over the next 15 years and to identify practical ways to close the gap.

Methodology and Methodological Considerations

Estimation Approach

This analysis estimates the infrastructure investment needed for WASH across 45 ADB DMCs between 2025 and 2040.[7] It draws on ADB's *Meeting Asia's Infrastructure Needs* (MAIN) report, which projected infrastructure needs from 2016 to 2030 using macroeconomic variables. While we use MAIN data to inform our baseline, this analysis applies an independent method and extends projections to 2040. Using a similar top-down approach, this chapter updates those estimates to reflect current conditions and future projections.

Investment needs were estimated using five macroeconomic indicators as proxies for infrastructure demand: GDP per capita, population, urbanization, manufacturing output, and agricultural output (Table 22). For each country, linear extrapolation was applied based on up to 10 years of historical data, then the average change across all five vectors was calculated to derive a scaling factor. This factor is applied to generate projections for total infrastructure needs from 2025 to 2040. MAIN projections for 2025 to 2030 are retained, with new estimates added for 2031 to 2040. All values are expressed in constant 2024 US dollars.

Estimating the share of infrastructure that is water-related is more complex. Definitions vary widely. MAIN data suggest water accounts for 3.5% of infrastructure needs, while the World Bank (2024) reports figures as high as 18.5%. We use the midpoint (11%) as a regional estimate. Although actual values likely differ by country, we apply this figure uniformly due to a lack of reliable, country-specific data.

Assumptions and Limitations

The estimates presented here should be interpreted with care. They are based on projected changes in macroeconomic variables, which serve as proxies for actual infrastructure needs. This approach simplifies a highly diverse regional context and cannot fully reflect the structural and sectoral differences between economies.

While the underlying analysis is conducted at the country level, results are presented as subregional aggregates, except for the PRC and India due to the scale of their projected investment. This helps avoid creating a false sense of precision that could result from country-level estimates and reflects the paper's primary aim: to identify the scale of investment required across the region.

A key limitation is that macroeconomic projections do not account for differences in the type, cost, or effectiveness of existing infrastructure. Nor do they reflect variations in water intensity across economic sectors. Although results were benchmarked against other studies and were found broadly consistent, for example, Borgomeo et al. (2022) estimate regional water investment needs of $120 billion–$330 billion per year through 2030, the method still offers only a high-level approximation.

Future work could strengthen this analysis through a complementary bottom-up approach. This could include national infrastructure inventories, sector-specific investment plans, and assessments of existing systems. It would also be valuable to examine funding sources, disbursement mechanisms, and access modalities that shape how investment is mobilized.

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[7] Australia, Japan, New Zealand, the Republic of Korea, and Türkiye were not included in this analysis.

Table 22. Infrastructure Demand Vectors

Economy	Population growth to 2040 (2025 = 100)	Change in urbanization to 2040 (2020 = 100)	Manufacturing output growth to 2040 (2023 = 100)	Agricultural output growth to 2040 (2023 = 100)
Afghanistan	144.8	133.67		169.66
Armenia	90.3	110.25		77.39
Azerbaijan	106.7	117.03	123.77	254.83
Bangladesh	115.6	136.67	170.23	232.88
Bhutan	108.4	126.02		74.76
Brunei Darussalam	108.6	106.74		102.67
Cambodia	115.3	143.53		309.33
China, People's Republic of	95	124.43	507.11	153.98
Cook Islands	74.1	106.42		58.34
Fiji	105.6	115.59	130.23	331.88
Georgia	98.1	115.39	203.4	90.22
Hong Kong, China	92.6	100	110.38	114.15
India	111.1	132.76	218.14	217.56
Indonesia	109.3	120.42	203.91	252.95
Kazakhstan	116.5	111.19	108.27	101.49
Kiribati	120.6	120.35		136.84
Republic of Korea	95	103.15	145.35	109.25
Kyrgyz Republic	120.3	127.73	83.76	179.88
Lao People's Democratic Republic	116.8	136.23		404.62
Malaysia	115.6	110.16	162.11	103.91
Maldives	106.4	121.64		101.39
Marshall Islands	73	107.42		72.98
Federated States of Micronesia	107.1	123.36		302.06
Mongolia	116.5	107.6		862.91
Myanmar	106.3	130.42		51.21
Nauru	116.7	100		86.59
Nepal	110.7	150.84	115.01	218.34
Pakistan	127.4	123.5	94.15	153.85
Palau	94.4	108.05		
Papua New Guinea	124.6	142		128.46
Philippines	111.1	118.12	137.35	105.24
Samoa	112.3	103.96		34.79
Singapore	105.9	100	263.55	197.08
Solomon Islands	135.8	134.41		136.65
Sri Lanka	105.7	137.44		96.03
Taipei,China	92.1	107.86	196.42	82.8
Tajikistan	127.3	132.46	91.91	478.06
Thailand	97.2	125.31	82.58	137.73
Timor-Leste	121.2	125.77		111.61
Tonga	98.1	113.09		49.54
Turkmenistan	117.7	121.02		208.76
Tuvalu	90	116.4		127.51
Uzbekistan	124.6	110.71	93	99.37
Vanuatu	135	119.08		73.11
Viet Nam	106.9	137.11	82.98	171.27

Source: ADB.

Intersection with AWDO Key Dimensions

This paper serves as a thematic chapter within AWDO 2025 and does not focus on a single KD. Instead, it demonstrates how investment needs relate to all five KDs.

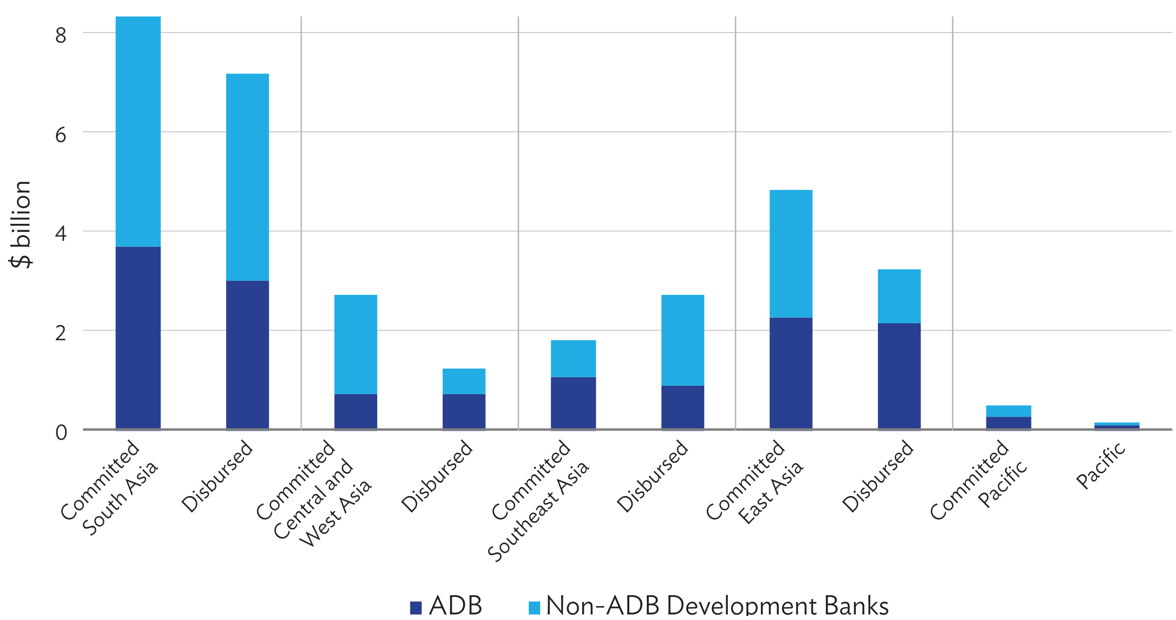
The strongest links are with KD1 (rural household water security) and KD3 (urban water security), with these investments also ultimately contributing to KD2 (economic water security). In closing the investment gap, it will be increasingly necessary to ensure adaptive resilience to climate stressors and to address the risk of ecosystem degradation. Therefore, this analysis is also salient for KD4 (environmental water security) and KD5 (water-related disaster resilience).

ADB's 2017 MAIN report included investment estimates both with and without climate mitigation and adaptation costs. By including these, the total estimates were increased by 13%. While that figure was not disaggregated for water infrastructure, it is likely a conservative proxy. Water systems typically require more adaptation-related investment than other infrastructure types. To avoid double-counting, climate-specific costs are not included in the main estimates. However, if the 13% uplift were applied to results, it would raise annual investment needs by $33 billion, from $250 billion to around $290 billion. This suggests that **climate resilience may be a significant source of underestimation.**

In relation to KD1 (rural water security), dataset was drawn from OECD (2024) to analyze WASH funding between 2018 and 2023. The dataset covers nearly all DMCs and allows to distinguish between commitments and disbursements. For the analysis, investments by MDBs were isolated—separating these from other sources such as philanthropic foundations and NGOs. ADB's investments are presented alongside those from other MDBs (Figure 40).

The dataset reveals key patterns. Differences in financing levels across subregions generally reflect population size and income level. However, the data also show ADB's central role as a financing partner for water across the region. One notable trend is the consistent gap between committed and disbursed amounts. This suggests that substantial investment may remain "locked" within existing commitments.

Figure 40. Water, Sanitation, and Hygiene Commitments and Disbursements by Multilateral Development Banks in Asia and the Pacific (2018–2023)



Source: OECD, 2024.

Household Self-Supply

A recent academic study (Foster et al. 2021) estimated that over 760 million people, about **32% of the population of East Asia, Southeast Asia and the Pacific, relied on self-supply for drinking water**, and not a utility, in the region in 2018. That number is growing by approximately 9 million people each year. Households therefore represent a major but frequently unquantified source of water infrastructure financing, with significant variation across DMCs. However, it is important to note that household self-supply often does not meet the safely managed standard.

Extrapolative investment models such as the one used in this paper typically do not include household self-supply in baseline estimates. Differences in household size, infrastructure type, maintenance and replacement needs, age of systems, and proximity to water sources all contribute to the complexity of estimating needs in this area.

While difficult to quantify at scale, household self-supply is likely to represent a material share of total water infrastructure investment in many DMCs. This form of investment is probably underestimated in most regional assessments, including this one. Future efforts to capture household contributions more accurately will be important to achieving a complete picture of regional water security.

Results

The analysis shows that around $4 trillion in investment, or $250 billion per year, is needed over 2025 to 2040. Accounting for more than three-quarters of this total are the PRC ($2.2 trillion) and India ($0.9 trillion). Table 23 presents a full regional breakdown. These figures are based on individual estimates for each of the 45 ADB DMCs in this analysis.

A widening investment gap is undermining regional water security goals. Current investment levels are estimated at around $100 billion per year, or less than 40% of projected needs. This shortfall varies widely between countries and is likely underestimated, as the current method does not systematically include the additional costs of climate adaptation.

Table 23. Investment Needs by Region

Water Infrastructure Needs 2025–2040
in 2024 constant currency

Region	Total ($ billion)	Annual ($ billion)
Central and West Asia	271	16.9
East Asia	2,207	137.9
East Asia excluding the PRC	48	3.0
South Asia	1,086	67.9
South Asia excluding India	148	9.2
Southeast Asia	426	26.6
Pacific	7	0.4
Asia and the Pacific	3,998	249.8
Asia and the Pacific excluding the PRC	1,839	114.9
Asia and the Pacific excluding the PRC and India	901	56.3

PRC = People's Republic of China.
Projected investment requirements use a country-level baseline derived from ADB's 2017 report, *Meeting Asia's Infrastructure Needs.*
Source: ADB.

Estimating Water Investment Needs for the PRC and India

Given their size and significance in the region, country-level point estimates are presented for the PRC and India. These are based on a step-by-step calculation using infrastructure investment projections and a share attributed to the water sector.

Step 1 – Establish baseline needs (2016-2030): Baseline estimates from the MAIN report, expressed in 2024 constant currency, indicate:

- The PRC: $15,300 billion in total, or $1,021 billion per year.
- India: $6,762 billion in total, or $452 billion per year.

Step 2 – Project changes for 2031–2040: A scaling factor was developed using forecast changes in key economic variables between 2016–2030 and 2031–2040 (Table 24).

Table 24. Variables Used in the analysis for India and the People's Republic of China

Variable	People's Republic of China	India
GDP per capita (%)	+72	+67
Population (%)	−3.8	+5.8
Urbanization (%)	+7.2	+13.8
Manufacturing production (%)	+70	+30
Agricultural production(%)	+16	+30
Scaling factor	**1.32**	**1.29**

Source: ADB.

Step 3 – Estimate annual needs for 2031-2040: The scaling factor is applied to the 2016–2030 annual baseline:

- The PRC: $1,021 × 1.32 = $1,350 billion per year.
- India: $452 × 1.29 = $582 billion per year.

Step 4 – Calculate total needs for 2025-2040: By combining the 2025–2030 estimate from the MAIN report with the scaled 2031–2040 figures:

- The PRC: $19,627 billion.
- India: $8,527 billion.

Step 5 – Attribute to the water sector: Assuming the water sector accounts for 11% of total infrastructure investment needs:

- The PRC: $2,159 billion in total, or $135 billion per year (2025–2040).
- India: $938 billion in total, or $59 billion per year (2025–2040).

Discussion

Current levels of water investment in Asia and the Pacific fall far short of what is needed. This analysis suggests that less than 40% of the annual investment requirement is being mobilized. **Bridging this gap will require more than increased financing alone, it will demand new approaches to valuing and pricing water.**

Estimates are consistent with prior studies of investment needs. Borgomeo et al. (2022) estimate regional water investment needs of $120 billion–$330 billion per year through 2030. An earlier study by the World Bank, cited by the OECD (2019) and included in the AWDO 2020 report, estimated the investment requirements for the region to be $198 billion per year to 2030. The estimation period in this paper is extended to 2040, and accounts for additional needs associated with population growth over the period.

Momentum is growing around the need to rethink how water is valued. Practitioner and policy literature increasingly reflect this shift. Yet efforts to reform pricing often face political resistance, especially where tariff reform is seen as too difficult to implement. As the urgency of the investment gap becomes more widely recognized, there is growing pressure to identify scalable and politically viable solutions that can break the status quo.

Annual water financing demand is a function of the spend required for capital, operating and maintenance expenditure, plus the cost of principal and interest repayments. Funding demand can be reduced by any savings from improved efficiencies. On the other side, the supply of finance and funding comes from user tariffs, government budgets, concessional finance, and commercial finance. For water systems to be sustainable, long-term financing supply must meet or exceed financing demand.

Reducing demand is challenging if countries are to meet their goals for climate-resilient water security. However, **gains in operational efficiency, asset management, and loss reduction can ease cost pressures.** Digital water innovations, such as smart sensors, predictive maintenance, and artificial intelligence, offer new opportunities. ADB is supporting these efforts through its Accelerated Innovation Approach and utility twinning programs.

Despite such initiatives, closing the gap will require new and expanded sources of funding and finance. There are five key levers: efficiency gains, tariff revenue, government subsidy, concessional finance, and commercial finance. These sources are not interchangeable. Many national investment plans focus on concessional or commercial finance but underutilize opportunities to boost revenue or save costs. Yet commercial finance depends on a project's ability to repay, making cost recovery strategies especially important.

Value-reflective tariffs offer a practical and effective way to close the investment gap. These tariffs increase revenue directly and create incentives for efficiency. They also strengthen the financial profile of utilities, enabling access to loans, climate finance, and private investment.

Implementing value-reflective tariffs involves several steps. Countries need processes for water value discovery, a financial framework, empirical tools to support tariff differentiation, and alignment with national policies. Stakeholder consultation and institutional capacity are also critical. In many cases, a transitional step is needed between value discovery and formal tariff reform.

Shadow pricing can play that intermediary role. It helps estimate the true economic value of water across sectors, such as agriculture, industry, and households, based on how, where, and when water is used. One method, hedonic pricing, links these characteristics to water's perceived or actual value. This provides a foundation for designing more equitable and effective tariff structures.

Applying financial frameworks like this at the national level is a novel approach. It supports tariff design by quantifying how much investment is needed and where. Final decisions remain with policymakers, who must weigh options such as subsidy levels, social protection mechanisms, and the degree of resilience required.

Roadside watertap, Dhaka, Bangladesh (Photo by ADB).

Conclusion and Next Steps

Meeting WASH needs in Asia and the Pacific through 2040 will require an estimated $4 trillion in investment, or $250 billion per year. At present, annual spending is only around 40% of this amount. **Closing this gap is essential for advancing water security across all five of AWDO's KDs.**

Investment needs linked to some KDs are not established. Likewise, household self-supply is excluded from baseline estimates, despite its growing scale. Both areas are expected to represent a larger share of total water investment needs by 2040.

A key issue is that **current funding systems do not reflect how the value of water varies depending on who uses it, when, where, and why.** Without change, millions of people in the region may remain trapped in long-term water insecurity.

By introducing shadow pricing as an intermediate step, countries can begin to reveal the true value of water across different uses and users. This can support the design of value-reflective tariffs that generate more funding, promote efficiency, and guide equitable investment.

Three next steps are proposed to strengthen future investment planning.

1. Improve the granularity of country-level water investment needs through a bottom-up assessment of existing infrastructure and also expanding it to wider water infrastructure investment. This should integrate demand projections by category of water user and supply projections that incorporate probabilistic analysis of localized climate change impacts.

2. Apply the data within a value discovery model to inform a shadow price water framework. This framework should account for not only the volume of water consumed, but also who is consuming it, when, where, and for what purpose. The aim is to enhance the financial sustainability of interventions that advance water security.

3. Pilot and validate the approach in a sample of DMCs. Expected outputs include value-reflective shadow pricing to guide tariff reforms and improve the financial sustainability of both water resource management and service provision. Stakeholder engagement should be embedded throughout design and implementation.

Community tap in Behala Slum area. Kolkata, India (Photo by ADB).

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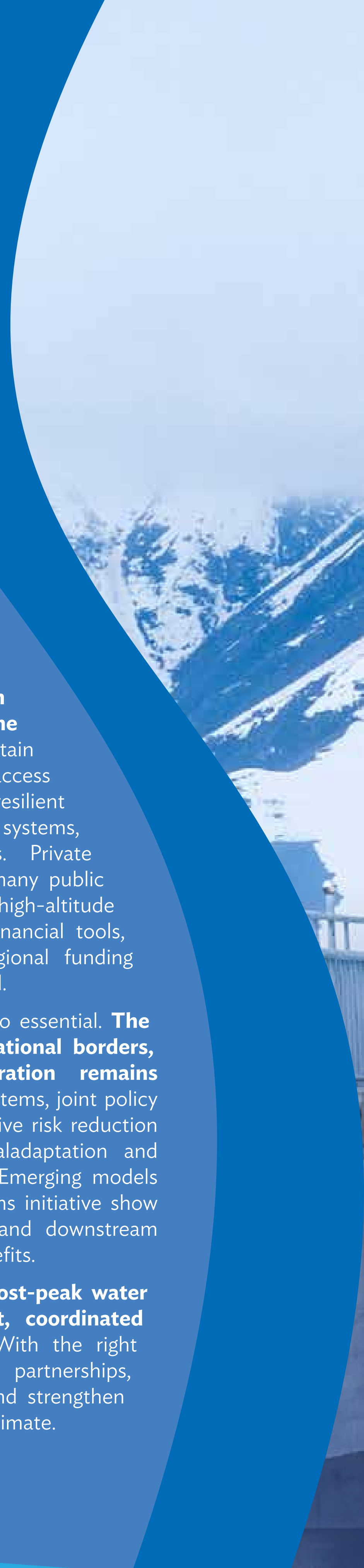
Changes to the State of the Cryosphere and the Impacts on Water Security



Summary

Glacier and snowmelt are vital to water security across Asia. The mountain cryosphere, including glaciers, snow, and permafrost, feeds rivers, supports agriculture and hydropower, and supplies drinking water to millions. As the climate warms, these frozen systems are shrinking rapidly (Figure 41). This is changing both how much and when water is available.

Approximately 70% of the Earth's fresh water is contained within the cryosphere, and over 2 billion people across Asia rely on it for part of their water supply. Even if global warming is limited to 2°C, **between 30% and 50% of glaciers in the Hindu Kush Himalaya are projected to disappear by the end of the century**, significantly affecting the supply of water in the region.

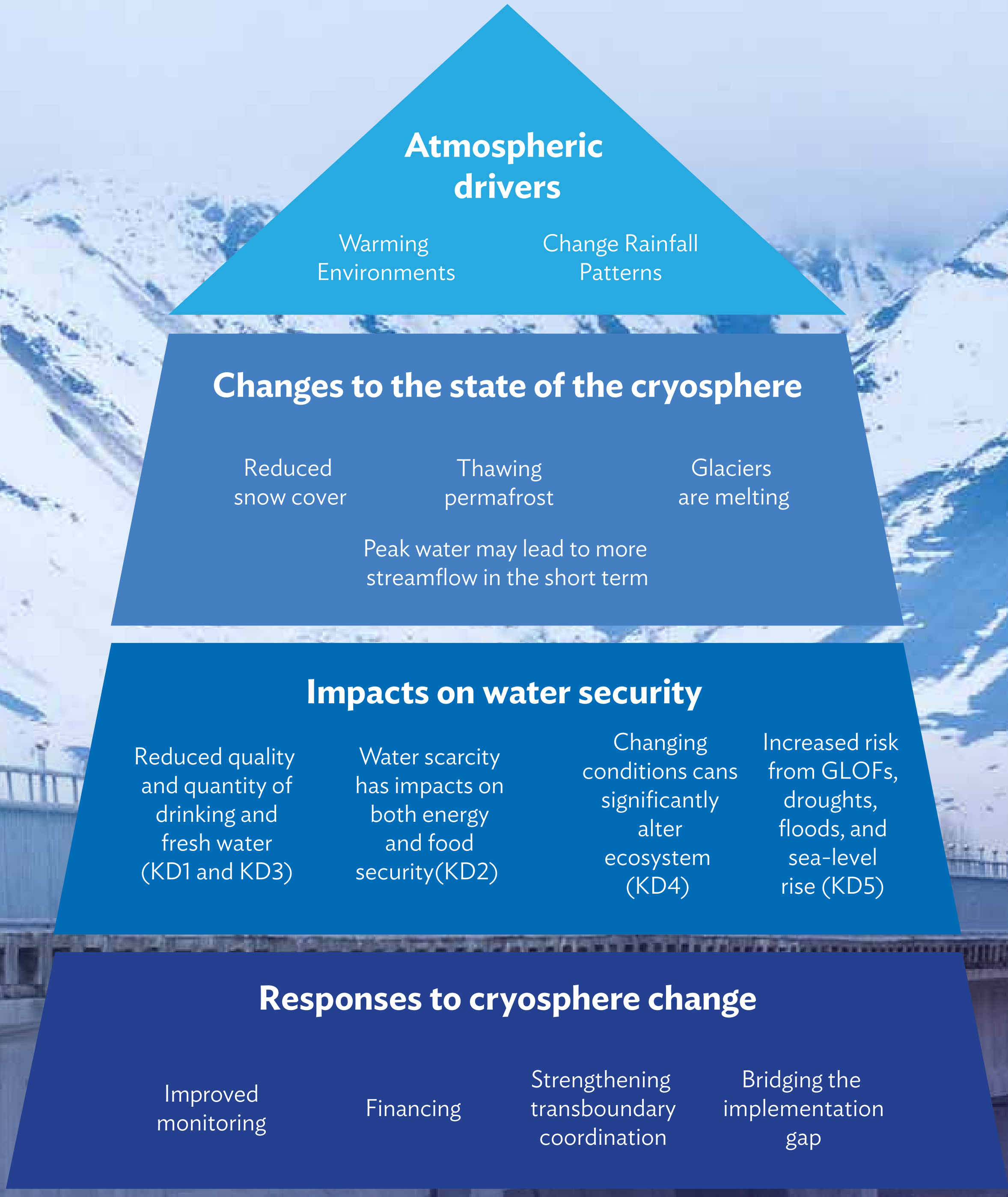
One of the most important changes underway is the arrival of peak water. As glaciers melt more quickly, river flows initially increase. This short-term gain may benefit irrigation, rural and urban water supply, and energy generation. But this boost is temporary. After reaching peak water, annual runoff begins to decline as glacier mass shrinks. Some river basins have already passed this threshold. Many others are expected to reach it in the coming decades. Planning that relies on today's high flows risks locking in future water scarcity.

Finance and coordination remain major gaps in the regional response. Mountain communities often lack access to funding for climate-resilient agriculture, early-warning systems, or infrastructure upgrades. Private investment is limited, and many public programs are not designed for high-altitude or remote areas. Tailored financial tools, incentive schemes, and regional funding platforms are urgently needed.

Improved coordination is also essential. **The cryosphere often spans national borders, but cross-border cooperation remains weak.** Shared monitoring systems, joint policy development, and collaborative risk reduction efforts can help avoid maladaptation and improve water governance. Emerging models such as the Glaciers to Farms initiative show how connecting upstream and downstream needs can deliver shared benefits.

Managing the shift to a post-peak water world will require urgent, coordinated action across all levels. With the right policies, investment, and partnerships, countries can reduce risk and strengthen water security in a changing climate.

Figure 41. Visual Summary of the Impacts of the Changing Cryosphere



GLOF = Glacial Lake Outburst Flood, KD = Key Dimension,
KD1 = rural household security, KD2 = economic water security,
KD3 = urban water security, KD4 = environmental water security,
KD5 = water-related disaster security.
Source: ADB.

Rasht Valley, Tajikistan.
Bridge along the road.
Photo by ADB

Introduction

Water security is one of the world's most urgent challenges. Around 70% of the planet's fresh water is stored in the cryosphere. These frozen regions play a vital role in regulating water supplies, with major consequences for food production, disaster risk, and energy systems (Hugonnet et al. 2021; Jackson et al. 2023).

The cryosphere refers to all the frozen water on Earth, including permafrost, glaciers, and seasonal snow cover. In Asia, these frozen systems regulate river flows, support agriculture, and sustain water supplies for billions of people across the region. They are essential for managing dry-season flows, groundwater recharge, and longer-term water availability in many of Asia's major river basins (Armstrong et al. 2019; Bajracharya et al. 2020).

Mountain glaciers are shrinking almost everywhere, both in area and volume (Hugonnet et al. 2021; Hock et al. 2019; GLaMBIE 2025; Dussaillant et al. 2019). This trend is accelerating. While some glacier loss is now unavoidable, research shows that preserving up to twice as much glacier mass is still possible if emissions are rapidly reduced and warming is limited to 1.5°C, in line with the Paris Agreement (Zekollari et al. 2025).

Glaciers in some areas are so small they may disappear entirely within a few decades. The future of Asia's glaciers will depend largely on the global emissions pathway. Even the least possible loss, such as the 15% decline projected under a sustained 1.5°C scenario in the Karakoram and western Himalaya, would have major consequences. Higher emissions will lead to faster and more extensive melt, with the most serious impacts in river basins already under water stress or dependent on seasonal meltwater (Zekollari et al. 2025; Khanal et al. 2021).

Glacier retreat will shape regional water availability, agriculture, and economic systems. Glaciers, and to some extent snow cover, act as a buffer for water resources. They are especially valuable for water resources during dry, hot weather, when melting increases. The risks are serious, but they may also drive new forms of cross-border cooperation and investment. The nature and severity of impacts will vary across Asia. Drylands that depend heavily on glacier and snowmelt may face greater water scarcity and drought, while monsoonal systems may experience more frequent and intense flooding and avalanches as the buffering effect of the cryosphere is lost (Barandun et al. 2020; Zheng et al. 2021). In response to a shrinking cryosphere, and other changes in water resources, efforts are being made across Asia to create artificial buffers. These range from large water reservoirs to small-scale ice stupas and avalanche farming and snow storage.

This chapter summarizes the risks and opportunities for water security in Asia and the Pacific arising from changes in the cryosphere. It highlights how future impacts will depend on the rate and scale of greenhouse gas reductions and explores how different basins and sectors may be affected. By understanding these dynamics, governments and development partners can better plan for adaptation, manage hazards, and protect critical water systems.

The relative contributions of glacier melt, snowmelt, and rainfall vary across Asia's major river basins (Table 25). Snowmelt often plays a larger role than glacier melt, highlighting the complex and varied sources of runoff in glacier- and snow-fed catchments (Armstrong et al. 2019; Deschamps-Berger et al. 2025). These dynamics are essential for managing seasonal water availability, infrastructure planning, and maintaining ecosystem health.

Table 25. Relative Contributions of Glacier Melt, Snowmelt, and Rainfall to Runoff in Asia's Major River Basins

Basin	Contribution to River Flow (%)		
	Glacier	Snowmelt	Rainfall
Amu Darya	4.4	74.4	5.4
Brahmaputra	1.8	13.2	62.1
Ganges	3.1	10.3	64.7
Helmand	0	77.5	5.2
Indus	5.1	39.7	43.9
Ayeyarwady	0	5.1	78.2
Mekong	0.3	7.4	55.1
Salween	1.4	14.7	55.7
Tarim	3.2	23.9	47.3
Plateau of Qinghai Province–Tibet Autonomous Region	2.3	15.3	32.8
Yangtze	0.2	5.5	71.0
Yellow River	0.1	9.6	63.9

Note: Other water sources, like groundwater, are not included in this table.
Source: Adapted from Khanal et al. 2021.

A group of locals collecting water from a stream formed by melted ice in Ladakh (Photo by Érico Hiller).

Changes to the Asian Mountain Cryosphere

Figure 42 summarizes glacier losses and hydrological impacts across Asia's mountain regions, primarily over the past 2–3 decades.

Mountain Glaciers: Loss and Impacts

High Mountain Asia is the most ice-covered region outside the poles, holding about 30% of the world's mountain glaciers across 98,752 km^2 (Yao et al. 2008; Wang et al. 2022). Between 2000 and 2019, almost all glaciers in the region showed accelerating mass loss (Hugonnet et al. 2021). Some, like those in the Karakoram, have been more resilient due to their elevation and geometry, but even these glaciers are now losing ice.

Hindu Kush Himalaya

Glacier retreat in the HKH has been slower than in some other regions, such as the Caucasus. However, there is a clear west–east gradient, and losses are increasing. With many people downstream relying on meltwater, even small changes can have large impacts. Since 2000, glacier loss has accelerated sharply, with 65% more mass lost in the 2010s than in the 2000s (Hugonnet et al. 2021, Jackson et al. 2023).

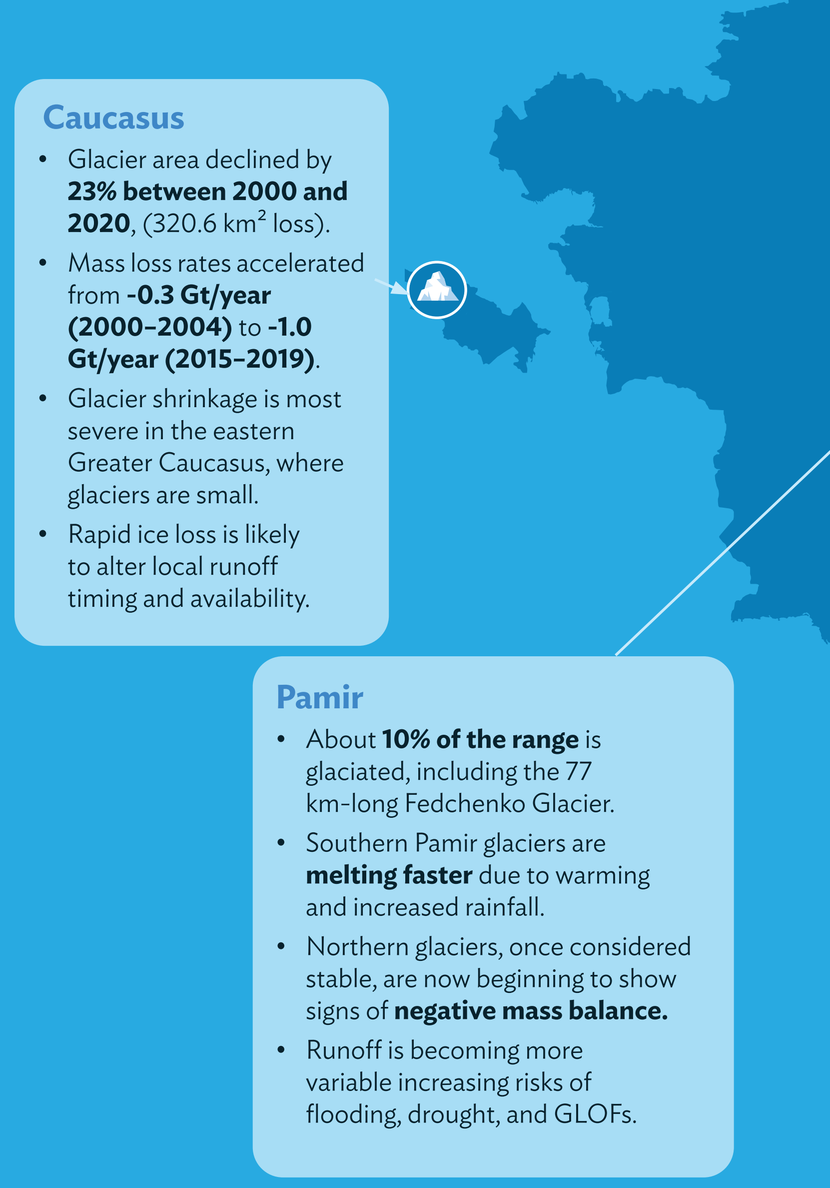
Karakoram and Western Himalaya

The Karakoram and Western Himalaya together hold 30,590 km^2, or nearly one-third of High Mountain Asia's glacier area, with a combined volume of 4,874 km^3 (Wang et al. 2022). Early in this century, the "Karakoram anomaly" described the region's stable or growing glaciers, a rare trend when most global glaciers were retreating (Kääb et al. 2012). This trend has now reversed. From 2010 to 2019, glaciers in this region were either stable or retreating (Hugonnet et al. 2021).

Caucasus

Between 2000 and 2020, glacier area in the Greater Caucasus declined by 23% (Tielidze et al. 2022). The number of glaciers fell from 2,186 to fewer than 2,000. The eastern part of the range saw the most significant losses, as glaciers here are smaller and more sensitive. Glacier loss in the Caucasus accelerated more than in any other region globally during 2000–2019, reaching a rate of 1 gigaton per year by 2015–2019 (Hugonnet et al. 2021).

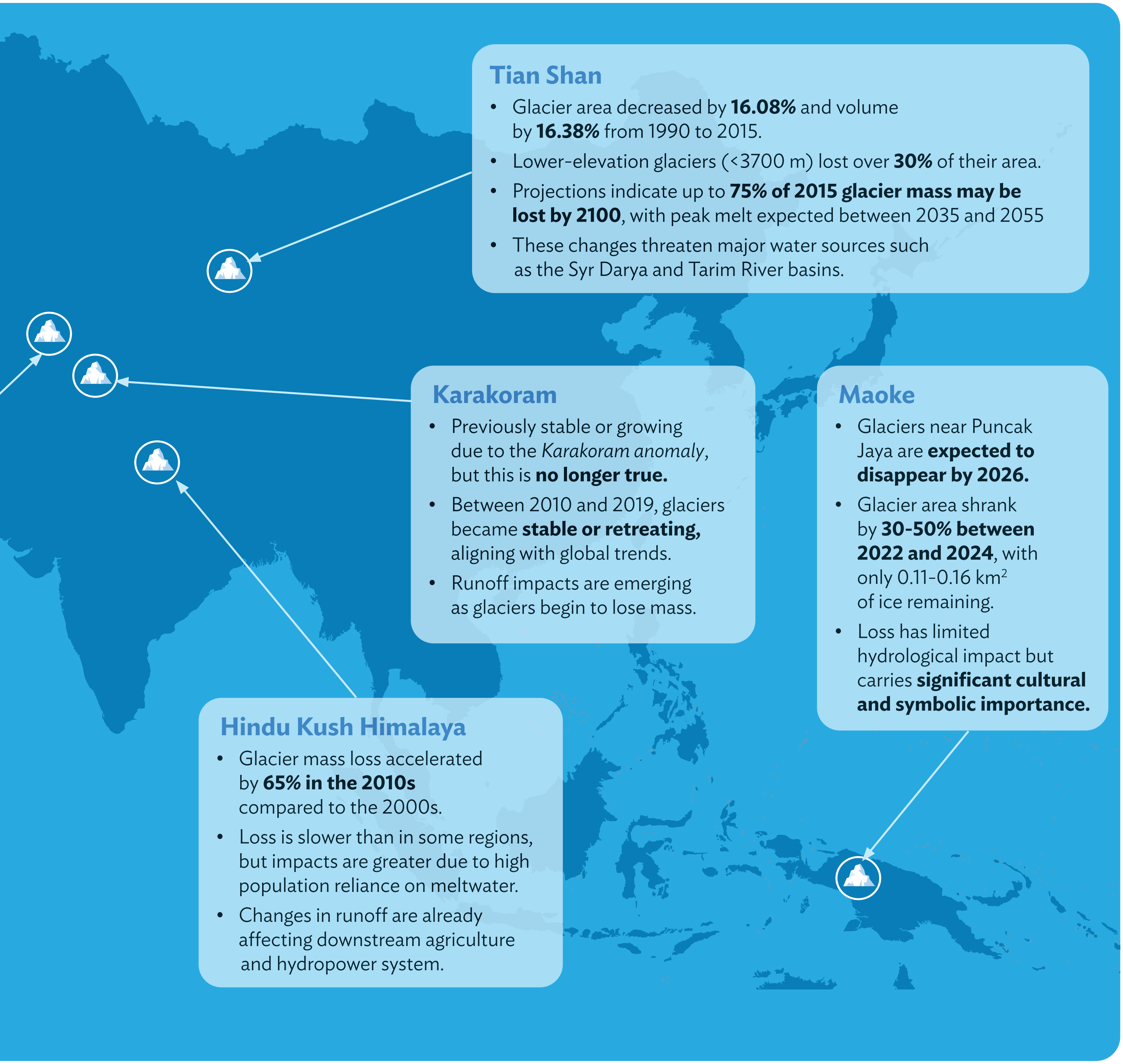
Figure 42. Changes to Asia's Glaciers



GLOF = Glacial Lake Outburst Flood, Gt = gigaton, km = kilometer, km^2 = square kilometer,.
Source: ADB.

Pamir

The Pamir mountains are home to over 13,000 glaciers, covering roughly 12,000 km^2 (Mölg et al. 2018). The 77-km long Fedchenko Glacier is the longest outside the polar regions. In the southern Pamir, melting is increasing with warmer temperatures and more rainfall (Goerlich et al. 2020). Glaciers in the northwest, previously seen as stable due to the Karakoram anomaly are now also showing signs of loss (Li et al. 2023).



Tian Shan

The Tian Shan has nearly 15,000 glaciers covering about 2,300 km^2 (Barandun et al. 2020). From 1990 to 2015, glacier area and volume declined by 16% overall, with a 30% loss for glaciers below 3,700 meters (Zhang et al. 2022). Recent modeling suggests that up to 75% of glacier mass could disappear by 2100 (Rounce et al. 2023).

Indonesia: The "Eternity Glaciers"

Glaciers near Puncak Jaya in Papua, Indonesia, are expected to disappear this decade, possibly by 2026 (Permana et al. 2019). Their area fell to just 0.11–0.16 km^2 by August 2024, down from 0.23 km^2 in 2022. These last tropical glaciers in Asia hold symbolic importance as indicators of global climate change.

Snow Cover

Snow cover in high mountain regions is highly variable and harder to monitor than glaciers. Its short-lived nature and strong seasonal changes make long-term tracking difficult. However, satellite technology now allows better monitoring of snow cover extent and timing.

Using MODIS satellite data from 2000 to 2018, Notarnicola (2020) found that 78% of mountain areas worldwide show a significant decline in snow cover. By extending the dataset back to 1982 and incorporating other sources, Notarnicola (2022) reported that snow cover duration has decreased by up to 43 days in some regions. On average, snow cover extent declined by −3.6% ± 2.7%. Similar findings from Young (2023) confirm a widespread loss of seasonal snow cover.

This decline has broader consequences. **Snowmelt supports many forest ecosystems across Asia.** A global atlas by Deschamps-Berger et al. (2025) showed that large areas rely on snowfall as a key moisture source. With less snow and earlier melt, forests are expected to become drier. This increases the risk of more frequent and more intense wildfires.

Regional studies show mixed trends. For example, Aizen et al. observed a reduction in snow depth and snow cover duration in the Tian Shan between 1940 and 1991. In contrast, parts of the eastern Tian Shan and Pamir have experienced longer snow seasons. This may reflect changing precipitation patterns that temporarily offset warming. Jackson et al. (2023) also found growing variability in snowfall intensity and distribution, making future projections more uncertain.

Permafrost

Permafrost is ground that stays frozen for at least 2 consecutive years. It underlies much of High Mountain Asia, including the Caucasus, Pamir, Karakoram, and Himalaya ranges. About 40% of the plateau of Qinghai Province–Tibet Autonomous Region is covered by permafrost (Huber 2016). Globally, 3.6 to 5.2 million km^2 of high mountain terrain is underlain by permafrost, up to 29% of the global total (Hock et al. 2019).

Permafrost is difficult to observe directly. However, satellite data help detect surface changes caused by thawing, such as slumps and erosion (Runge et al. 2022). Ground-based measurements are still sparse, especially outside the Qinghai Province–Tibet Autonomous Region economic corridor. Where available, they show a clear warming trend. Biskaborn et al. (2019) reported average permafrost warming of 0.19 ± 0.05°C per decade between 2007 and 2016. Longer-term data confirm ongoing degradation across the Tian Shan, Mongolia, and plateau of Qinghai Province–Tibet Autonomous Region(Cao et al. 2018).

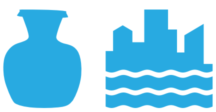
Thawing permafrost destabilizes the ground, increasing the risk of landslides, floods, and infrastructure failure. It also releases greenhouse gases like methane, which reinforce global warming (UNFCCC 2021). Events such as the Chamoli rockslide and Melamchi debris flow highlight these risks (Shugar et al. 2021; Maharjan et al. 2021). On the plateau of Qinghai Province–Tibet Autonomous Region, thawing permafrost is responsible for 30% of all road damage (ICEMOD 2023). Globally, infrastructure damage linked to permafrost thaw could cost billions of dollars by 2100 (Hjort et al. 2022).

As development expands across the region, understanding where permafrost lies and how it is changing will be essential for building resilient infrastructure and protecting communities.

Impacts on Water Security

Cryosphere change affects not just how much water is available, but when. As glaciers retreat and snowpacks shrink, meltwater increasingly arrives earlier in the year. This shift disrupts seasonal water cycles. In many areas, it brings flooding and sedimentation during planting, followed by water shortages at harvest. These changes place major pressure on food security, livelihoods, and water management systems.

The risks extend beyond agriculture. Cryosphere loss raises the chance of GLOFs, landslides, and erosion. These hazards are especially dangerous in densely populated or rapidly urbanizing areas. Beyond direct hazards, cryospheric change affects energy production, irrigation, fisheries, drinking water, tourism, transportation, and migration. Even distant regions are affected, as glacier loss contributes to sea-level rise, saltwater intrusion, and coastal erosion far downstream.



Drinking Water and Freshwater Availability – KD1 and 3

Snow and ice melt support fresh water availability during dry seasons. In many basins, they keep rivers flowing, sustain crops, and supply drinking water for millions. In the Hindu Kush Himalaya (HKH), changes in snow and ice directly affect more than 2 billion people, including 1.65 billion living downstream (Mountain Research Initiative 2023).

As glaciers decline, water quality may also be affected. Retreating ice can disturb long-established flow patterns and release pollutants, both natural and human-made, previously trapped in ice.

Current emissions trends pose serious threats to these water sources. On a high-emissions path, over 80% of glacier volume in the HKH could be lost by 2100. Losses would be even greater in Central Asia and the Caucasus. However, if warming is held near 2°C, ice loss could be reduced to 30%–50% (ICEMOD 2023). Glacier decline occurs when melting exceeds snow accumulation, leading to negative mass balance over time.

The contribution of glacier and snowmelt varies widely across river systems. Glacier melt provides up to 60% of irrigation water in the Indus Basin, despite contributing less overall to river volume (Biemans et al. 2019). In contrast, snowmelt dominates the Amu Darya (74.4%) and Helmand (77.5%) rivers (Khanal et al. 2021). The Ganges and Brahmaputra rely less on cryospheric input, only 13%–15% of total flow, while the Yangtze receives just under 6%. Still, warming affects all these systems. Research shows the Yangtze and Yellow rivers could lose up to 17% of their meltwater supply for every 1°C of warming (Chandrashekhar 2022).

A lone figure stands before the prize-winning 33.5-meter-tall Shara Phuktsey ice stupa, the highest in Ladakh.(Photo by Ciril Jazbec).

Box 13.

Understanding Peak Water: A Critical Turning Point in Glacier-Fed Basins

As glaciers melt more rapidly, annual runoff increases at first. This leads to greater water availability in river basins, temporarily supporting agriculture, energy, rural and urban water supply. But this trend does not continue indefinitely. Eventually, glacier volume shrinks to the point where annual runoff starts to decline. This moment is known as peak water (Hock et al. 2019).

The Indus River in Pakistan (Photo by ADB).

Each glacier basin will reach peak water at a different time. Some basins fed by smaller glaciers, such as the Kuban River in the western Caucasus, have already passed this threshold. Other regions, such as the Central and East Himalaya, East Tian Shan, and Hengduan Shan, are expected to reach peak water during the 2020s.[a]

The short-term increase in meltwater can boost rural and urban water supply and support food and energy systems. But **planning based on these temporary gains can be misleading**. Once peak water is passed, water availability will decline, increasing the risk of long-term scarcity.

Peak water also raises concerns for water quality. As glacier ice melts, it can release trapped pollutants and nutrients, affecting ecosystems and human health downstream. Monitoring these changes will be essential to protect drinking water and aquatic ecosystems.

Hazards around peak water are complex. Melting ice, unstable slopes, permafrost thaw, and intense rainfall can combine to increase the risk of floods and landslides. While glacial lake outburst floods are driven by lake formation and glacier structure, the added runoff during peak water can amplify the impact of extreme events.

Infrastructure and economic planning must account for peak water. Hydropower plants, irrigation systems, and water supply projects should be designed with realistic long-term water availability in mind.

The timing and severity of peak water will depend on future greenhouse gas emissions. Under a 1.5°C-consistent pathway, many larger glaciers may stabilize around 2060, helping preserve some dry-season flows and making long-term water planning more reliable.

[a] Lyu, L. et al. (2024). Peak water estimates across Asian glacier basins. Nature Communications, [advance online publication]

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Source: ADB.

Food and Energy Security – KD2

Food Security

Agriculture remains a primary livelihood in many parts of the region. This is especially true in the HKH, where more than 70% of people depend on farming for income and food security (Tiwari 2000). The region is highly sensitive to changes in snow and glacier melt. As the climate warms, cryosphere shifts are expected to disrupt food production and rural economies (Hart et al. 2014).

Water availability is one of the main concerns. Snow and glacier melt are essential for irrigation during late spring and early summer, especially in areas with limited rainfall (Shrestha et al. 2015). Many river basins in the HKH are projected to reach peak water by mid-century. After that, runoff will begin to decline (ICEMOD 2023).

Farmers in the Indus and Ganges basins already face growing pressures. Around 129 million of them rely at least in part on meltwater to irrigate their fields (Biemans et al. 2019). At the same time, food demand is rising quickly across South Asia due to population growth and economic expansion (Wada et al. 2019; Smolenaars et al. 2019). This intensifies the strain on already stressed water and food systems.

Livestock systems are also vulnerable. In many mountain areas, livestock provide food, income, and resilience. These systems often integrate pasture, cropland, forest, and nutrient recycling. However, pasture degradation, drought, and shrinking water sources are reducing herd capacity (Hussain et al. 2016). In Bhutan, India, and Nepal, yak herding has declined in response to these pressures (Ning et al. 2016). In Pakistan's Balochistan province, a prolonged drought from 1998 to 2002 killed 1.8 million animals and affected over 2 million people (Shafiq and Kakar 2007; Rasul et al. 2014).

Fisheries are another critical but vulnerable source of food and income. Fish provide protein to over 3.3 billion people (Wolf 2024). Asia supports 84% of global fisheries employment, and the PRC produces around 60% of the world's farmed fish (FAO 2017; FAO 2022). Changing river flows, rising temperatures, and sediment shifts disrupt fish migration, breeding, and water quality. Infrastructure such as dams compounds these impacts, sometimes harming downstream crops, displacing communities, or reducing access to productive farmland.

Energy Security

Energy demand is growing fast across South, Southeast, and Central and West Asia. In Southeast Asia, demand has increased by 3% each year for the past 2 decades. Yet many countries still rely heavily on fossil fuels, and current policies fall short of sustainability targets (International Energy Agency 2022). At the same time, there is strong potential to expand low-emissions energy, including bioenergy and hydropower.

Mountain hydropower offers a key opportunity for decarbonization. Several countries are already taking action. In late 2023 and early 2024, regional agreements and joint ventures were launched by Azerbaijan, Georgia, Iran, Kazakhstan, the Kyrgyz Republic, and Uzbekistan (AKI Press 2023; Uzbekistan Energy Week 2024).

However, hydropower depends on a stable cryosphere. Climate variability is already affecting reliability. In the Kyrgyz Republic, the Toktogul reservoir provides 40% of the country's electricity and supports irrigation in downstream Kazakhstan (Putz 2024). In early 2024, cooler temperatures reduced snowmelt, lowering reservoir levels. As a result, power generation dropped and dirtier energy sources were brought back online.

Effects on Biodiversity and Ecosystems – KD4

Glacier retreat is reshaping mountain ecosystems and threatening biodiversity. These changes alter both the timing and availability of water. In the Hindu Kush Himalaya alone, up to 70% of flora and fauna have been lost over the past century due to cryospheric changes (Chaudhary 2024).

Some impacts are direct, such as habitat loss or extinction of species that rely on frozen ecosystems. Endemic species may respond in different ways. The black-necked crane, for example, has adapted to rising temperatures by adjusting its egg incubation behavior (Zhang et al. 2017). Others, like the snow leopard, face shrinking food sources and fragmented habitats that may push them toward decline (Li et al. 2016). Climate change also drives genetic stress. Among amphibians, such as the Kashmir and Himalayan paa frog, mutation-related decline has already been observed (Saeed et al. 2021).

As glaciers recede, non-native species can spread into newly exposed landscapes. This raises risks for native biodiversity, especially in high-elevation zones. Agroforestry systems in places like Nepal are particularly vulnerable to this shift (Paini et al. 2016; Gurung et al. 2021, Sheergojri et al. 2022).

Glacier melt is also reshaping river systems. As ice recedes, it exposes new deposits of unconsolidated glacial sediment. This can destabilize slopes and cause short-term increases in sediment transport (Milner et al. 2017). At the same time, reduced sediment delivery over time will change erosion dynamics. Downstream, lower flow from shrinking glaciers will increase water temperatures and reduce sediment loads during the summer months.

Cryosphere-Related Hazards – KD5

Glacial Lake Outburst Floods

GLOFs are one of the most dangerous cryosphere-related hazards in mountain regions. These sudden floods can cause widespread loss of life, destroy infrastructure, and disrupt downstream communities. Their frequency is increasing as glacier retreat accelerates, forming more glacial lakes and increasing the likelihood of sudden breaches. Since the 1990s, the number and area of glacial lakes have grown by about 50% due to atmospheric warming (Lützow et al. 2023).

GLOFs are particularly difficult to predict and prepare for. Some occur with little or no warning due to sudden moraine breaches or cascading events, while others remain poorly mapped or monitored. The lack of consistent, regionwide hazard mapping adds to the challenge of early warning and risk reduction.

Future projections suggest a substantial increase in GLOFs across much of the region. **A threefold rise in GLOF events is possible by the end of the century** under current warming trends (ICEMOD 2023). However, regional variation is expected. For example, parts of the eastern HKH may see a decline in GLOF frequency by mid-century, likely due to differing climatic or topographic conditions.

The economic impacts of GLOFs are closely linked with permafrost thaw and broader cryospheric instability. On the Qinghai–Tibet Plateau alone, permafrost thaw and related hazards, including GLOFs, could require $6.31 billion in adaptation under SSP2-4.5 warming scenarios (Ran et al. 2022). The difference between 1.5°C and 2°C warming could translate into $1.32 billion in additional costs, emphasizing the importance of mitigation.

Recent GLOF events illustrate the growing risks and challenges in the region:

In Bhote Koshi (2016), a small glacial lake flood triggered by heavy rainfall caused a massive debris flow that destroyed roads, hydropower infrastructure, and bridges, with losses exceeding $70 million at the Bhotekoshi River hydropower plant in Nepal (Sattar et al. 2022). The lake, Gongbatongsha, was located across the border in the PRC, highlighting the challenges of cross-border monitoring and response for small lakes.

Risk assessment and research on South Lhonak (2023) in Sikkim, India, showed this lake had high potential for an outburst flood. The flood in October 2023, damaged the newly built 1,200 MW Teesta III hydropower plant and caused multiple fatalities (Sattar et al. 2021; Mishra 2023). An EWS was installed before the event, but due to technical issues, was not operational at the time of the event. However, many glacial lakes may exist for years or even decades before they burst, or just slowly decrease in size. The status and urgency is rarely clear, even to technical experts.

In Thame (2024), a flood in Nepal's Khumbu region displaced over 130 people and damaged homes, a school, and health infrastructure. The event originated from two small lakes not previously considered dangerous. Fortunately, early warning by a local resident prevented fatalities, though the case revealed the limitations of assessing the risk potential of glacial lakes (Bajacharya et al. 2020; Lord 2024).

These events show that even small or overlooked glacial lakes can cause severe damage, and that both cross-border coordination and local preparedness are essential for effective GLOF risk management.

Drought

Drought is a growing concern in the Caucasus and HKH, where fresh water demand is rising while availability declines. This combination threatens regional water security, agriculture, and ecosystems. Climate change is expected to worsen drought frequency and intensity, especially in areas already vulnerable due to geographic and climatic conditions. Snowpacks and glaciers help buffer these effects by releasing meltwater during dry seasons, but their stability is diminishing (Pritchard 2019).

Drought also has geopolitical dimensions, particularly in regions with transboundary rivers. Water scarcity has historically contributed to tensions between neighboring countries. Poor infrastructure and management can make drought impacts worse. In Uzbekistan, which supplies more than half of Central Asia's irrigated land, up to 70% of water is lost between the river and the field.

Floods

Flooding is one of the most frequent and destructive climate-related disasters in mountain regions worldwide. Between 1998 and 2017, Asia experienced 41% of global flooding events, affecting 1.5 billion people, 93% of the worldwide total. The PRC and India alone accounted for more than half of all people impacted, with 900 million and 345 million people affected respectively (Centre for Research on the Epidemiology of Disasters 2020).

Mountain flooding is driven by multiple factors, including glacier melt, changing precipitation, and compounding events. Melting snowpacks and glaciers, intensified rainfall, and rain-on-snow events all increase runoff, while drought can reduce soil absorption and make floods more severe (Hock et al. 2019). These processes will expand flood risk to new mountain areas and increase the frequency of landslides, erosion, and infrastructure failure. Glacier retreat and unstable slopes will further amplify these hazards.

Sea-Level Rise

Sea-level rise is driven by both ocean warming and the melting of land-based snow and ice. As seawater warms, it expands, a process known as thermal expansion. At the same time, melting glaciers and ice sheets add more water to the ocean. While the Antarctic and Greenland ice sheets hold far more potential for long-term sea-level rise, mountain glaciers are the largest historical contributors among cryosphere sources to-date (Oppenheimer et al. 2019).

The impacts of sea-level rise will be especially severe for small island nations and low-lying coastal cities. Becker et al. (2023) highlight the vulnerability of islands in the western tropics and the western Indian Ocean, where rising seas threaten infrastructure, fresh water supplies, and national sovereignty. In Asia, six major Southeast and South Asian coastal megacities, Bangkok, Chennai, Ho Chi Minh City, Kolkata, Manila, and Yangon, are at particularly high risk. Other populous cities, such as Karachi and Dhaka, also face increasing threats from sea-level rise in the coming decades.

Other Related Impacts

Transportation infrastructure across glaciated and downstream regions of Asia faces mounting risks from climate-related hazards. Flooding, permafrost thaw, monsoons, landslides, GLOFs, and erosion threaten roads, railways, and hydropower assets. Nie et al. (2023) noted that the region's recent boom in infrastructure development coincides with a rise in outburst floods, surging glaciers, and weakening moraines, factors that jeopardize long-term economic growth. GLOFs are especially dangerous due to limited monitoring, often providing little or no warning. When disasters strike, damaged or blocked transport routes can delay emergency access, particularly in mountainous terrain. River transport is also vulnerable. Many Asian rivers support heavy shipping for goods and people, yet declining water levels, sedimentation, and competing demands strain navigation. The desiccation of the Aral Sea is a stark example of how transport, environmental change, and mismanagement intersect (Sidik 2022).

Tourism places growing pressure on water security, particularly in mountain regions such as the HKH. Tourists typically consume far more water than residents, ranging from 200 to 800 liters per person per day, and high seasonality creates sharp peaks in demand that stress infrastructure, while facilities remain underutilized in the off-season. The HKH illustrates these challenges clearly. Glaciers, forests, and scenic landscapes attract millions of visitors, yet unsustainable practices have led to resource pressure, waste, erosion, and land degradation (Nepal 2011; Naitthani and Kainthola 2015; Tiwari and Joshi 2016). Increased demand for water and energy in tourist zones can strain upstream resources, while transboundary air pollution from agriculture, industry, and forest fires creates haze that obscures mountain views and undermines the region's appeal.

Migration in the HKH and Caucasus is shaped by both economic and environmental pressures. In the Caucasus, post-Soviet transitions have led to significant outward migration, especially to the Russian Federation, the European Union, and the United States (Migration Policy Centre 2013). In the HKH, internal migration dominates, with many rural residents relocating to cities, and 72% of Bhutan's urban population comes from rural areas (Ministry of Agriculture 2006). Water scarcity, erosion, and climate-related disruptions are key drivers (Ghobadi et al. 2005; Mohanty and Bhagat 2013; Siddiqui et al. 2019). Migration often outpaces infrastructure and social support, leaving new arrivals underserved (Bhagat et al. 2013).

Forest fires further compound the region's vulnerabilities. They transform forests from carbon sinks into sources of emissions, while ash and soot darken ice and snow, accelerating melt (Usha et al. 2021). Fires also worsen air pollution, with transboundary plumes linked to increased glacier melt, permafrost thaw, erosion, and serious health risks (Sastry 2022; Chen et al. 2021; Mirzabaev et al. 2019).

Responses to Cryosphere Change

Adapting to cryosphere change requires more than technical fixes. It demands coordinated action across science, policy, finance, and governance. The links between changing snow and ice conditions and their downstream effects are often poorly understood. As glaciers retreat and snowpacks shrink, the impacts cascade, across agriculture, energy, infrastructure, and urban systems. These changes may come through sudden events, like GLOFs, or through slower-onset risks such as drought, permafrost thaw, and altered precipitation patterns. Climate pressures are reshaping water demand, yet our understanding of how the cryosphere can meet that demand remains limited.

Improving Monitoring

Monitoring the cryosphere is one of the region's most urgent gaps. In much of the HKH, particularly in Afghanistan, Bhutan, Myanmar, Nepal, and Pakistan, basic in situ observations are still missing. Many high-elevation glaciers lie above 5,000 meters, where access is dangerous and monitoring is costly (Wester et al. 2019; Chakraborty et al. 2018).

Two major knowledge gaps hinder progress. First, **process gaps** limit understanding of how cryosphere systems like permafrost interact with hydrology. Second, **information gaps** stem from sparse data, especially on snow accumulation, melt dynamics, and permafrost extent. Without reliable snowmelt data, it is nearly impossible to model contributions to streamflow or predict seasonal availability. Existing datasets often lack consistency, making cross-regional analysis difficult.

Progress is underway. Glacier monitoring programs in Central Asia, many discontinued after the collapse of the Soviet Union, are being reestablished. By combining historical data, satellite imagery, and weather records, scientists are reconstructing glacier mass balance trends (Barandun et al. 2020). But permafrost monitoring remains far behind. It is still poorly mapped in the HKH, despite clear links to landslides, infrastructure damage, and ecosystem disruption (Coe 2020; Wang et al. 022).

Early-warning systems for hazards such as GLOFs and floods are a cost-effective way to reduce risk. Though they require maintenance and may not operate year-round, they can save lives and reduce losses (Bhutan Ministry of Home and Cultural Affairs 2017; Kumar 2022; Dickie et al. 2023). Expanding these systems should be a regional priority.

Reducing Risks to People and Infrastructure

Some cryosphere risks unfold in hours; others, over decades. GLOFs can destroy communities and infrastructure within hours. Drought and permafrost thaw build slowly but can have lasting effects. Without adequate emissions reductions, many of these risks will become permanent.

The first step to reducing risk is understanding where it lies. This includes mapping regional topography, infrastructure, and hazard zones, and developing data tools to integrate satellite and local observations. Risk assessments should include site-specific and basin-level planning.

Next comes planning and mitigation. Risk-informed design, such as resilient water systems, evacuation routes, and land-use planning, can help protect communities. Good practices should be documented, shared, and scaled through regional platforms and investment pipelines.

Implementation and financing are critical. Risk reduction needs financial support, public investment, and monitoring to stay effective. This includes policies that incentivize climate-resilient infrastructure and private sector engagement (ADB 2025).

Financing Cryosphere Resilience

Mountain communities remain underfunded. Investment is lacking in disaster preparedness, sustainable agriculture, climate-resilient infrastructure, and soil conservation. Government subsidies often miss local needs, while private investment remains low due to perceived risks.

Finance must be tailored to local contexts. Incentive schemes should reflect geographic and climate realities. Regional coordination can also improve efficiency, especially in transboundary basins where risks and benefits are shared. ADB-led Glaciers to Farms project, launched in 2024, connects highland water sources with downstream food systems.

Strengthening Transboundary Collaboration

The cryosphere offers both challenges and opportunities for regional cooperation. Snow and glacier systems often straddle national borders and sit far from national capitals. In some cases, mountain communities have stronger ties to one another across borders than to their own governments.

Collaboration remains essential but difficult. Political tensions often slow progress, even when legal frameworks exist. Moving forward requires structured engagement: shared data systems, joint policy planning, and forums for resolving disputes. Efforts must also guard against maladaptation, where actions like upstream diversions cause downstream harm.

Bridging the Implementation Gap

Technology exists, but it often fails to reach those who need it. The barriers are not just technical, but practical. Without reliable power, roads, or communications, mountain communities cannot access new tools or services (Rahman et al. 2012; Agarwal and Zimmerman 2008; Guttikunda and Koppaka 2012). These gaps delay adoption of clean energy, public transport, and sustainable farming, reinforcing high-emissions systems (Zhang et al. 2012).

Solutions are available. What is needed now is coordinated implementation, connecting finance to knowledge, building trust across borders, and prioritizing investment where cryosphere impacts are greatest.

Conclusion

Glacial melt is reshaping water security across High Mountain Asia, and far beyond. As snow and ice retreat, water supplies are becoming less reliable, placing stress on ecosystems, economies, and communities. These challenges are most immediate for agriculture, drinking water, and disaster risk.

In the short term, retreating glaciers may increase water availability. This "peak water" can support agriculture and hydropower, for now. But as ice reserves shrink, dry-season flows will decline, creating long-term stress. Some smaller glaciers may disappear entirely, removing critical buffers during drought.

These trends pose serious risks for agriculture. Over 129 million farmers in the Indus and Ganges basins rely on snow- and glacier-fed irrigation. Runoff is shifting earlier in the season, leaving less water during harvest. Climate change is also intensifying drought, erosion, and extreme rainfall. While drought-tolerant crops, like improved maize hybrids, offer some relief (Mukherjee 2024), heavy rain often runs off quickly, degrading soils and limiting moisture retention.

Groundwater-based drinking systems are also at risk. In much of South Asia, rural communities depend on springs and high-elevation recharge zones. These sources are vulnerable to changes in snowmelt and seasonal flow. Rasul (2014) highlights how difficult it is to manage water in resource-scarce mountain settings where seasonal dependence is high and infrastructure is limited.

Not all effects are negative. In parts of Nepal and Pakistan, **warmer temperatures have enabled high-altitude farming of fruit and vegetables** (Hussain et al. 2016; Thapa and Hussain 2021). But these benefits are unlikely to offset long-term losses in cryospheric water storage.

Adaptation is underway, but efforts remain fragmented. Most initiatives are local, with varying levels of support. As cryosphere impacts cross borders, regional cooperation will become increasingly important. Regional collaboration to ensure shared monitoring, joint planning, and trust-building are essential to avoid conflict and ensure fair access to shared water sources.

Managing cryosphere-related water insecurity will require action at every level, from farm fields to regional agreements. Collaboration, innovation, and sustained investment are needed to keep water a source of resilience rather than risk in a warming world.

Changes to the cryosphere will continue to reshape water availability, reliability, and risk across Asia. These shifts will have direct implications for national water security and future AWDO assessments, where NWSI and KD scores are likely to reflect increasing cryosphere-driven pressures.

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Unseen Impacts: Gendered Dimensions of Heat and Water Stress

Summary

Extreme heat and water insecurity are converging across Asia and the Pacific. While these pressures are widely acknowledged in climate discourse, their intersection with gender remains critically underexplored. This section uncovers a neglected crisis: women and girls face some of the harshest impacts of rising temperatures and vanishing water supplies, not because of inherent vulnerability, but because water security systems have failed to recognize and respond to gender inequality.

Across all five KDs of water security, gender disparities are deepening.

- **KD1: Rural household water security** is of increased importance as women without rural household water security walk further for water under extreme heat, facing exhaustion, illness, and violence.
- **KD2: Economic water security** is threatened as climate-sensitive jobs, largely held by women, collapse under heat stress, with few protections or alternatives.
- **KD3: Urban water security** is unevenly distributed across populations, often failing low-income women, especially in informal settlements where heat, poor sanitation, and infrastructure breakdowns converge.
- **KD4: Environmental water security** losses disproportionately affect women managing household water and food systems as ecosystems degrade.
- **KD5: Water-related disaster security** falls short when women's needs in emergencies, privacy, hygiene, caregiving, are overlooked, and their contributions undervalued.

These impacts are structural, not incidental. Women are central to managing water at the household and community level, yet their needs, knowledge, and leadership remain absent from most climate and water responses. This gap reflects outdated models of water security that prioritize infrastructure over inclusion. Without change, climate shocks will continue to reinforce exclusion, deepen poverty, and widen gender inequality.

A gender-responsive approach to water security is urgently needed.

This chapter proposes a phased strategy to address the crisis:

- Short-term (0–2 years): Deliver targeted emergency measures to protect women's access to safe water, sanitation, and cooling during heat waves and droughts.
- Medium-term (2–5 years): Build adaptive capacity by funding women-led innovations, integrating gender into budgeting and governance, and improving data systems across all KDs.
- Long-term (5+ years): Reform institutions to guarantee women's rights to land, water, participation, and finance, embedding equity across the water sector.

Water security cannot be achieved without gender justice. The evidence is clear: every KD of water security intersects with women's lives. Recognizing that this is not optional, it is essential to building a resilient, equitable future. Women are not just affected by climate impacts. They are leading solutions. It is time to fund them, follow their lead, and redesign water systems that serve everyone.

Women and girls face some of the **harshest impacts** of rising temperatures and vanishing water supplies, because water security systems have failed to recognize and respond to **gender inequality.**

Introduction

The Deadly Extremes of Heat Waves

Extreme heat is rapidly becoming one of the most serious threats to water security in the Asia and Pacific region. Heatwaves are becoming longer, hotter, and more frequent. These events increase evaporation, reduce rainfall, and dry out groundwater, leaving communities and ecosystems with less water. Agriculture, fisheries, and livestock suffer first, but the impacts spread quickly. Human health, food supply, and biodiversity all come under strain as water becomes scarce (India Water Portal 2025).

Heat extremes rarely occur in isolation. In many areas, extreme heat now coincides with droughts, floods, and erratic rainfall (German Watch 2019). Urban areas are especially vulnerable, with the Urban Heat Island effect making cities hotter for longer (Guleria and Gupta 2018). Nearly 60% of urban residents in the region have already experienced double the global average warming since 1950. By 2050, about 800 million people in South Asia could face dangerous heat exposure (Mani et al. 2018).

As global temperatures pass the 1.5°C threshold, the risks will rise sharply. Heat stress already affects 68 million people. At 2°C warming, over 1 billion people could face life-threatening conditions (Met Office 2021). Asia accounts for nearly half of global deaths linked to extreme heat, with more than 220,000 people dying every year from 2000 to 2019 (WHO 2024). Prolonged exposure increases heart, lung, and mental health risks (WHO 2024).

Extreme heat and water scarcity also deepen inequality. Low-income communities, informal settlers, and rural populations face the greatest exposure. Women and girls are disproportionately affected. In Asia and the Pacific, women are 60% more likely to lack access to cooling. A 1°C rise in temperature can increase the risk of miscarriage or stillbirth by up to 42% (ADB 2024). Gaps in basic water and sanitation services worsen these impacts, increasing the risks of disease, unsafe menstrual hygiene, and violence during water collection (UNICEF and WHO 2023).

South Asia is experiencing some of the world's most severe heat and water challenges. India has recorded 12 of its hottest years since 2006, while heat waves have increased by 25% (IMD 2023). The region's pre-monsoon heat events are now 30 times more likely due to climate change (World Weather Attribution 2024). In Bangladesh, shifting rainfall threatens 60% of the country's rice-growing areas, despite its overall water abundance (UN Women and IUCN 2022).

Southeast Asia's heat waves in 2024 and 2025 pushed temperatures above 40°C across Cambodia, Myanmar, the Philippines, Thailand, and Viet Nam. These dry- and humid-heat events are now hotter due to climate change and have disrupted food systems, damaged ecosystems, and strained power and water supplies (World Weather Attribution 2024). At the same time, cities like Bangkok, Jakarta, and Manila face rising water demand and mounting infrastructure stress. Droughts in Indonesia, the Philippines, and Thailand continue to erode food and water security (FAO and AWP 2023).

Pacific island nations are highly vulnerable to both heat and sea-level rise. While most households have basic water and sanitation access, climate change is increasing water stress through rising seas, salinity, aging infrastructure, and drought (UNESCO and ADB 2025). Saltwater intrusion is contaminating groundwater, while extreme rainfall and coastal flooding are damaging water systems and displacing vulnerable communities.

In March 2025, **Central and West Asia** faced record-breaking heat, with temperatures 10°C above normal (World Weather Attribution 2025). Melting glaciers and snow are causing a dangerous cycle of spring floods followed by summer water shortages. Agriculture dominates water use, yet outdated irrigation systems waste nearly half the supply (Eurasian Development Bank 2024).

Extreme heat is no longer a future threat. It is already disrupting water systems, harming health, and deepening inequality across Asia and the Pacific. Without integrated solutions, these intersecting risks will continue to strain water systems and widen gender inequality.

Women Bear the Brunt of the Water Crisis and Extreme Heat

Extreme heat and water stress affect everyone, but women in Asia and the Pacific face far greater risks due to unequal roles, responsibilities, and access to resources. As the primary managers of household water, food, and care, women bear the brunt of climate impacts (UN Women 2024). Longer dry seasons and rising temperatures increase the time needed to collect water, adding physical strain and reducing time for education, paid work, or rest (Carr et al., 2024). The burden is especially dangerous during heat waves, where dehydration and heat-related illness become life-threatening (WHO 2024). Pregnant women face an increased risk of miscarriage and stillbirth due to extreme heat, while elderly women often suffer from prolonged exposure during caregiving or cooking (World Bank 2023).

Many women work in informal sectors like agriculture and street vending, where exposure to heat is high and access to cooling is low (ADB 2024). These risks are amplified by poor sanitation, a lack of cooling infrastructure, and limited voice in decision-making (UNICEF and WHO 2023).

Heat and water stress also undermine women's safety and dignity. Where piped water is unavailable, women queue at distant taps or unsafe sources, often facing exploitative pricing or harassment (WaterAid 2016). In cities and villages alike, the lack of toilets forces women to ration food and water to avoid using the bathroom during the day. This leads to dehydration, urinary tract infections, and heat-related illnesses (Venugopal et al. 2016).

Water-related disasters like droughts and floods further increase gendered risks. Droughts extend the time and distance women must travel for water, heightening exposure to heat, injury, and violence (UN Women 2024). Floods, meanwhile, disrupt sanitation infrastructure, spread disease, and displace households, often forcing women and girls into unsafe shelters with poor hygiene and heightened risks of assault (UNICEF and WHO 2023). In both cases, women's unpaid care work expands significantly, while their access to income, education, and health care is reduced (FAO and AWP 2023). These shocks add to existing stressors and push many toward harmful coping strategies, such as early marriage or migration into hazardous urban environments (UN Women and IUCN 2022).

Table 26 shows the overlap between gendered impacts of heat stress and the AWDO KDs.

A group of women cleaning wheat grains(Photo by ADB).

Table 26. Gendered Impacts of Heat and Water Stress

AWDO Key Dimension	Impact Area	Why Extreme Heat Makes It Worse – and Why It is Gendered
Key Dimension 1 and Key Dimension 3	Health	Women face higher risks of heat-related illness due to caregiving roles, poor sanitation, and reproductive health vulnerabilities (e.g., increased miscarriage risk)
	Safety and Security	Heat and drought force longer water treks, increasing women's exposure to violence and harassment, especially in remote or unsafe areas
	Education	As water collection becomes harder, girls are more likely to drop out of school to support household needs – limiting long-term opportunities
Key Dimension 2	Labor	Informal, outdoor work sectors dominated by women (like agriculture and vending) are highly heat-exposed, with little access to cooling or health protections
	Livelihoods	Women's dependence on climate-sensitive jobs, wage gaps, and lack of land ownership mean income losses and food insecurity rise faster for them
Key Dimension 4	Empowerment	As ecosystems degrade, changes to environmental water security disproportionately affect women managing household water and food systems
Key Dimension 5	Disasters	Droughts expand unpaid care burdens and water tasks; floods destroy WASH systems and displace women into unsafe, unhygienic environments

WASH = water, sanitation, and hygiene.
Source: ADB.

Intersectional Vulnerabilities and Adaptive Capacity

Women's exposure to extreme heat and water insecurity is shaped by occupation, income, and geography. It varies widely based on their work, living conditions, and access to services. Many women in Asia and the Pacific take on high-risk roles in agriculture, street vending, and domestic work, jobs that are exposed to intense heat and often lack protective measures like rest breaks, shade, or access to clean water (UN Women 2024). These pressures are worse in water-scarce or arid areas, where collecting water, usually a woman's task, becomes more time-consuming and physically dangerous as temperatures rise.

Social and structural disadvantages increase women's vulnerability to heat stress. Gender roles and cultural norms limit their ability to protect themselves. In many places, women are discouraged or even prohibited from using public cooling shelters, especially at night. Pregnant women face higher risks of heat-related health issues. Poor menstrual hygiene during water shortages adds another layer of stress. Undernutrition and chronic illness, already more common among poor women, increase the likelihood of heat-related illness or death (WHO 2024).

Unpaid caregiving burdens limit women's ability to adapt to extreme heat. Women take care of children, older people, and the sick. During heat waves, this unpaid work expands as more people fall ill. If schools close because of extreme heat, women take on extra childcare duties. When men migrate for work, women are left to manage farms and households with little support. This phenomenon is sometimes called the feminization of agriculture. Without access to land, credit, or decision-making power, these added burdens push many deeper into poverty.

Women's ability to adapt to heat and water stress varies depending on their access to resources and support systems. Some can cope and recover from heat waves more easily than others. This depends on their income, health, education, social connections, and mobility. Table 27 shows how these factors influence a woman's ability to respond to climate stress.

Table 27. Determinants of Women's Adaptive Capacity to Heat and Water Stress

Factor	Higher Adaptive Capacity	Lower Adaptive Capacity
Economic Resources	Stable income allows investment in cooling, water, and health	Daily wage workers cannot afford to miss work or buy extra water
Social Support	Strong networks share resources and help with care duties	Isolated women (e.g. widows, migrants) have few support options
Education	Educated women access heat alerts and take protective actions	Low literacy delays recognition of heat stress and reduces preparedness
Geographic Location	Urban areas near services offer better access to cooling/shelter	Urban slums and remote villages lack safe water, health care, and emergency support
Age and Health	Young, healthy women may better manage heat stress	Older, pregnant, or chronically ill women face greater risks and fewer options
Cultural Norms	Empowered women negotiate rest or seek help when needed	Restrictive norms can trap women indoors without cooling, water, or social connection

Source: ADB.

Targeted responses are needed because women experience climate risks differently based on their circumstances. Some face overlapping disadvantages that reduce their ability to adapt to climate extremes. Others may have the resources and support to cope, but only if systems recognize and remove the barriers they face.

To reduce gendered climate impacts, policies must be designed with this diversity in mind. Rural agricultural laborers, slum-dwelling migrants, and informal workers will need different kinds of support. This includes social protection, safe water and sanitation, access to health care, and women's full inclusion in climate planning and decision-making. Without targeted interventions, climate extremes like heat waves and droughts will deepen existing inequalities.

Box 14.

Systemic Failures Leave Women Behind in A Heating World

Women face growing risks from extreme heat and water scarcity, but many of these risks are not simply natural, they are the result of systemic failures and policy blind spots. In many cases, governments and institutions are aware of the impacts but fail to act or direct support where it is needed most. The table below outlines the structural, institutional, and cultural barriers that prevent women from accessing climate resilience resources.

Area	Systemic Challenge	Gendered Impact
Public Systems	Chronic underinvestment and exclusion from formal institutions	Women rely on informal networks during disasters, with limited access to state support
Water Governance	Focus on infrastructure over access; weak community committees; lack of gender data	Women's needs ignored in water supply planning; limited decision-making power; inadequate data
Urban Infrastructure	Poor heat mitigation (few green spaces); unreliable energy; little intra-urban heat data	Women in informal settlements lack cooling options and face heightened exposure
Policy Gaps	Heat plans and water policies rarely address gender; informal workers not protected	Women's safety, health, and livelihoods are overlooked in official planning
Budgeting and Aid	Inadequate gender budgeting; resources bypass grassroots women's groups	Projects fail to fund women-led solutions or monitor gender impacts
Cultural Norms	Restrictions on women's mobility and public participation	Women cannot reach cooling shelters, water points, or aid due to social barriers
Public Infrastructure	Lack of shaded areas, sanitation, or safe water in public spaces	Women and girls face exposure, dehydration, and safety concerns during heat waves and droughts
Aid Distribution	Humanitarian aid often routed through male heads of household	Women excluded from emergency relief or adaptation resources
Tokenism in Climate Policy	Gender added late or ignored in project design and monitoring	Women's expertise is sidelined, and interventions lack long-term impact

Source: ADB.

Box 15.

Rural Household Water Security in Ghamroj Village – A Woman-Led Solution

In Ghamroj, a rural village in Haryana, a northern Indian state known for its blistering summers and chronic water shortages, access to safe water was once a daily struggle. Women, especially those from marginalized communities, bore the brunt of this crisis. They walked long distances in extreme heat to fetch water or depended on male relatives with motorcycles. Often, the water was unsafe, leading to skin rashes and infections.

Sadhna Rani, elected as the village Sarpanch (the local head of the village council or Gram Panchayat), had experienced these hardships herself. Determined to create change, she partnered with the Navjyoti India Foundation to address water insecurity through practical, gender-sensitive solutions. Her leadership helped install decentralized water purification systems, including ultrafiltration, UV treatment, and biosand filters. These were placed strategically to reduce travel distances and were maintained by trained local women, creating a sustainable and empowering system.

Recognizing inequities in water distribution, Sadhna also advocated for and secured a government-sanctioned pump booster. This intervention ensured more consistent water supply, especially during peak summer months, reducing household stress and illness.

Beyond infrastructure, Sadhna focused on inclusive governance. She revitalized the Mahila Panchayat, a forum for women to raise concerns about water and sanitation. She also strengthened the Village Water and Sanitation Committee, promoting collective planning and accountability. Her upcoming plans include restoring the village pond for groundwater recharge and flood protection, aligning with nature-based solutions and long-term resilience.

Sadhna's leadership shows how empowering women in governance can deliver transformative results in rural household water security. Her integrated approach, blending infrastructure, institutional reform, and inclusive participation, demonstrates how local solutions can build adaptive capacity in the face of extreme heat and water stress.

Source: ADB.

Members of Women's Self Help Group in India (Photo by ADB).

Results and Discussion: A Gendered Water Security Crisis Hidden in Plain Sight

This section has revealed that extreme heat and water insecurity are exposing deep, systemic gender inequalities that have long been left out of water security frameworks. While women and girls have always been central to water systems through their roles as users, managers, and stewards, their experiences remain poorly reflected in regional assessments and national responses. The AWDO provides a strong foundation for understanding water security, but this crisis shows why gender must be integrated more explicitly within each dimension of water security.

KD1: Rural Household Water Security – Exposure and burden are rising. Rural women are collecting water from increasingly distant or unsafe sources, especially during heat waves or droughts. This increases physical strain, heat related illness, and time poverty.

KD2: Economic Water Security – Women's livelihoods are collapsing under heat. Women dominate informal, outdoor sectors like farming, vending, and domestic work. These jobs are highly exposed to heat but offer little protection, no cooling, and few rights. Water insecurity also reduces agricultural productivity and increases food costs, affecting both income and household nutrition.

KD3: Urban Water Security – Urban infrastructure is not designed with women in mind. In cities, poor women in informal settlements often lack piped water and safe toilets. Water stress leads to long queues, unsafe collection points, and heightened exposure to violence. During urban heat waves, lack of cooling, combined with unreliable water access, undermines health and dignity.

KD4: Environmental Water Security – Women face the fallout of degraded systems. As heat and drought degrade water quality and ecosystems, women bear the brunt of coping. They manage household water even as springs dry up and fish stocks decline. These losses are not only environmental but deeply social.

KD5: Water-Related Disasters Security – Women are least protected, last supported. Floods and droughts displace families, destroy water infrastructure, and spread disease. Women and girls are often left behind in disaster response planning, facing unsafe shelters, poor hygiene, and heightened risks of assault. They also carry the burden of caregiving during recovery.

What is needed now is a phased, gender responsive response grounded in the AWDO framework:

Short-term (0–2 years): Prioritize immediate protections across all KDs. Deliver water, cooling, and sanitation services targeted to women's needs. Establish safe water points, women-only spaces in shelters, and distribute menstrual hygiene and health supplies during heat waves and droughts.

Medium-term (2–5 years): Strengthen systems that build women's adaptive capacity. Integrate gender into climate and water budgeting. Support women-led innovations in water technology and ensure women's participation in urban water governance. Improve data systems to track gendered impacts across all KDs.

Long-term (5+ years): Reform institutions to embed gender equity in all dimensions of water security. Advance land and water rights for women, invest in care infrastructure that frees time for engagement, and establish legal quotas or mandates to include women in water governance bodies. Direct financing to grassroots women's organizations must be built into all resilience planning.

Water security in a heating world will not be achieved without women's full inclusion. Every KD of water security intersects with gender. But unless systems recognize who bears the burden, who is excluded, and who is leading change on the ground, solutions will remain partial and inequitable. Women are already adapting, organizing, and innovating. It is time for policy to catch up.

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Water Governance for Enhanced Water Security in the Context of SDG 6

Summary

This chapter examines how water governance influences water security in Asia and the Pacific. It draws on data from the AWDO and SDG indicator 6.5.1 on Integrated Water Resources Management (IWRM). The analysis offers the first regional comparison between governance scores and AWDO's five KDs of water security, supported by detailed assessments in five countries: Bangladesh, Cambodia, Nepal, Pakistan, and Tajikistan.

Water governance and water security are strongly linked, but the relationship is not one-to-one. In many cases, governance reforms have led to improvements in water security, but not always immediately or consistently. Outcomes are shaped by a range of socioeconomic and environmental factors, and progress can vary between countries and subregions. This reinforces that water governance is an essential enabler, but not the only driver.

Financing and management instruments are among the strongest levers for improving water security. These tools, such as water allocation frameworks, basin management plans, tariff structures, and monitoring systems, show the closest correlation with water security scores among the four governance dimensions assessed under SDG 6.5.1. They determine how policies translate into action, with financing providing the resources to implement plans and management instruments guiding the efficient and equitable use of those resources. Despite their importance, these areas remain the least developed in many countries. Strengthening them can deliver rapid and cost-effective gains, particularly when supported by a strong enabling environment and well-coordinated institutions. The country assessments provide clear examples of how focusing on these areas can accelerate water security.

Urban and economic water security are most responsive to better governance. These dimensions often reflect centralized decisions and national investments, making them more immediately affected by governance changes. Rural and environmental water security may respond more slowly and require broader integration across sectors and governance levels. The analysis also shows that improved governance contributes to **stronger adaptive capacity, helping countries manage both rapid and slow-onset climate-related water risks.**

Political will is critical for achieving and sustaining progress. Where national leadership has prioritized water governance and invested in long-term reform, results have followed. Embedding governance targets in national water security strategies, climate plans, and development frameworks, such as ADB's country partnership strategies (CPSs), can align efforts and increase accountability.

All actors have a role in accelerating climate-resilient water governance. Development partners, governments, and the private sector should use water governance frameworks, such as SDG 6.5.1, to guide reforms, align investment, and reduce cross-sector trade-offs. Strengthened coordination through regional platforms can support knowledge-sharing, build political momentum, and help turn plans into lasting improvements for people and ecosystems.

Water governance and water security are strongly linked, but the relationship is not one-to-one.

Introduction

Effective water governance is essential for achieving water security (Sadoff et al. 2015). However, **governance alone is not enough.** Many other factors, such as population growth, urbanization, infrastructure, climate, and water availability, also influence outcomes. This chapter explores the relationship between water governance and water security, **recognizing that one does not always lead directly to the other.**

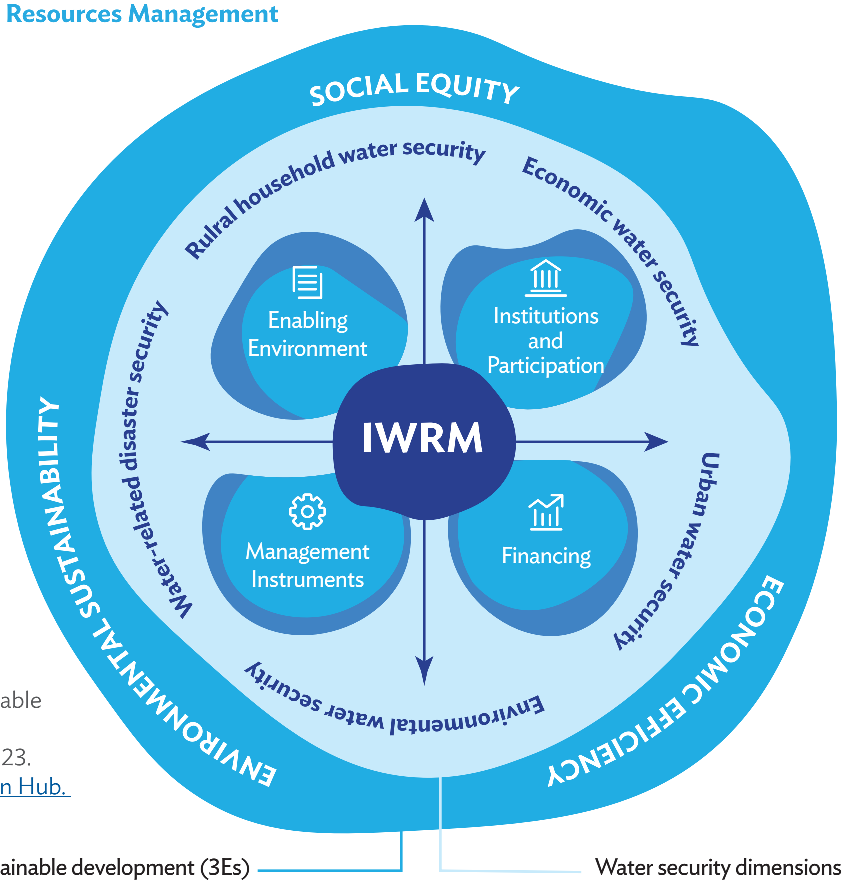
To study this relationship, we use two proxies. Water security is assessed using the five KDs from the AWDO, that has been applied consistently across four editions (2013, 2016, 2020, and 2025). Water governance is examined through SDG indicator 6.5.1, which is used as part of the SDG indicators to assess the degree of IWRM implementation. For this chapter, IWRM is used as a proxy for good water governance.

SDG 6 aims to ensure the availability and sustainable management of water and sanitation for all. Target 6.5 focuses specifically on IWRM and is measured through indicator 6.5.1. Countries report progress by completing a standardized survey with 33 questions across four dimensions (UN-Water 2025):

- **Enabling environment** – policies, laws, and plans to support IWRM
- **Institutions and participation** – roles and coordination of actors
- **Management instruments** – tools and frameworks for decision-making and management
- **Financing** – budget and financial planning for water management

These four dimensions form the basis of a governance framework that, when aligned with AWDO's five KDs, provides a five-by-four matrix. This matrix enables cross-comparison of governance and water security, **revealing which aspects of governance most strongly support improvements in each KD.** It also helps identify gaps and align future efforts. Figure 43 illustrates this conceptual framing.

Figure 43. Integrated Water Resources Management



IWRM = Integrated Water Resources Management.
Note: IWRM (the inner circle) as a means to achieve water security (the middle rim), and through it, contribute to sustainable development (the outer circle)
Source: Adapted from GWP. 2023. [IWRM Explained | IWRM Action Hub.]

While global and regional progress on SDG 6.5.1 has been steady, it is not fast enough. **In Asia and the Pacific, the average implementation level rose from 46% in 2017 to 57% in 2023.** At current rates, the 2030 target would not be met until 2049 (UNEP 2024). Subregions like South and Southeast Asia have made faster gains, offering lessons for others.

This chapter presents the first regional analysis comparing AWDO water security data with SDG 6.5.1 governance results. It also draws on country assessments from Bangladesh, Cambodia, Nepal, Pakistan, and Tajikistan. Together, these findings aim to identify actionable governance reforms that can accelerate water security across Asia and the Pacific.

Methodology

This chapter draws on a **mixed-methods approach,** combining quantitative analysis with qualitative insights. Neither data type alone would have provided a complete picture. **Quantitative results without context** risk misleading conclusions. Likewise, **qualitative interpretation without data** may lack rigor. The analysis aimed to balance both, allowing for a more grounded understanding of how water governance and water security interact.

Quantitative analysis relied on SDG 6.5.1 data from 2017, 2020, and 2023, and AWDO data from 2013, 2016, 2020, and 2025. **Indicator and sub-indicator scores** for both were examined at national, regional, and subregional levels. To reflect population differences, **regional and subregional averages were weighted** accordingly. **Correlation analysis** between the five AWDO KDs and the four components of IWRM was conducted using RStudio[8]. This analysis identified patterns and relationships at both Asia and the Pacific and subregional levels, highlighting which governance elements were most closely associated with water security outcomes.

To explore potential causal relationships, **a generalized linear model** was developed to predict AWDO 2025 scores. Explanatory variables included SDG 6.5.1 scores, population, education, irrigated land, urbanization, per capita renewable water availability, Human Development Index, and Gini Index. All statistical analyses were conducted using **R (Stats package, version 3.6.2).**

Qualitative data came from five country case studies in AWDO 2025: Bangladesh, Cambodia, Nepal, Pakistan, and Tajikistan. These included consultations and feedback with ADB resident missions and regional experts. National policy documents, IWRM Action Plans, NDCs, SDG 6 acceleration case studies, and **stakeholder reports** enriched the analysis. **Free-text responses** from the SDG 6.5.1 survey provided additional context and insight.

While SDG 6.5.1 is based on a self-evaluation survey, which introduces some subjectivity, the indicator methodology and stakeholder consultations are designed to deliver robust reporting at national, subregional, and regional levels. In the five country case studies, broad stakeholder consultations were conducted at least twice, which helped improve accuracy and shared understanding. These consultations were facilitated through the SDG 6 IWRM Support Programme and are recommended for all countries to enhance the reliability of reported data.

Finally, the analysis considered **both geographical and temporal trends.** Progress was reviewed across six ADB subregions: Central and West Asia, East Asia, South Asia, Southeast Asia, the Pacific, and Advanced Economies. The study also examined how water governance reforms aligned with improvements in water security across different time periods, helping to identify when such changes begin to show impact.

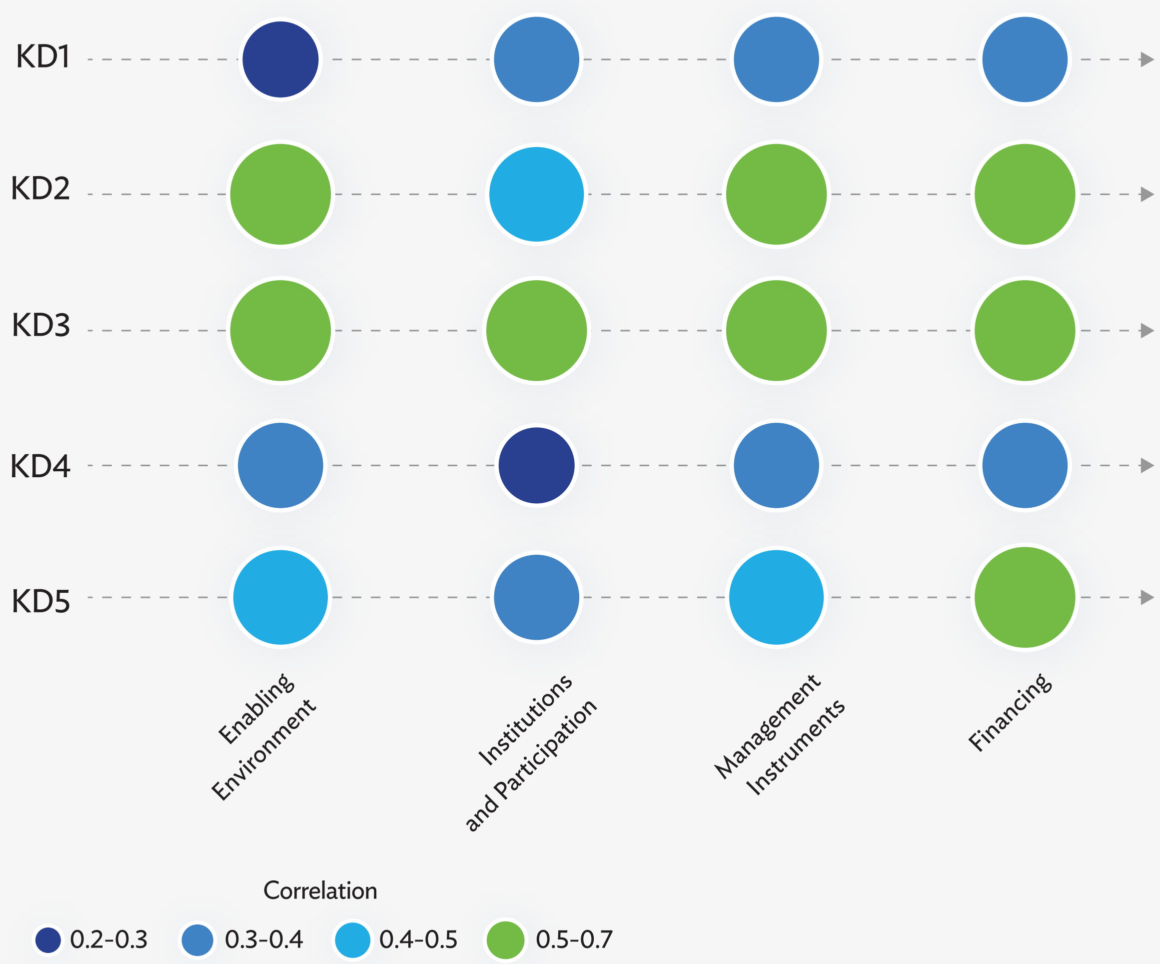
8. RStudio is an integrated development environment (IDE) used for coding and data analysis in R.

Results and Discussion

A positive relationship between water governance and water security is evident across the Asia and Pacific region. The regional analysis highlights a strong correlation between improved IWRM implementation (SDG 6.5.1) and enhanced performance across AWDO's five KDs (Figure 44). **KD2 (economic water security)** and **KD3 (urban water security)** show the highest correlations with water governance (Figure 45).

For KD2, better governance helps reduce trade-offs between competing uses of water. Growing urbanization and water demand across the region place pressure on resources for consumption, food, energy, and ecosystems. The data suggest that stronger management instruments and legal frameworks can coordinate these demands more effectively.

Figure 44. Correlation Analysis Between Integrated Water Resources Management Dimensions and Asian Water Development Outlook KDs

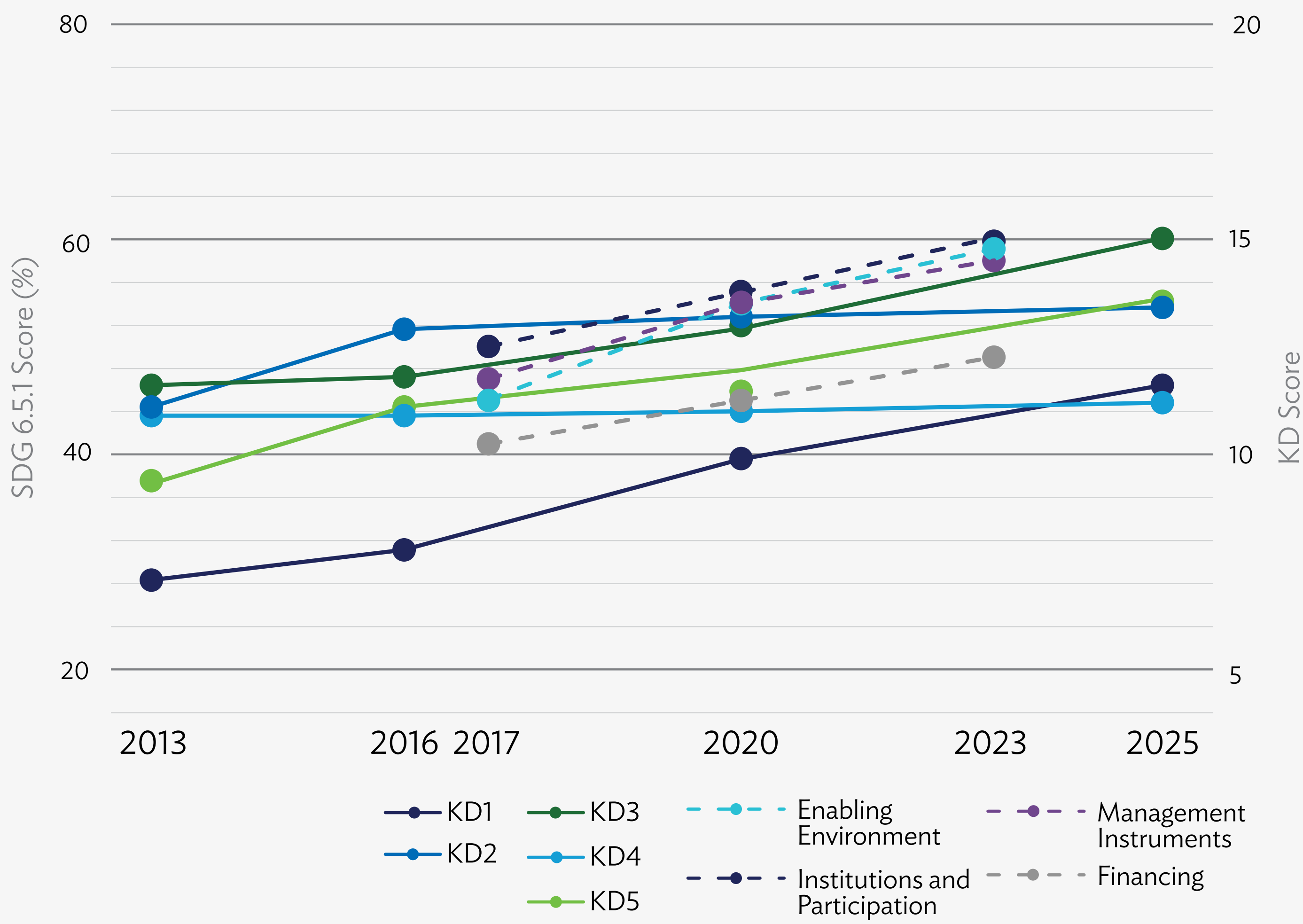


KD = Key Dimension, KD1 = rural households and water security,
KD2 = economic water security, KD3 = urban water security, KD4 = environmental water security,
KD5 = water-related disaster security, SDG = Sustainable Development Goal.
Source: ADB.

For example, Bangladesh illustrates how strengthening management instruments and financing can drive progress. In recent years, the government has improved its national water strategies and basin management frameworks, which has provided a clearer basis for coordinated action across sectors. At the same time, sustained public investment and strong donor support have expanded access to water supply and sanitation, while also enabling rehabilitation of critical infrastructure. Together, these improvements have not only advanced water security but also helped Bangladesh build greater resilience to climate shocks such as flooding and cyclones.

In urban water security (KD3), where infrastructure and institutional presence are often stronger, governance reforms, such as new financing schemes or legal tools, tend to show more immediate results. In contrast, rural household water security (KD1) may respond more slowly due to capacity gaps in implementation. KD4 (environmental water security) also correlates positively with governance improvements, especially when IWRM emphasizes integrated resource management. Yet other drivers, like land-use change or energy policy, remain influential.

Figure 45. Relationship Between Water Security (Asian Water Development Outlook) and Water Governance (SDG 6.5.1) (2013–2025)



AWDO = Asian Water Development Outlook, KD = Key Dimension, SDG = Sustainable Development Goal.
Source: ADB.

Financing remains the weakest-performing dimension across the region and globally. Expanding public budget allocations, aligning development partner funding with national strategies like ADB's CPSs, and leveraging private finance through risk-sharing can help scale progress. The five country assessments identify potential CPS entry points that can connect governance improvements to long-term water security gains.

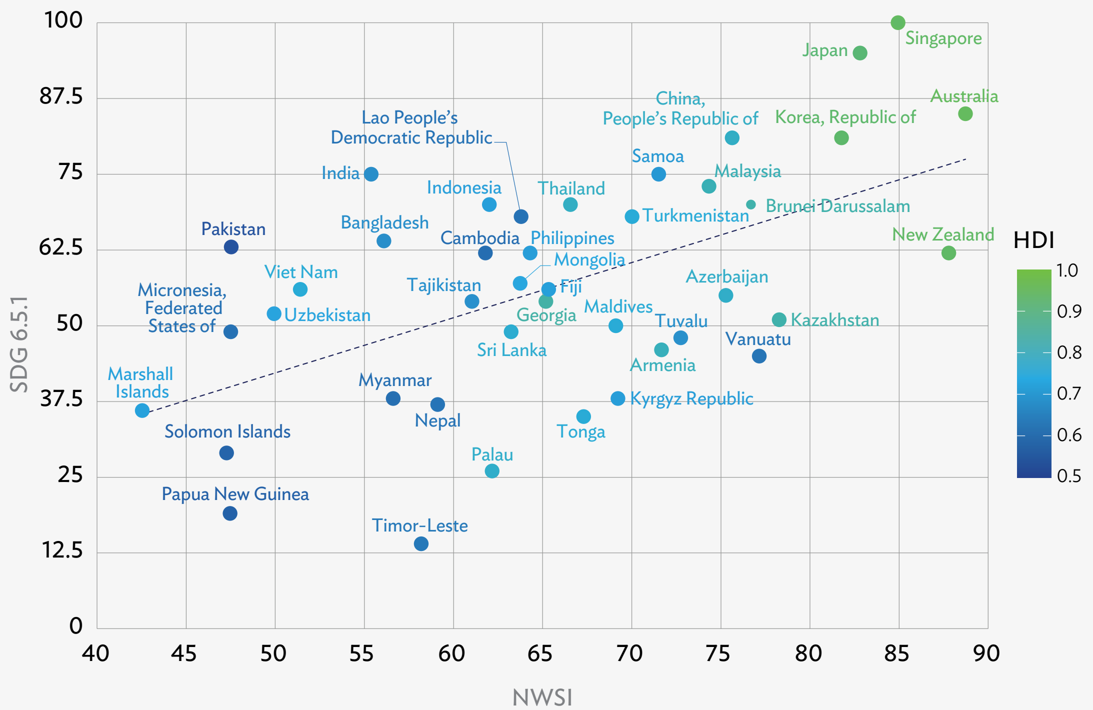
Among the governance dimensions, **financing and management instruments** show the strongest links with water security outcomes. These results suggest that **future investments in water governance should prioritize these two areas.** While enabling environments and institutions are more developed, they still require ongoing support.

Improved water governance also builds adaptive capacity. Climate extremes, such as heat causing glacier melt in Tajikistan, floods in Pakistan, and droughts in Nepal, have recently undermined water security gains. Correlation analysis of **KD5 (water-related disaster security)** shows that governance is more strongly linked to resilience when hazard exposure is removed from the KD5 calculation. This suggests that while hazard exposure is fixed, governance can shape a country's ability to manage and adapt to risk (Pahl-Wostl 2014).

A generalized linear model was also applied to examine how other development factors influence water security. The analysis found that both **Human Development Index (HDI)** and **IWRM implementation** were significantly associated with better water security outcomes. This relationship held even after accounting for income, population growth, and education. In several cases, countries with similar economic and demographic profiles showed different results based on their governance practices.

Figure 46 illustrates that **higher HDI generally aligns with stronger water governance and water security,** though exceptions exist. For example, Palau has high water security and HDI, but lower governance scores, while Pakistan has relatively strong governance but low HDI and water security. These mismatches suggest either a time lag between governance reforms and outcomes or possible data discrepancies.

Figure 46. Relationship Between Water Security, Water Governance, and the Human Development Index



HDI = Human Development Index, IWRM = Integrated Water Resources Management, SDG = Sustainable Development Goal.
Source: ADB.

At the subregional level, the contrasting cases of Southeast Asia and South Asia reveal important insights. In Southeast Asia, **water governance improved significantly,** with SDG 6.5.1 scores rising from 46% in 2017 to 62% in 2023. Over a similar period, **water security scores across all five Key Dimensions also increased,** but the gains were modest and inconsistent. **Progress varied across dimensions and years,** and was not always sustained. This nonlinear pattern suggests that improvements in governance may take time to translate into measurable outcomes for water security, and that other drivers, such as infrastructure, investment, and socio-political factors, can shape these outcomes independently.

There is not a 1:1 relationship between water governance and water security. Even where governance improves, the effects on water security may lag, fluctuate, or be overridden by external shocks such as droughts or floods. This is particularly evident in Southeast Asia, where despite strong gains in governance, overall water security improvements were limited.

South Asia presents a different pattern. **Governance scores increased from 37% in 2017 to 56% in 2023,** and this was accompanied by **significant gains in water security scores across multiple dimensions.** This suggests a closer alignment between governance reforms and sector outcomes in this subregion. It may also reflect more favorable enabling conditions, such as stronger institutions, targeted investments, or higher political priority for water sector reform.

These contrasting examples reinforce that water governance matters, but its impact is neither immediate nor automatic. **The effects of governance reforms depend on timing, context, and the presence of complementary factors.** Experience across Asia and the Pacific shows that strengthening governance is essential for achieving water security, but it must be supported by parallel efforts in infrastructure, and enhanced and coordinated political will and investment from the highest level.

Details from the Country Assessments

Bangladesh has strengthened its economic water security (KD2) through long-term planning and targeted investments. The Delta Plan 2100 and Barind Multipurpose Development Authority programs have modernized irrigation systems, promoted climate-smart groundwater use, and enhanced cross-sectoral coordination. **These efforts were supported by policy-guided investment strategies** and public–private partnerships, particularly in drought-prone regions, helping to improve both management instruments and financing dimensions of water governance.

Cambodia has made significant gains in urban water security (KD3) through expanded service coverage. The Phnom Penh Water Supply Authority has implemented a financial bundling mechanism, using **revenue from central, wealthier neighborhoods to subsidize service provision in poorer areas.** This approach has improved access and equity.

Nepal has increased political momentum for water sector reform through multi-stakeholder processes. The 2022 IWRM Action Plan and the 2024 Response Strategy for Water Resources Management (WECS 2024) laid the groundwork for a new Water Resources Bill. Once passed, the bill is expected to benefit all five KDs by strengthening legal and institutional frameworks for integrated water governance.

Pakistan has improved rural household water security (KD1) through enhanced monitoring and use of data. A rural water quality monitoring program has generated detailed assessments of drinking water in both rural and urban areas. These findings have informed policy decisions and system upgrades, particularly in sanitation and hygiene, contributing to progress under the health-related sub-indicators of KD1.

Tajikistan has advanced its water-related disaster security (KD5) by investing in early-warning systems and risk preparedness. The implementation of the "Early Warnings for All" initiative and a national road map for Multi-Hazard Early-Warning Systems has strengthened the enabling environment for disaster risk reduction. However, cross-sectoral enforcement and institutional coordination remain critical areas for continued improvement.

These country examples illustrate that targeted governance reforms, especially when **supported by strong political will**, can accelerate progress across different aspects of water security. They also highlight the potential for subregional cooperation to foster shared learning and scale up investment.

Conclusion

The analysis confirms a **positive link between water governance and water security** across Asia and the Pacific. **However, this relationship is not 1:1.** While countries with stronger governance generally show higher water security, many other factors, such as infrastructure, climate, and economic capacity, also influence outcomes. In some subregions, like South Asia, gains in governance are aligned with significant improvements in water security. In others, such as Southeast Asia, progress was more uneven and nonlinear.

Institutions and finance are key areas for strengthening. Among the four governance components assessed through SDG 6.5.1, financing and management instruments are most strongly associated with gains in water security. By contrast, enabling environments and institutional participation are more advanced, but still require continued support to ensure coherence and capacity at all levels.

Improved governance can also **enhance countries' adaptive capacity to climate-related water risks.** The analysis shows that stronger institutions, planning systems, and financing structures help countries respond more effectively to both floods and droughts. Adaptive governance supports better long-term management of the changing hydrological cycle, making water systems more resilient.

Political will is a critical driver of progress. Countries that demonstrated leadership, backed by sustained investments and reform momentum, made greater gains. Political will must be mobilized and maintained, not just through high-level declarations, but through integration into national strategies, legislation, and financing frameworks. The country assessments, in particular Nepal, support this point.

To advance this work, countries should be supported to **set national targets aligned with both AWDO and SDG 6.5.1.** These targets can help translate governance frameworks into clear priorities across sectors and at the local level. Embedding such targets in national water security strategies, ADB's CPSs, and sustainable development plans will ensure better alignment of policies, budgets, and accountability mechanisms.

Governance frameworks, such as SDG 6.5.1, offer **valuable tools for aligning investment and planning.** Using them to shape national water security goals allows for more targeted financing, avoids sectoral trade-offs, and unlocks co-benefits across climate, agriculture, energy, and health.

To accelerate progress, **stronger regional coordination is needed**. Platforms like the Asia-Pacific Water Summit, ASEAN, and Central Asia Regional Economic Cooperation offer opportunities for joint learning, investment, and reform. These efforts would benefit from more deliberate alignment.

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Construction worker plows through the drainage construction under the Urban Services Improvement Investment Program in Kutaisi, Georgia (Photo by ADB).

4

COUNTRY AND REGIONAL ASSESSMENTS

Introduction and Methodology

Water security is central to sustainable development. It supports public health, protects ecosystems, strengthens livelihoods, and underpins economic growth. Although Earth has abundant water, it is not always available where or when it is needed. Natural systems, infrastructure, and governance all influence how water is accessed and managed. As demand rises, ensuring reliable water supply becomes more complex.

Water also plays a critical role in global development goals. While SDG 6 focuses directly on water and sanitation, nearly every SDG depends on safe, sufficient, and well-managed water. Within SDG 6, indicator 6.5.1 tracks how well countries implement IWRM. This is widely used as a measure of water governance capacity.

This assessment explores the link between governance and water security. Five countries Bangladesh, Cambodia, Nepal, Pakistan, and Tajikistan, were examined using AWDO's water security scores and SDG 6.5.1 data. These scores helped identify how governance practices align with water security outcomes across the AWDO framework.

These assessments were designed as a pilot using a light-touch approach. Each review focused on existing data and networks, while beginning to build a clearer picture of each country's water security status and the pressures that shaped it. Future assessments may build on this foundation. Over time, this approach could become a valuable tool to support country-level planning and decision-making.

This chapter includes a regional assessment of the Pacific. From the outset, it was clear that the Pacific context is distinct from the rest of Asia, requiring a different approach to water security assessment. The Pacific study, therefore, explores how an AWDO-style assessment could be applied in the region as a first step toward future country-level assessments. As a result, this chapter differs from the standard country assessments, with its own methods and objectives described in detail within the chapter.

Objectives of Country Assessments

The country assessments were developed with four main objectives:

Methodology of Country Assessments

The Global Water Partnership (GWP) led the assessments, supported by national experts and UNEP-DHI. GWP's global SDG team coordinated the process, drawing on its regional and national networks. Technical guidance and quality assurance were provided by UNEP-DHI throughout.

A consistent methodology was applied in all five countries, involving the following steps (Figure 47):

1 Review of AWDO's Methodology

Experts reviewed how AWDO calculates each of its five Key Dimensions. This included examining data sources, assumptions, and scoring methods to ensure consistency and understanding.

2 Country-Level Analysis of KD Data

Experts analyzed KD and indicator scores for their country. A project data analyst supported this process to validate trends and identify key patterns.

Figure 47. Overview of Country Assessment Method
AWDO = Asian Water Development Outlook, CPS = country partnership strategy, IWRM = Integrated Water Resources Management, KD = Key Dimension. Source: ADB.

To build a clear and up-to-date picture of each country's water security status using the AWDO KDs.

To assess how progress on IWRM, measured by SDG indicator 6.5.1, aligns with improvements in water security.

To contextualize these results with national policies, programs, political changes, and recent events.

To produce practical, evidence-based reports that outline key findings, challenges, and opportunities.

3 Analysis of IWRM Implementation (SDG 6.5.1)

Experts reviewed the 2017, 2020, and 2023 IWRM reports. They examined detailed scores across IWRM components and questions, supplemented by relevant national plans, policies, and stakeholder consultation reports.

4 Country Assessment Grid

Each expert completed a standardized assessment grid that linked AWDO scores to IWRM performance.

- Pressure sections identified key drivers of water stress such as population growth, infrastructure gaps, and climate impacts.
- State sections described the current condition of water systems and their impact on people and ecosystems.

For each IWRM and KD intersection, experts summarized:

- Progress and achievements
- Key barriers or bottlenecks
- Strategic opportunities to strengthen water governance and security

5 Review of ADB CPSs

Experts assessed their country's CPS and engaged with ADB staff to identify ways AWDO findings could inform future CPS development.

6 Stakeholder Consultations

Targeted interviews were held with government officials, GWP partners, and others. While AWDO scores were not shared directly, these discussions explored recent changes in governance and institutional frameworks.

7 Development of Initial Findings:

Experts first prepared PowerPoint presentations using a shared template. These presentations outlined key findings and recommendations, which were presented and refined at the 2025 ADB Water and Urban Development Forum in Manila.

8 Report Drafting

Country experts then drafted the full reports using a common format. Reports blended data analysis with case examples and qualitative insights, highlighting the relationship between governance and outcomes.

9 Final Review and Submission:

Each report was shared with both the central AWDO coordination team and ADB resident missions. Feedback from these teams helped shape the final versions, which are presented in the following sections.

Bangladesh Country Assessment

Summary

Bangladesh's water security assessment provides an overview of progress between 2013 and 2025, alongside water governance performance from 2017 to 2023. It draws on the AWDO framework and SDG indicator 6.5.1 to explore the relationship between governance and water outcomes.

The findings show that while policy frameworks have expanded and some sectoral gains have been achieved, progress remains uneven. Institutional fragmentation, weak financing, and rising climate pressures continue to limit broader water security outcomes.

Rural household water security remains a concern. National programs have improved service access and sanitation, but arsenic contamination, drought, and groundwater overuse still threaten large parts of the country. Local institutions face challenges in service delivery, and coordination between agencies remains limited. Rural water governance lacks the capacity to fully address these overlapping risks.

Economic water security has benefited from new planning frameworks and institutional investments, particularly in agriculture. However, water remains poorly allocated between sectors. The absence of permits, pricing mechanisms, and cross-sectoral water accounting limits both productivity and sustainability. Institutional reforms have begun, but governance tools are not yet fully embedded in practice.

While policy frameworks have expanded and some sectoral **gains** have been achieved, progress remains **uneven**.

People riding a boat to cross a river in Bangladesh (Photo by ADB).

Urban areas continue to experience fragmented water and sanitation services. While infrastructure has expanded in some cities, informal and peri-urban settlements are often left behind. High nonrevenue water, poor wastewater management, and exposure to floods and salinity are persistent challenges. Urban planning has yet to fully integrate water resilience or equitable service delivery.

Environmental water security remains weak. Pollution, declining flows, and wetland degradation are ongoing problems. Institutional mechanisms exist to support ecosystem protection, but they lack funding, real-time data, and enforcement power. Ecosystem needs are not well integrated into basin planning processes.

Water-related disaster resilience shows partial progress. Infrastructure like cyclone shelters and embankments is widespread, but nonstructural tools such as early-warning systems, drought response, and forecast-based financing remain underused.

Across all areas, weak coordination, limited local capacity, and fragmented financing hinder progress. Strengthening cross-sectoral planning, protecting ecosystems, investing in inclusive services, and integrating climate risks into national frameworks are essential steps toward climate-resilient water governance.

Review of Bangladesh's Water Security Score

Rural household water security (KD1) remains a pressing concern with poor water quality widespread throughout the country. Arsenic contamination, seasonal drought, and unsustainable groundwater use affect large areas, particularly the Barind Tract and coastal districts. Over 22 million people still rely on arsenic-contaminated water sources, while changes in rainfall patterns driven by climate change and salinity in coastal areas increase water stress (DPHE 2022; SDG 6.5.1 2023). Limited investment in hygiene at the household level amplifies risks for rural communities.

Between 2013 and 2025, Bangladesh's KD1 score rose from 7.3 to 9.4, moving from the lower to the higher end of *Capable*. The improvement reflects progress under national strategies such as the 2014 National Strategy for Water Supply and Sanitation, and projects led by the Department of Public Health Engineering (DPHE 2022). However, results have been incremental due to gaps in interagency coordination (both vertically and horizontally), fragmented mandates, and limited focus on the most vulnerable areas. The "access to water" indicator remained consistently high, scoring 4 out of 5, while sanitation and hygiene indicators scored between 2 and 3 out of 5, showing slower gains.

Economic water security (KD2) faces growing stress. Competing demands from agriculture, industry, and energy sectors are increasing, while water allocation remains inefficient and poorly regulated. Agricultural production is threatened by saltwater intrusion, declining groundwater levels, and erratic monsoon patterns, particularly in the southwest and northwest (Barind) regions (GED 2018; MOI 2022). Industrial demand is growing rapidly, especially in economic zones and export-oriented sectors like textiles, but regulation is weak.

The KD2 score rose from 10.2 in 2013 to 13.0 in 2025, reflecting improvements in policy and institutional reform. The Bangladesh Delta Plan 2100, the 2022 National Industrial Policy, and the growing role of agencies such as Barind Multipurpose Development Authority (BMDA) all contributed to this progress (GED 2018; MOI 2022). Agriculture and energy indicators reached 4 and 3.3 out of 5 respectively, while industry and broad economy lagged at 3.0 and 2.7 respectively. Bangladesh is also a major exporter of virtual water, especially through rice and textiles. Applying the Fair Water Footprint framework may help align water use with sustainability. However, further gains are limited by the lack of national water permits, tariff systems, and cross-sectoral accounting tools (SDG 6.5.1 2023).

Urban water security (KD3) is under rising pressure. Rapid urbanization, climate shocks, and deteriorating infrastructure affect water supply and sanitation in major cities like Chattogram, Dhaka, and Khulna. Low sanitation coverage, and poor wastewater treatment are common. Informal settlements are especially vulnerable, often lacking connections to public systems and facing service disruptions and poor quality water (DWASA 2022; ADB 2020). Urban flooding and salinity intrusion are also increasing due to climate change and poor drainage.

Bangladesh's KD3 score increased slightly from 9.2 in 2013 to 10.8 in 2025. This reflects limited success from specific interventions such as the Khulna Water Supply Project and modernization by DWASA (DWASA 2022). Despite some progress, most utilities still operate below cost-recovery levels and lack performance monitoring systems.

Environmental water security (KD4) has been stable. Pollution, flow regulation, and land-use change are degrading key river and wetland systems. Major rivers like the Buriganga, Karnaphuli, and Turag remain heavily polluted due to untreated domestic and industrial wastewater. Wetland degradation and rising salinity are harming biodiversity in ecosystems such as the Sundarbans and Haor wetlands (NRCC 2021; MOEFCC 2009). River flows are further reduced by upstream diversions from the Teesta and Ganges.

The KD4 score remained at 11.4 from 2013 to 2025. Institutional arrangements such as the NRCC and the Haor Master Plan are in place, but financing is weak, environmental data is limited, and enforcement of environmental flows is minimal (GED 2018; SDG 6.5.1 2023).

Water-related disaster security (KD5) remains a national priority. Bangladesh experiences frequent floods, cyclones, droughts, and riverbank erosion. While structural investments such as embankments and cyclone shelters have improved resilience, nonstructural measures like early-warning systems, forecast-based financing, and risk-informed planning remain limited (MODMR 2021; ADB 2020). New challenges include more frequent heat waves, urban waterlogging, and flash floods.

KD5 scores rose from 9.4 in 2013 to 10.0 in 2016 and gradually improved to 11.5 by 2025 despite the significant impacts of flash floods, cyclones, and droughts in the northwest. Since 2013, the capacity to manage water-related disasters has more than doubled. National planning frameworks have since improved, including the Standing Orders on Disaster (2019) and the integration of disaster planning in the Delta Plan 2100 (GED 2018; MODMR 2021). The flood indicator remains the lowest at around 1 out of 5, while drought indicators score closer to 4.5. Storm-related indicators vary, depending on infrastructure and preparedness. Integration of slow-onset hazards such as drought and salinity into water planning is still lacking.

Marma women returning home from the village market (Photo by ADB).

State of Bangladesh's Water Governance (SDG indicator 6.5.1)

Between 2017 and 2023, Bangladesh made gradual progress in implementing IWRM, as reflected in its SDG 6.5.1 scores (Figure 48). In 2023, scores were 67% for management instruments, 66% for enabling environment, and 67% for institutions and participation. Finance remained the lowest performing area at 57% (SDG 6.5.1, 2023). The data shows gains in planning tools and monitoring, but ongoing gaps in legal enforcement, institutional coordination, and funding (ADB 2020; SDG 6.5.1 2023).

The enabling environment is built on a sound legal and policy foundation. The Water Act 2013 and the Delta Plan 2100 set a framework for integrated water planning (Government of Bangladesh 2013; GED 2018). Additional policies in sanitation, industry, and disaster risk reduction have strengthened the sector (MOLGRD&C 2020; MOI 2022, MODMR 2021). However, enforcement on recent water-related policies is weak and laws remain poorly aligned. Local authorities lack clarity in their roles and operate with minimal oversight or legal authority (SDG 6.5.1 2023).

Institutional arrangements involve multiple ministries, including the Ministry of Water Resources (MOWR), the Ministry of Local Government, Rural Development and Co-operatives (MOLGRD&C), and the Ministry of Environment, Forest and Climate Change (MOEFCC). Yet, coordination is limited and mechanisms for stakeholder engagement are underdeveloped. Local government institutions and community-based organizations often have little influence, especially in rural areas (SDG 6.5.1 2023). Capacity constraints and the lack of vertical links between national and local institutions are major issues (ADB 2020).

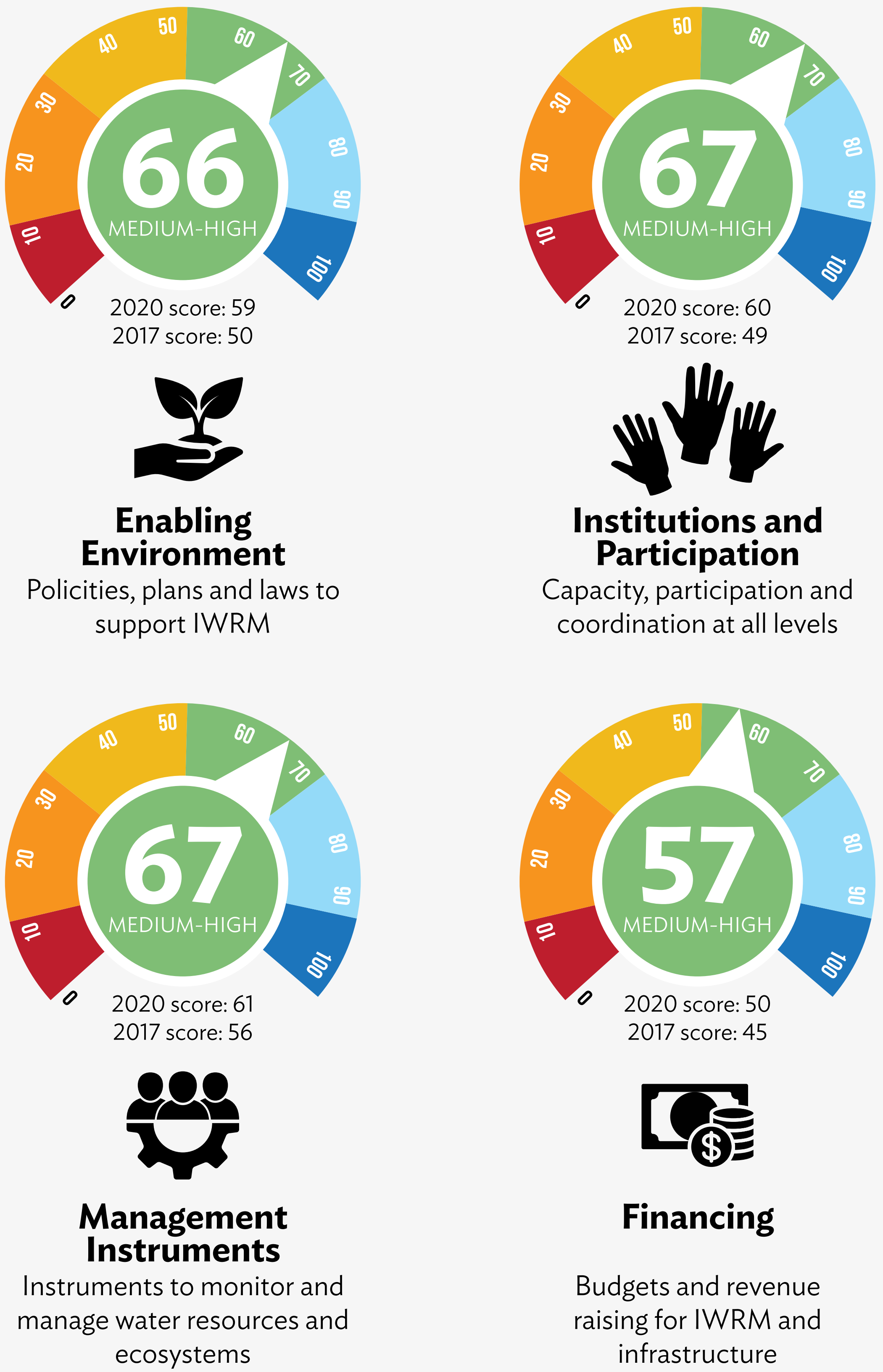
Management instruments have advanced the most. Bangladesh has improved hydrological assessments, water quality monitoring, and disaster risk data (BWDB 2021; MODMR 2021). But gaps remain in real-time data, adaptive management, and cross-sectoral planning. Tools like drought modeling and climate projections exist but are underused (MOEFCC 2009; ADB 2020).

Financing remains a critical constraint. Most infrastructure projects depend on donor support. Domestic financing is low, and economic instruments such as permits and eco-tariffs are not in use (SDG 6.5.1 2023). Opportunities for green finance, public–private partnerships, and fiscal decentralization remain largely untapped (MOLGRD&C 2020).

In summary, Bangladesh has established a robust IWRM framework, but gaps in coordination, enforcement, finance, and local capacity continue to limit implementation.

A tube well installed in a small island in the Karnaphuli River during the first phase of Chittagong Hill Tracts Rural Development Project by ADB (Photo by ADB).

Figure 48. SDG Indicator 6.5.1 and Sub-Components for Bangladesh (2023)



IWRM = Integrated Water Resources Management, SDG = Sustainable Development Goal.
Source: SDG 6.5.1; 2023.

Relationship Between Bangladesh's Water Security and Water Governance

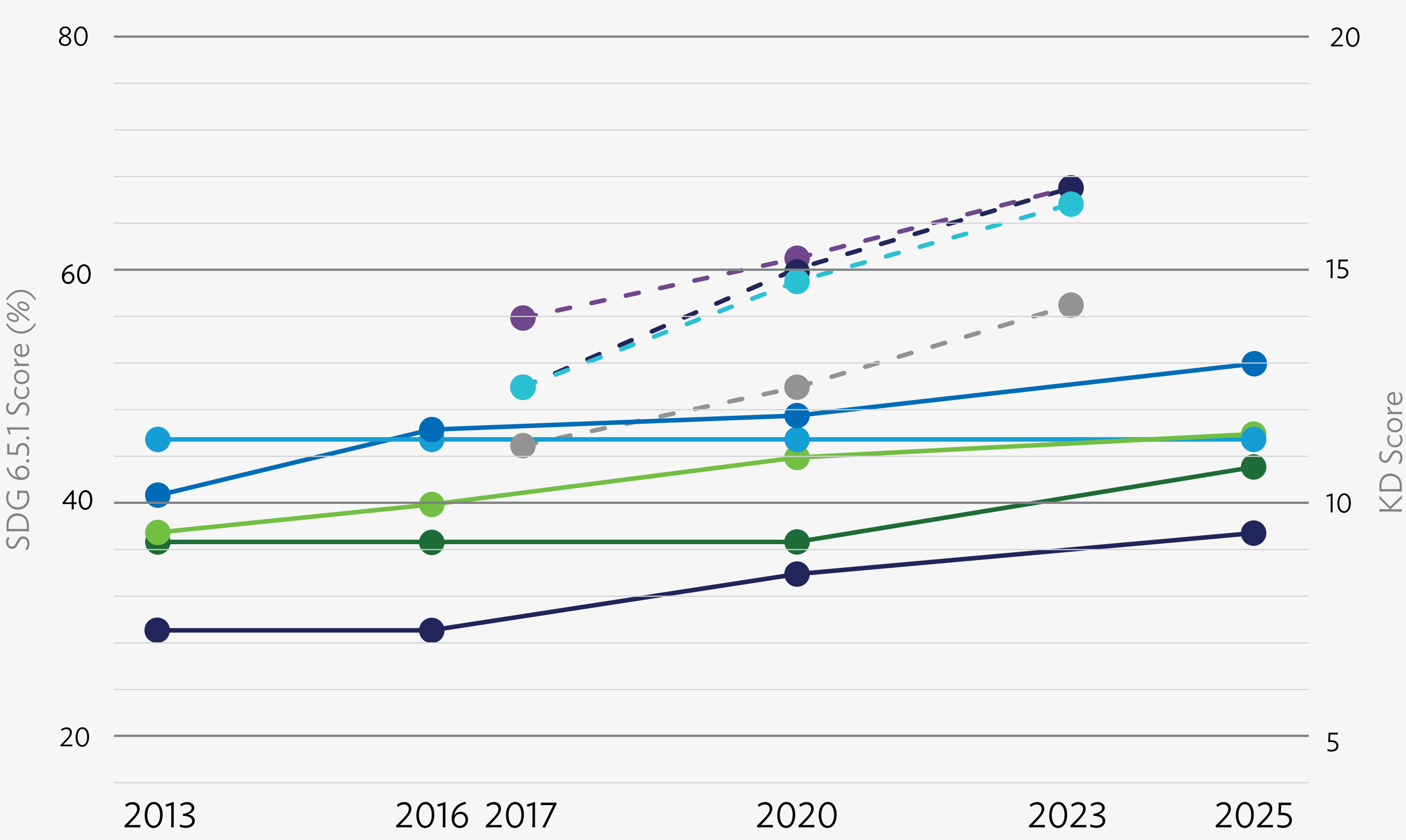
Bangladesh's water security trajectory between 2013 and 2025 aligns with gradual improvements in IWRM (Figure 49). Policy instruments such as the Water Act and the Delta Plan have helped shape national responses, but implementation remains uneven across the five KDs (ADB 2020; SDG 6.5.1 2023). Areas with stronger planning tools show more progress, while dimensions with weak institutional coordination and financial constraints continue to lag (UN-Water 2021).

KD1 improvements reflect targeted service delivery projects. However, weak local governance, limited decentralization, and low community engagement restrict broader adoption of IWRM principles (DPHE 2022; MOLGRD&C 2020). There remains a mismatch between national planning and local capacity.

KD2 gains align with better planning instruments and institutional leadership from agencies like BMDA (GED 2018). However, the lack of economic governance tools such as permits and water pricing systems continues to constrain efficient water use (SDG 6.5.1 2023). Progress remains fragile without structural reforms.

KD3 improved modestly, with further progress limited due to poor integration of IWRM into urban governance. Utilities face technical and financial challenges. Although some IWRM tools, such as urban resilience strategies and climate-adaptive infrastructure plans, have been introduced, their integration into city-level policy remains partial. Weak collaboration between utilities, city planners, and ministries has contributed to poor sanitation and weak resilience planning (DWASA 2022; ADB 2020).

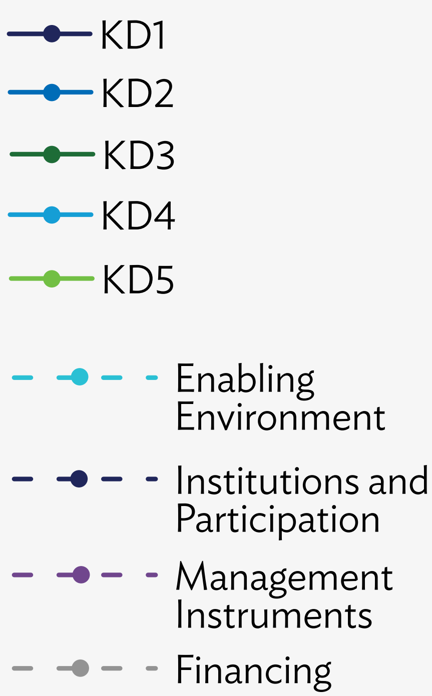
Figure 49. Status of Water Governance vs. Water Security in Bangladesh



KD4 stagnation is tied to weak integration of ecosystem needs. Data gaps, poor interagency coordination, and limited use of green infrastructure prevent progress (MOEFCC 2009; NRCC 2021). Environmental flows are not legally protected or enforced.

KD5 shows some gains, but risk planning is still dominated by infrastructure. Early-warning systems, climate finance, and slow-onset hazards remain under-addressed. Vertical coordination is poor, and data sharing is limited between agencies like the Bangladesh Water Development Board (BWDB), BMDA, and local governments (MODMR 2021; SDG 6.5.1 2023).

> Overall, selective progress in water security reflects partial success in IWRM. Embedding IWRM principles across governance levels and sectors is essential to sustain national water security.



KD = Key Dimension.
Source: SDG 6.5.1 and AWDO 2025 data.

Findings and Recommendations

Institutional coordination remains the central weakness in Bangladesh's water security. National frameworks such as the Bangladesh Delta Plan 2100 and the 2013 National Water Act provide a strong foundation, yet responsibilities remain fragmented across ministries and agencies. This separation slows implementation and prevents effective cross-sectoral planning. Strengthening coordination mechanisms at both national and basin levels would help align water, environment, disaster management, and urban development strategies. Anchoring these platforms within the Delta Plan and scaling up initiatives such as ADB's Haor Flood Management and Livelihood Improvement Project could build momentum for IWRM.

Environmental water security continues to deteriorate. Ecologically critical zones such as the Sundarbans and Haor wetlands face pressures from reduced flows, land-use change, and pollution. Legal mechanisms to protect minimum flows are weak and enforcement is limited. Updating monitoring systems and enforcing standards under the Water Act 2013 would provide a path forward. National projects, such as the Dhaka River Restoration Project, offer opportunities to test real-time flow and water quality monitoring and apply lessons more broadly. Strengthening the role of the Bangladesh Water Development Board (BWDB), National River Conservation Commission, and the Department of Environment will be critical for enforcement.

Financing remains a systemic constraint across all dimensions of water security. Bangladesh depends heavily on external donors, while cost recovery and domestic financing remain low. Innovative tools such as eco-tariffs, pollution taxes, blended finance, and green bonds could expand the financing base. Scaling up climate finance from sources such as the Green Climate Fund and Adaptation Fund would help address climate-resilient infrastructure needs. Local governments in peri-urban and informal settlements require stronger financial planning capacities. The PPP Act 2015 also provides a framework to attract private investment, but water utilities will need targeted support to make such partnerships viable.

Urban water systems face growing pressure from flooding, population growth, and aging infrastructure. Cities such as Dhaka and Khulna continue to struggle with high water demand, service gaps, and limited coverage of informal settlements. Frequent disruptions and a lack of resilient infrastructure limit the reliability of services. Addressing these issues will require investments in smart metering and flood-resilient sanitation systems. Expanding public-private partnerships, as piloted in projects such as the Urban Water Supply and Sanitation Project and the Chattogram Water Supply Improvement Project, could accelerate improvements in service delivery.

Bangladesh has made important progress in managing rapid-onset hazards, but gaps remain for slow-onset risks. Large-scale structural investments have improved resilience to floods and cyclones, yet drought, salinity intrusion, and extreme heat are not adequately reflected in disaster planning. These risks are growing with climate change and need to be incorporated into long-term water and disaster management strategies. Promising pilots, such as GIZ's drought preparedness programs and the World Food Programme's climate insurance scheme in Rajshahi, should be integrated into national policies. Forecast-based financing, hazard zoning, and climate insurance can strengthen resilience for rural and water-dependent livelihoods.

Participation and monitoring remain weak, especially at local levels. While planning and monitoring tools have improved under IWRM, implementation remains uneven. Civil society and local governments are often excluded from decision-making, particularly in rural and environmental sectors. Real-time data systems and cross-sectoral budget coordination are limited, which hinders accountability and evidence-based decision-making. Expanding participatory approaches and updating monitoring infrastructure would improve integration and support more effective governance.

In summary, Bangladesh has established strong policy frameworks, but implementation gaps persist. Building coordination platforms, enforcing environmental flow standards, diversifying financing sources, and strengthening urban systems are urgent steps. At the same time, integrating slow-onset hazards into national strategies and expanding participation will be critical to sustain long-term water security. Together, these actions would align Bangladesh's progress with its vision under the Delta Plan 2100 and create a more resilient foundation for development.

Small boats wait for passengers by the riverbank of the Buriganga River in Dhaka City, Bangladesh (Photo by ADB).

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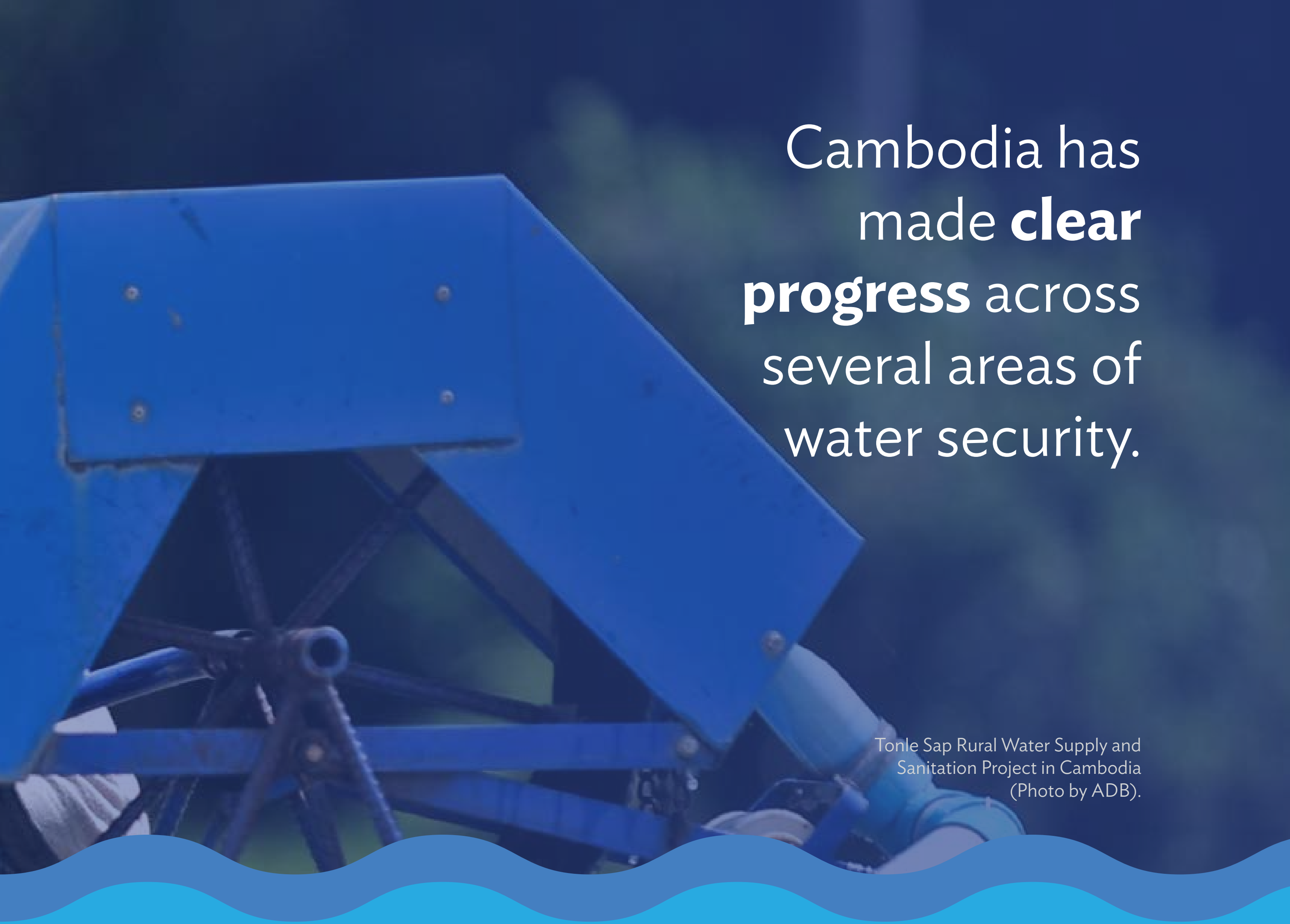
Cambodia Country Assessment

Summary

Cambodia's water security assessment provides an overview of progress between 2013 and 2025, alongside water governance performance from 2017 to 2023. It draws on the AWDO framework and SDG indicator 6.5.1 to explore the relationship between governance and water outcomes.

Cambodia has made clear progress across several areas of water security. Access to WASH has expanded, particularly in urban areas, and efforts to improve disaster risk management have strengthened national and local response capacity. These gains have been supported by improvements in water governance, including new laws and policies, stronger stakeholder engagement, and the gradual rollout of coordination mechanisms. However, progress has not been uniform. Rural services remain vulnerable to climate shocks, economic water security continues to face pressure from weak infrastructure and investment gaps, and environmental conditions show signs of increasing stress.

Governance reforms have improved the enabling environment for water management, but implementation remains inconsistent. While Cambodia has passed important national legislation, some regulatory gaps persist, especially around water licensing and groundwater use. At the same time, coordination across agencies and levels of government remains a challenge. Information systems for water disasters are underdeveloped,



Cambodia has made **clear progress** across several areas of water security.

Tonle Sap Rural Water Supply and Sanitation Project in Cambodia (Photo by ADB).

making it difficult to monitor risks or respond quickly to disruptions. Financial constraints are particularly acute at the subnational level, where investment depends heavily on donor support.

Key pressures on Cambodia's water systems include rapid urbanization, increased water demand, limited wastewater treatment, groundwater overuse, deforestation, and climate-driven extremes such as floods and droughts. These issues threaten both water quality and long-term sustainability, particularly in rural and environmentally sensitive areas.

To address these challenges, the report recommends strengthening coordination between sectors and governance levels; updating the legal framework to include water licensing and groundwater regulation; developing and implementing basin plans; improving data systems; and increasing public investment in water and weather infrastructure. Cambodia's new IWRM Action Plan (MOWRAM 2025) offers a timely opportunity to advance these priorities and align water governance with national development and climate goals.

Review of Cambodia's Water Security Score

Cambodia has made steady progress in expanding WASH services since 2013. However, rural–urban gaps remain significant, and services are increasingly disrupted by drought, heat, and other climate shocks. Without adaptive measures, these risks could reverse recent gains, particularly for vulnerable populations. The government has committed to achieving universal access to safe water for all uses and providing safely managed WASH services for all urban residents and at least half of the rural population by 2030. Financing remains a major barrier. Although the National Strategy for Rural WASH (2011–2025) outlines the cost estimates, its implementation has been only partial. Currently, just 3% of rural WASH financing comes from domestic sources, raising concerns about long-term sustainability (WHO 2022).

Rural household water security (KD1). Cambodia's KD1 score increased from 6.0 in 2013 to 9.1 in 2025. This improvement reflects better access to WASH, along with reduced diarrheal disease burden driven by increased investment. However, rural services remain vulnerable to frequent interruptions caused by droughts, competition with irrigation demands, and groundwater degradation. With 74% of the population living in rural areas in 2024, and rural demand expected to grow, further infrastructure investment and groundwater management will be critical.

Economic water security (KD2). Cambodia's KD2 score declined slightly from 12.0 in 2013 to 11.1 in 2025. Economic water security is under pressure from limited infrastructure, inefficient irrigation, and repeated climate extremes. These conditions have reduced water productivity and affected river flows

during shortages and floods. While there have been improvements in recent years, these have not fully offset earlier declines on water access for agriculture, energy, and industry.

Urban water security (KD3). Cambodia's KD3 score rose significantly from 6.3 in 2013 to 14.6 in 2025, reflecting strong gains in urban water security. This progress has been driven by the government's commitment to 100% coverage of urban water supply, sanitation, and hygiene. However, urban growth is placing increasing pressure on water systems. Water demand has nearly doubled, sewerage remains limited, and flood risks from poor drainage persist. Sustaining these gains will require continued investment in resilient infrastructure and wastewater treatment.

Environmental water security (KD4). Cambodia's KD4 score increased slightly from 13.5 in 2013 to 13.8 in 2025. The score reflects a relatively stable condition of aquatic ecosystems and moderate environmental governance. However, these systems face growing threats from deforestation, groundwater overuse, and wetland encroachment for agriculture. While the CASCI and EGI remain relatively strong, a declining trend in groundwater highlights emerging risks that could undermine environmental water security.

Water-related disaster security (KD5). Cambodia's KD5 score improved from 8.2 in 2013 to 13.3 in 2025, driven by stronger national and community disaster response capacity. The country remains highly exposed to seasonal floods and droughts, particularly across the Mekong, Tonle Sap, and Bassac basins. Infrastructure gaps, arsenic contamination (natural and human sources), and changing upstream hydrology continue to strain disaster resilience. The increase in KD5 reflects efforts led by the National Committee for Disaster Management to improve early-warning systems and local preparedness.

Farmers that lives in Trapeang Prey village (Photo by ADB).

State of Cambodia's Water Governance

Cambodia has made steady progress in implementing IWRM since 2017. According to SDG 6.5.1 data, all four IWRM dimensions improved between 2017 and 2023 (Figure 50). The average score increased from 46% to 62%, with the strongest gains seen in institutional development and stakeholder participation.

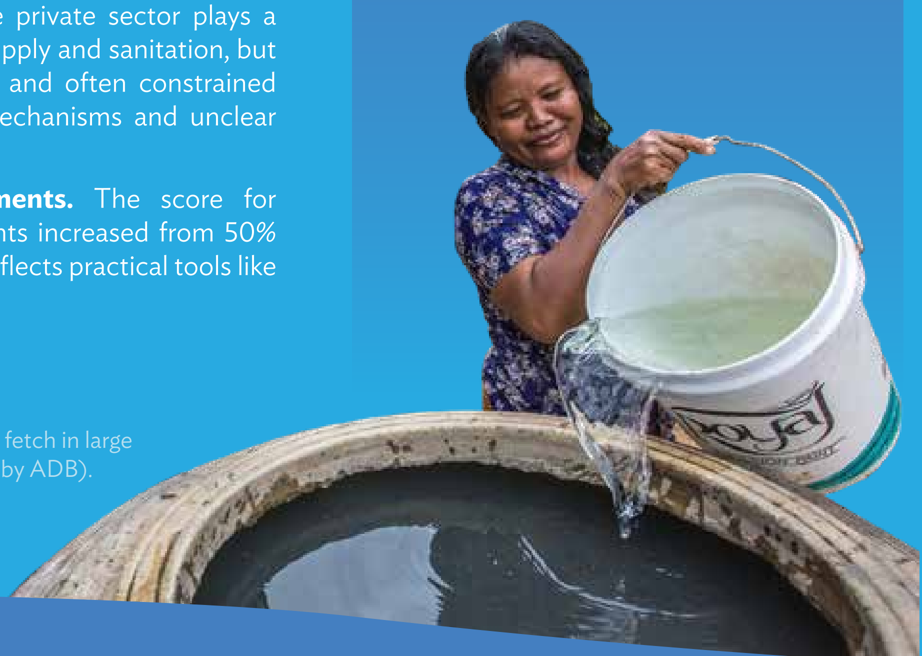
Enabling environment. The enabling environment score rose from 54% in 2017 to 66% in 2023. This reflects the introduction of several key legal instruments, including the 2007 Water Law, the 2023 Environmental and Natural Resource Code, and the 2023 Law on the Management of Clean Water Supply. These frameworks support IWRM principles at both national and subnational levels. However, some critical areas remain underdeveloped. There are still no sub-decrees on water licensing or groundwater regulation, and implementation of the broader framework remains limited. Dissemination and enforcement across sectors and levels of government need further strengthening.

Institutions and participation. Institutional and participation scores rose from 46% to 68% between 2017 and 2023. This progress reflects improvements in coordination among government agencies and wider stakeholder engagement. River basin committees have been established at national and subnational levels, though coordination remains a challenge due to overlapping responsibilities and limited technical capacity. The private sector plays a growing role in water supply and sanitation, but engagement is uneven and often constrained by limited financing mechanisms and unclear regulatory frameworks.

Management instruments. The score for management instruments increased from 50% to 63%. This progress reflects practical tools like cross-subsidies that improve access to water services. For example, investments in central Phnom Penh support lower-income areas through a Social Fund, where 5% of profits are set aside for staff welfare and broader community initiatives, and differential pricing. Despite these efforts, Cambodia still lacks river basin development plans. A 2015 sub-decree on river basin management has yet to be implemented. In addition, water information systems remain underdeveloped, making timely and informed decision-making difficult. Definitions of environmental flows are also unclear and need regulatory attention.

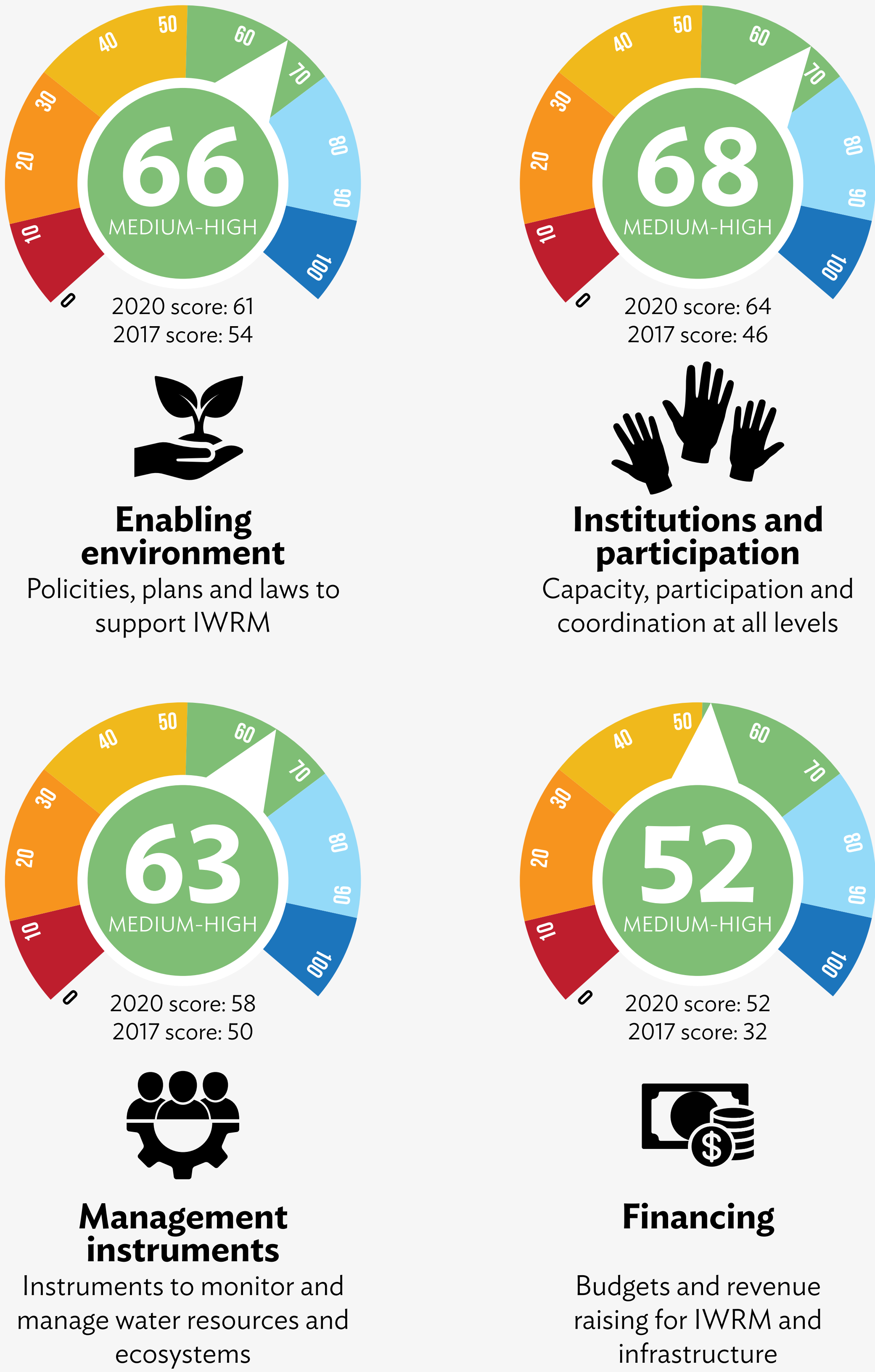
Financing. Cambodia's financing score rose from 37% in 2017 to 52% in 2023 but has not increased since 2020. The national budget for IWRM was rated at 60% in 2023, but subnational budgets and revenue generation remain limited. Low investment productivity and fragmented planning have constrained external financing. Subnational/basin-level financing scored 40%, and IWRM revenue raised scored just 50%. These limitations affect both infrastructure delivery and the broader capacity to implement governance reforms.

The average score increased from 46% to 62%, with the strongest gains seen in institutional development and stakeholder participation.



Farmer stores the water she fetch in large water container jars (Photo by ADB).

Figure 50. SDG Indicator 6.5.1 and Sub-Components for Cambodia (2023)



IWRM = Integrated Water Resources Management, SDG = Sustainable Development Goal.
Source: SDG 6.5.1, 2023.

Relationship Between Cambodia's Water Security and Water Governance

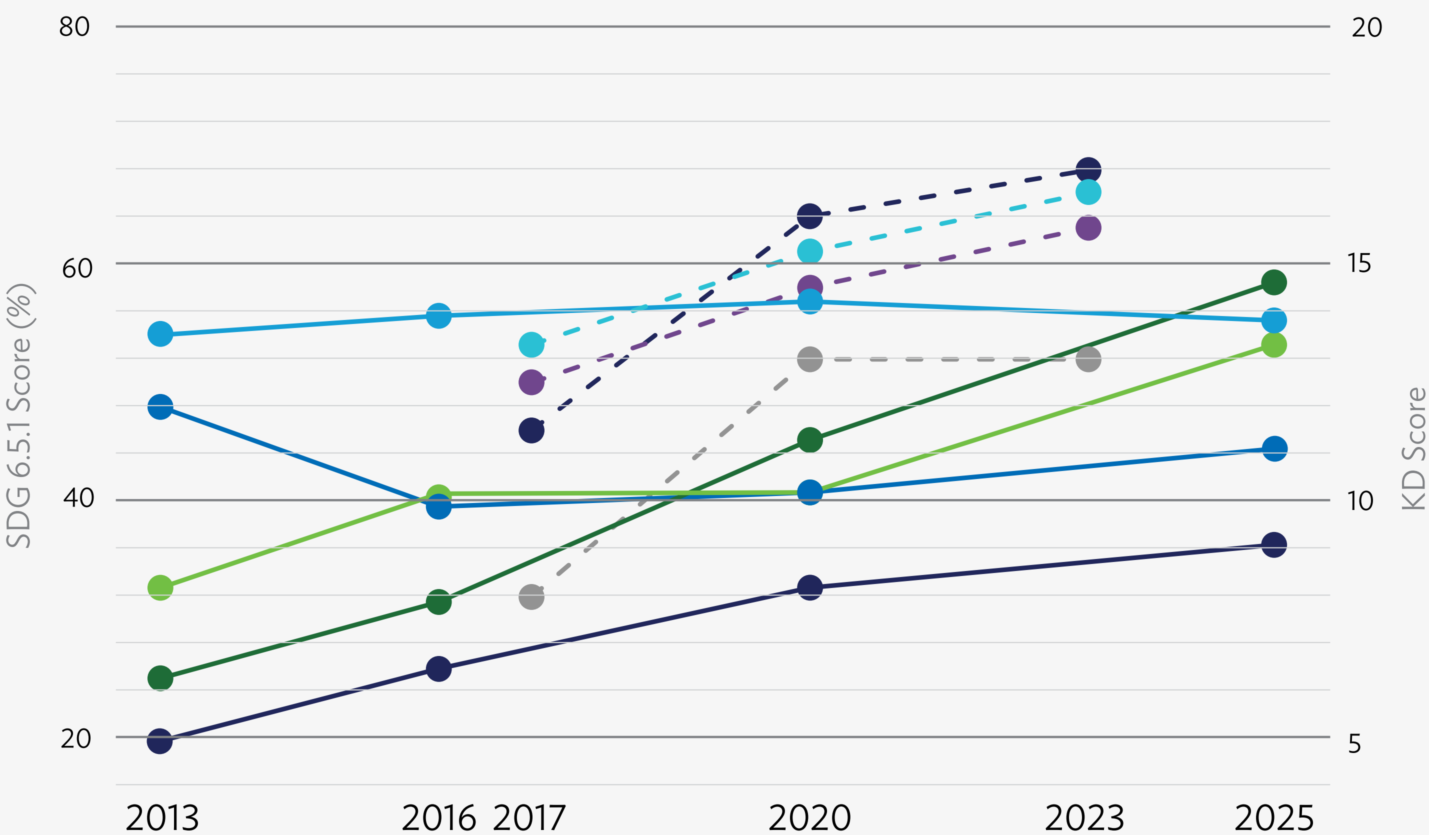
Cambodia has made steady progress in both water governance and water security over the past decade (Figure 51). While gains have varied across different dimensions, a clear relationship can be seen between improved governance structures and stronger performance in several areas of water security. The following analysis highlights these interlinkages, drawing on AWDO and SDG 6.5.1 data and complemented by expert insights.

Rural household water security (KD1) has benefited from improvements in the legal and institutional framework. The expansion of piped water supply, increased coordination across ministries, and broader WASH access all align with a more comprehensive governance approach. These advances reflect stronger policy alignment, better-defined institutional roles, and improved stakeholder engagement. However, challenges remain in financing rural systems and ensuring coordination across government levels, particularly in areas affected by climate-related disruptions.

Economic water security (KD2) shows a more complex relationship with governance. While frameworks for planning and stakeholder participation have strengthened, economic water use continues to be constrained by infrastructure gaps, inefficient irrigation practices, and climate pressures. The limited availability of funding, particularly for agriculture, industry, and energy water systems, has slowed progress. This highlights the need for better integration of governance reforms with targeted investment in both hard infrastructure and institutional capacity.

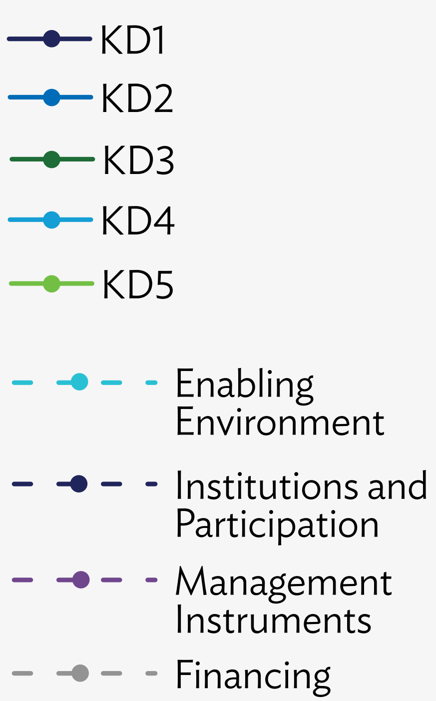
Urban water security (KD3) demonstrates a strong link with improved governance. National legal reforms, centralized water utilities, and increasing private sector involvement have

Figure 51. Status of Water Governance vs. Water Security in Cambodia



helped drive gains in urban service delivery. Innovations such as cross-subsidies and social funds have also expanded access in low-income areas. However, urban resilience still faces regulatory gaps in wastewater management and the absence of regulatory mechanisms like groundwater extraction licenses. These are areas where further governance development could deliver significant gains.

Environmental water security (KD4) has seen only marginal improvement, reflecting weak alignment with governance efforts to date. While legal protections for water resources exist, their enforcement is inconsistent. Environmental goals are not always integrated into planning or regulatory processes. Ongoing threats from land conversion, deforestation, and groundwater extraction point to the need for stronger cross-sectoral coordination and better monitoring systems. Subnational capacity and access to water data remain especially weak, limiting the effectiveness of environmental governance.



Based on SDG 6.5.1 and AWDO 2025 data.
Source: ADB.

Despite improvements, water-related disaster security (KD5) has had limited correlation with IWRM-related governance reforms. Disaster management is led by separate institutions with their own strategies, such as the National Committee for Disaster Management. While strong community networks and early-warning systems have been established, coordination between national and local actors is often fragmented. Communication delays and limited financing further hinder resilience. Aligning disaster risk management more closely with IWRM planning could help bridge this gap and support more effective adaptation.

Cambodia's new IWRM Action Plan for 2026–2030 offers a platform to strengthen the connection between water governance and water security. It identifies key areas for reform, including legal updates, institutional capacity building, and improved data systems. Embedding these priorities into national development planning will be essential for building a more integrated and resilient water governance system.

Findings and Recommendations

Cambodia's main governance challenge is not the absence of frameworks but the gap between law and practice. Legal and institutional structures are largely in place, yet weak enforcement and missing sub-decrees, particularly for groundwater and water licensing, continue to limit progress. Bridging this gap will require stronger accountability mechanisms, targeted capacity building, and improved coordination across sectors and government levels. Horizontal and vertical integration is essential if reforms are to deliver outcomes on the ground.

Legal instruments need to be expanded and enforced to address emerging pressures. The introduction of sub-decrees on water licensing and groundwater management would provide the tools to regulate surface water allocation and avoid overextraction in rapidly growing urban and agricultural zones. These measures would strengthen transparency, reduce risks to water supply, and improve outcomes for both cities and rural households. Similarly, basin-level planning must be accelerated. Although a sub-decree on river basin management was adopted in 2015, it is yet to be fully implemented. Developing river basin plans at both national and subnational levels, with inclusive, multisector participation, would help operationalize IWRM and ensure governance coherence across all dimensions of water security.

Equity in access has benefited from cross-subsidy mechanisms, which provide lessons for the wider region. Phnom Penh's utility has successfully bundled revenues from higher-income areas to extend services to poorer neighborhoods, complemented by the establishment of a social fund. This model has contributed to measurable gains in both rural and urban water security. Its continued refinement, and potential expansion to other urban centers, could help sustain service delivery while reducing reliance on external financing.

Weak information systems remain a serious constraint to effective water governance. Fragmented and incomplete data limit the ability of institutions to plan, monitor, and respond to risks. The development of the National Water Resources Management Data Center presents an important opportunity to centralize information and improve data sharing across agencies. Once operational, this platform could strengthen drought response, flood forecasting, allocation decisions, and ecosystem protection. Ensuring regular updates and linking the platform with decision-making processes will be critical to its success.

Financing gaps continue to slow progress. Although national allocations to the water sector have grown, they remain well below what is required, particularly at subnational levels where local budgets are highly constrained. Heavy reliance on donors and private actors has filled part of the gap but has not provided long-term stability. Greater public investment is needed, supported by transparent, results-based mechanisms to track outcomes. Scaling local financing capacity would also reduce dependency and build institutional resilience.

Climate and disaster risks require significant additional investment. Cambodia has advanced strategies such as the Cambodia Climate Change Strategic Plan 2024–2033 and participates in regional frameworks under the Mekong River Commission, yet implementation lags. Expanding investment in water and weather infrastructure, aligned with these strategies, will be essential to reduce risks from floods, droughts, and other climate impacts. Embedding monitoring systems to track performance and ensure investments support adaptation goals will help translate plans into tangible resilience.

In summary, Cambodia has built a solid foundation of legal and policy frameworks but continues to face challenges in implementation, enforcement, and financing. Expanding sub-decrees, accelerating basin planning, strengthening data systems, and scaling investment, while building on successes such as cross-subsidies in Phnom Penh, can create the momentum needed to close the implementation gap and advance water security across all five dimensions.

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Nepal Country Assessment

Summary

Nepal's water security assessment provides an overview of progress between 2013 and 2025, alongside water governance performance from 2017 to 2023. It draws on the AWDO framework and SDG indicator 6.5.1 to explore the relationship between governance and water outcomes.

Nepal has made some progress in expanding water supply and sanitation, particularly in rural areas, but systemic challenges continue to undermine overall water security. Water quality remains poor, and infrastructure is often unreliable. Urban systems are under pressure from rapid growth, with limited drainage and near-absent wastewater treatment. Economic water use remains low, and the country has not yet realized the potential of its irrigation or hydropower resources. Environmental conditions are deteriorating due to pollution, weak enforcement, and disrupted flows. Disaster-related risks, including floods, landslides, and GLOFs, are increasing and often exceed local response capacity.

These challenges are rooted in persistent governance gaps. Nepal's transition to a federal system has created overlapping mandates and unclear roles across government levels. IWRM implementation remains limited, with a 2023 score well below the regional average. Most water-related agencies operate in silos, and coordination is ad hoc. Stakeholder participation is limited to service delivery, with few opportunities for meaningful input in planning or policy. Budget allocations for water have declined in real terms, and financing tools for cost recovery or investment remain underdeveloped.

Nepal has made some **progress in expanding water supply and sanitation**, particularly in rural areas.

Villagers collecting drinking water from the community tap (Photo by ADB).

Nepal's enabling environment has improved through new water-related policies and standards, though enforcement remains a challenge. Basin planning efforts have also begun. However, implementation lags, and legal reforms, particularly the passage of the Water Resources Bill, remain stalled. The country's ability to move from planning to action will determine future water security outcomes.

With stronger governance, Nepal can convert its water abundance into a foundation for resilience and development. This requires clarifying institutional roles, empowering local governments, and improving coordination. Capacity building and technical support for water user associations and subnational agencies are essential. Basin-level planning and cross-sectoral decision-making will help address seasonal variability and competing demands. Sustainable practices, including nature-based solutions and pollution control, will improve environmental and disaster resilience. Modern financing approaches, including cost recovery, green bonds, and public-private partnerships, are also needed to sustain progress.

Nepal's IWRM Action Plan (WECS 2022) and Global Water Leadership program provide a path forward. With political commitment and targeted support, these reforms can strengthen water governance and unlock progress across all five dimensions of water security.

Review of Nepal's Water Security Score

Nepal is rich in water resources, with an estimated 225 billion cubic meters of surface water available each year (WECS 2002). Major rivers such as the Gandaki, Karnali, and Koshi originate in the Himalayas and contribute significantly to the Ganges River system. These transboundary rivers hold geopolitical significance for India and Bangladesh. Groundwater is available in the valleys and Terai region, with annual renewable volumes estimated between 8.8 and 14.3 billion cubic meters (Baral 2023).

Despite this natural abundance, water security remains a challenge. Climate change, pollution, increasing urbanization, and underdeveloped infrastructure all place pressure on water systems. Glacial melt is accelerating, increasing the risk of GLOFs. Monsoon patterns have become more erratic, leading to frequent floods and landslides. In urban areas, rivers like the Bagmati are heavily polluted by untreated sewage and industrial waste. Over-pumping in the Kathmandu Valley has depleted aquifers and dried up traditional springs. In the hills and mountains, many springs have declined or disappeared (Adhikari et al. 2021).

In the Terai, shallow aquifers are overused, leading to seasonal water shortages. Naturally occurring arsenic in alluvial sediments contaminates groundwater in some areas, posing serious health risks. Only about 25% of the population has access to fully functional drinking water systems. These pressures have direct impacts across all five Key Dimensions of water security.

Rural household water security (KD1) improved from 4.8 in 2013 to 10.3 in 2025. Over 91% of rural households now use piped or protected sources, yet almost half face contamination. Infrastructure often breaks down and sanitation remains a challenge. Waste frequently pollutes groundwater and rivers. Cost-recovery mechanisms are weak. Most systems charge flat fees per tap without volumetric pricing, and few funds are set aside for maintenance. Nevertheless, recent progress in sanitation and hygiene, supported by post-COVID awareness, has likely contributed to the improved KD1 score.

Boy getting water from the community tap in Darbang, Nepal (Photo by ADB).

Economic water security (KD2) rose slightly from 10.1 in 2013 to 10.5 in 2025. Annual water use remains below 8%, despite significant hydropower and irrigation opportunities (Sharma et al. 2023). Water availability is uneven throughout the year, concentrated in the monsoon season. Irrigation infrastructure covers 1.53 million hectares, but only one-third of this area receives reliable year-round supply (Government of Nepal 2023). Crop productivity and intensity remain low (Baral 2023). Hydropower capacity has increased in recent years, reaching 2,765 MW in 2024 (DOED 2024).

Urban water security (KD3) increased modestly, from 8.3 in 2013 to 11.7 in 2025, but remains under pressure from rapid urbanization and unplanned development. The urban population is growing at more than 4.5% annually, and in cities like Kathmandu, water is supplied intermittently for only 3–4 hours every alternate day. During floods, shutdowns of the Melamchi system reduce supply to approximately 30% of normal levels, leaving many households dependent on costly storage, filtration, or bottled water. Drainage systems remain inadequate, leading to frequent urban flooding, while wastewater treatment is almost absent, with only 2.1% of wastewater and less than 1% of fecal sludge treated. Open drains and clogged networks continue to pose major health risks. Improvements in utility operations through Kathmandu Upatyaka Khanepani Limited have strengthened service delivery capacity, and progress toward regulatory compliance is supported by the Water Supply and Sanitation Tariff Fixation Commission (WSSTFC), which provides oversight of tariff-setting and operational standards.

Environmental water security (KD4) improved slightly, from 12.9 in 2013 to 13.7 in 2025. However, it remains under growing pressure. Hydropower construction, diversions, and weak governance have reduced environmental flows and degraded catchments. Urban pollution, land-use change, and riverbed mining have damaged aquatic ecosystems. CASCI has remained stable overall, with localized degradation in areas like the Roshi Khola catchment, where floods in 2024 caused major damage. EGI has performed better, reflecting widespread terrestrial protection in rural areas. Still, wastewater treatment remains limited.

Water-related disaster security (KD5) improved modestly between 2013 and 2025, from 11.8 to 13.0, reflecting gradual progress in disaster resilience. The 2023 National Disaster Management Policy and expanded early-warning systems contributed to these gains. However, zoning regulations and enforcement remain weak, and coordination between water and disaster institutions is limited. Further improvement will require more integrated planning through the IWRM framework and stronger stakeholder participation.

State of Nepal's Water Governance

Nepal's implementation of IWRM remains in its early stages (Figure 52). In 2023, the SDG 6.5.1 score stood at 37 out of 100, well below the Central and South Asia average of 55. The 2030 global target is 91. Without faster reform, Nepal is unlikely to meet this benchmark.

The country's federal structure, adopted in 2015, introduced seven provincial and 753 local governments. These levels share overlapping mandates on water, which has led to confusion, gaps, and duplication. Water governance is still sectoral, with weak coordination between institutions and limited stakeholder participation.

Enabling environment. Nepal's Constitution guarantees the right to a clean and healthy environment. It also commits the state to manage water resources for multipurpose use, energy, irrigation, and disaster reduction. However, legal frameworks are still catching up with this vision.

The 1992 Water Resources Act remains the main legal instrument, though it is outdated. A new Water Resources Bill is under parliamentary review. If passed and enforced, the bill would mandate IWRM, define roles across government levels, and create basin offices. It also includes strict regulations for water extraction, pollution control, groundwater monitoring, and environmental flows. Until this bill becomes law, many subnational policies remain stalled due to a lack of federal guidance.

Institutions and participation. Many water-related agencies exist at the federal and provincial levels; no single lead agency coordinates IWRM. Interagency collaboration is weak, with limited vertical coordination across levels of government. Communication is ad hoc and often limited to specific projects. Water responsibilities are split across multiple ministries. The Ministry of Energy, Water Resources and Irrigation (MOEWRI) and the Water and Energy Commission Secretariat (WECS) lead at the federal level. Other ministries, including those responsible for agriculture, water supply, environment, urban development, and planning, also have overlapping roles.

Participation in project delivery is stronger than in policy or planning. Community involvement is high in rural water supply and irrigation, but national policymaking remains top-down. Stakeholder mapping and engagement are usually funded through individual projects, not embedded in regular governance systems.

Institutional performance has declined. The institutions and participation score fell from 51 in 2020 to 40 in 2023. Key setbacks include the delay in forming river basin organizations, the dissolution of the Ground Water Resource Development Board, and persistent confusion over responsibilities across government levels.

Management instruments. Nepal's management tools for water are improving slowly. The score under this IWRM dimension rose from 36 in 2020 to 41 in 2023. WECS has developed several river basin plans, although implementation is still limited. Tools such as water audits and integrated planning models remain underdeveloped.

Hydrometeorological data collection has improved, but coverage is sparse. The Department of Hydrology and Meteorology operates over 150 hydrological stations, 330 precipitation stations, and 68 climate stations. However, many seasonal rivers and catchments remain unmonitored. Groundwater monitoring is still mostly manual, with recent pilots using automated systems yet to be scaled up.

Water quality monitoring has received a boost with the 2022 and 2023 standards, but enforcement remains weak. Regulatory action against polluters is rare. Socioeconomic data and risk assessments are also lacking, making it hard to target interventions or assess trade-offs between water uses.

Efforts to promote water efficiency are mostly limited to small-scale projects. Some irrigation schemes use rotational methods or drip systems. Rainwater harvesting and groundwater recharge projects are also underway in parts of the country but lack broad support or funding.

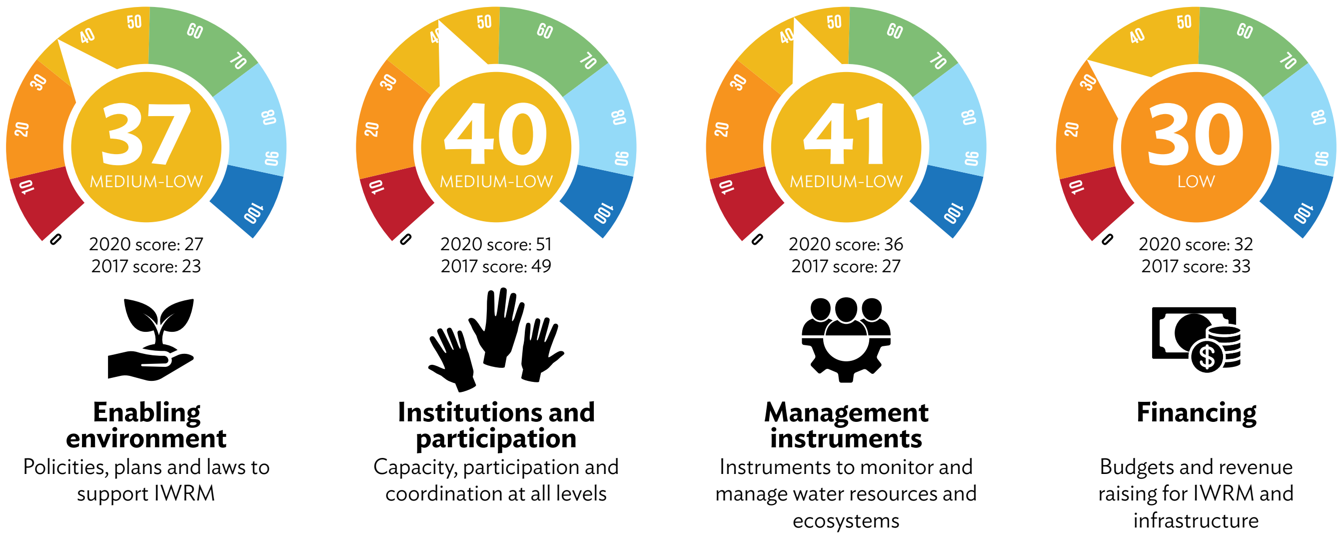
Financing. Financing for water governance and IWRM is a key constraint. This component score dropped from 32 in 2020 to 30 in 2023. Nepal has no dedicated funding mechanism for IWRM. Instead, related projects are funded through public investment or donor grants.

Most water-related infrastructure is publicly funded. Hydropower is the main exception, with some independent producers raising private capital. No user fees are charged for irrigation or drinking water withdrawals. Collection of irrigation service fees is weak and fails to cover operational costs. Sanitation and drainage are bundled with water tariffs where piped services exist. Recreation-based water uses are licensed, but pollution charges are not in place. A surcharge on petroleum products, originally introduced to fund the Budhi Gandaki Hydropower Project, has not yet been used for water infrastructure.

Overall, investment in water has declined in real terms. Budget allocations are insufficient for sustaining operations, especially for local service providers. Education and health spending have increased, but water has not kept pace.

Building Climate Resilience of Watersheds in Mountain Eco-Regions (Photo by ADB).

Figure 52. SDG Indicator 6.5.1 and Sub-Components for Nepal (2023)



IWRM = Integrated Water Resources Management, SDG = Sustainable Development Goal.
Source: SDG 6.5.1. 2023.

Relationship Between Nepal's Water Security Progress and Water Governance

Nepal's water security and governance trends show a gradual but uneven pattern of progress (Figure 53). KD scores improved slightly in rural, economic, and urban dimensions between 2013 and 2025, while environmental gains remained limited and disaster-related security declined. Over the same period, SDG 6.5.1 scores for IWRM remained low, rising only marginally in most dimensions and declining in others. This section explores how water governance gaps continue to constrain improvements in water security.

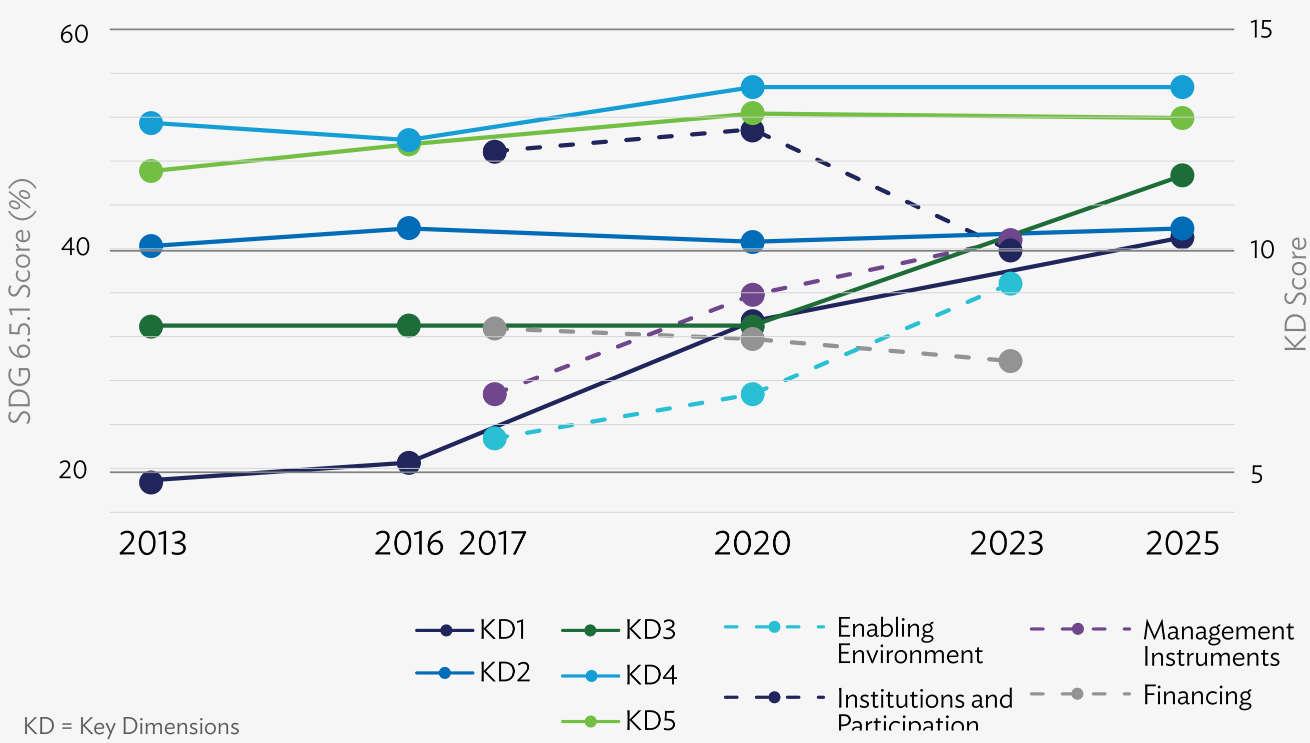
A fragmented governance structure is a major obstacle. Overlapping mandates across federal, provincial, and local governments make service delivery inconsistent. Lack of coordination weakens pollution control, disaster preparedness, and infrastructure maintenance. These challenges point to the importance of legal clarity, strong institutions, and coordinated planning, core elements of IWRM that Nepal is still developing.

Better implementation of IWRM could support more integrated, efficient, and inclusive water management. Basin-level planning and participatory models offer a clear path forward, especially if roles and responsibilities are defined and financing is secured. Nepal's policy progress provides a foundation, but enforcement, coordination, and financing remain weak.

Enabling environment and management instruments appear to support improvements in KD1 and KD3. Legal and policy reforms likely contributed to the expansion of rural water supply and hygiene services, and to modest gains in urban sanitation. However, without institutional capacity and financing, these improvements remain fragile.

KD2 offers a mixed picture. Economic water security improved slightly despite drops in the "institutions and participation" and "financing" dimensions of IWRM. This may reflect the positive influence of legal and planning tools,

Figure 53. KDs and Integrated Water Resources Management SDG 6.5.1 Dimensions for Nepal



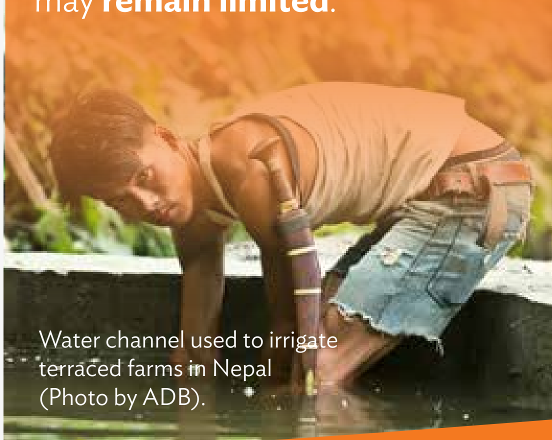
KD = Key Dimensions
Source: ADB.

particularly for hydropower development. With better-informed decision-making, Nepal can manage trade-offs across sectors and increase water-related economic returns.

KD4 remains mostly unchanged despite increases in the enabling environment and management instruments. One explanation is that recent improvements are not yet implemented at a scale large enough to affect environmental outcomes. Declines in participation and financing may also be limiting impact. This suggests that environmental water security requires both stronger enforcement and greater investment to make gains visible.

KD5 improved due to disaster management policies like the 2023 National Disaster Management Policy. Early-warning systems have expanded, but zoning regulations and enforcement are still weak. Coordination between disaster and water institutions is limited. Further KD5 improvements will require greater participation and more integrated planning through the IWRM framework.

In summary, Nepal's experience shows that better water governance **can improve** water security, but only if progress occurs **across all four governance pillars**: enabling environment, institutions and participation, management instruments, and financing. Without stronger leadership, clearer mandates, and more consistent funding, future gains in water security may **remain limited**.



Water channel used to irrigate terraced farms in Nepal (Photo by ADB).

Findings and Recommendations

Nepal faces a paradox of abundance and scarcity. Despite plentiful water resources, the country struggles with both shortages and floods. Infrastructure gaps, fragmented governance, and climate pressures limit reliable and equitable access. Water and sanitation services have improved, especially in rural areas, but water quality, seasonal variability, and disaster risks remain persistent concerns.

Weak and unclear governance continues to hinder progress. Federal, provincial, and local actors often share overlapping roles, leaving leadership undefined. Many agencies exist at the federal and provincial levels, but no single lead institution coordinates IWRM. Responsibilities are spread across ministries, including energy, agriculture, water supply, environment, urban development, and planning, which limits both horizontal and vertical coordination. The MOEWRI and the WECS are nominal leaders at the federal level, but collaboration with other agencies remains weak. Institutional performance has also declined in recent years, with delays in forming river basin organizations, the dissolution of the Ground Water Resource Development Board, and continuing uncertainty over roles and mandates. The WSSTFC has provided a degree of regulatory oversight, but its impact remains limited without stronger coordination and enforcement mechanisms. These gaps undermine enforcement, reduce accountability, and prevent the consistent management of extraction, pollution, and ecosystem flows. Strengthening institutional clarity and giving more authority to local governments would improve coordination, responsiveness, and service delivery across all five dimensions of water security.

Implementation of IWRM remains limited. Political support for water has been inconsistent, and the sector still does not command the same policy attention as other infrastructure areas. The IWRM Action Plan (2022) provides a strong framework, but its impact will depend on clarifying mandates, boosting enforcement, and aligning legal and financial tools with water security goals. Building momentum requires greater capacity at local and provincial levels, where water user associations and government agencies need training, financing, and monitoring systems to improve performance. While some communities engage in irrigation and rural water supply, they are rarely included in long-term planning. Reliable data and accessible tools are needed to enable meaningful engagement in decision-making. Expanding participation within the IWRM process would not only strengthen governance but also improve the resilience of water systems to climate shocks.

Seasonal and regional variability adds to the challenge. Monsoon rains bring heavy flows and flood risks, while winter months leave supplies scarce. Infrastructure to capture and regulate water, such as storage and inter-basin transfers, carries engineering, environmental, and social risks. Basin-wide planning, scenario modeling, and cross-sectoral coordination are essential to balance these trade-offs, reduce conflict, and secure ecosystem needs.

Infrastructure underperformance undermines water security. Irrigation and supply systems frequently break down, wastewater treatment is almost absent in urban areas, and hydropower development remains below potential, forcing electricity imports. Systems lack redundancy and remain vulnerable to shocks. Sustainable financing is critical to reverse these trends. Modern mechanisms such as green bonds, pollution taxes, and public-private partnerships can increase investment in resilient infrastructure. Tariff structures that balance cost recovery with inclusivity for low-income users will also strengthen financial sustainability.

Environmental degradation is worsening. Pollution, deforestation, and river encroachment are threatening biodiversity and ecosystem services. Mandated environmental flows are rarely enforced, and most polluters face no consequences. Climate change further intensifies these pressures by increasing floods, droughts, and landslides. Land-use zoning, flood-risk mapping, pollution control, and nature-based solutions will be essential to protect ecosystems, reduce disaster risks, and strengthen water storage capacity.

Springs and groundwater reserves are in decline, threatening rural water security. Communities dependent on these sources face worsening shortages, with some families relocating due to failing local systems. These losses jeopardize livelihoods, cultural heritage, and social stability. Addressing spring depletion requires integrated watershed management, reforestation, and protection of recharge areas.

In summary, Nepal's water abundance can become a source of resilience and growth if governance and finance gaps are addressed. Strengthening institutions, clarifying roles, empowering local governments, modernizing finance, and embedding IWRM into basin-level planning will allow Nepal to manage variability, safeguard ecosystems, and build inclusive water security for the future.


Elderly drinking water (Photo by ADB).

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Pakistan Country Assessment

Summary

Pakistan's water security assessment provides an overview of progress between 2013 and 2025, alongside water governance performance from 2017 to 2023. It draws on the AWDO framework and SDG indicator 6.5.1 to explore the relationship between governance and water outcomes.

Pakistan's rural household water security remains under pressure due to ineffective service models, limited surveillance, and persistent contamination, though improvements in hygiene and health outcomes have been observed. Economic water security is constrained by falling per capita water availability, insufficient storage, and heavy reliance on poorly monitored groundwater resources for industrial activity. Urban water security has shown only modest gains, with rising demand, untreated wastewater, and urban flooding straining infrastructure and service delivery. Environmental water security has declined slightly, as rapid population growth, industrial activity, and untreated wastewater continue to degrade aquatic ecosystems. Water-related disaster security fell during the early part of the period and has remained stagnant, with Pakistan experiencing major flood and drought events, including GLOFs.

Overall, Pakistan's national water security score improved moderately from 2013 to 2025 by 6.4 points. At the same time, water governance performance, measured through SDG 6.5.1, rose from 50% in 2017 to 63% in 2023. This progress reflects a sound legal and policy foundation, aligned with IWRM principles, but implementation remains weak. Institutional fragmentation, limited coordination, low

Pakistani woman washing the utensils with the water drain coming from the mountains this water is also used in daily life. (Photo by ADB).

technical capacity, and underinvestment continue to restrict progress, especially in light of growing population pressures, climate risks, and systemic inefficiencies in water management.

Water governance and water security outcomes are closely linked. Pakistan's National Water Policy and other frameworks support IWRM, but the gap between planning and implementation has limited impact. Efforts to improve equity, participation, and resilience are underway but require stronger integration across sectors and levels of government. Without more coordinated and well-financed governance, gains in water security will remain uneven and difficult to sustain.

To improve water security, the chapter recommends strengthening institutional coordination under the National Water Council, introducing volumetric pricing to promote efficiency and investment, embedding gender, equity, and social inclusion in decision-making, establishing an independent water quality authority, and expanding environmental regulation and ecosystem protection. These steps will help deliver on the policy foundation already in place and support implementation of ADB's 2026–2030 Country Partnership Strategy for Pakistan.

Review of Pakistan's Water Security Score

Pakistan faces growing pressure on its water resources due to rapid population growth, climate change, and poor water management. Per capita water availability dropped from 3,500 cubic meters (m^3) in 1972 to just 1,100 m^3 in 2020. More than 80% of the population lacks access to safe drinking water, contributing to widespread waterborne diseases. Groundwater overuse in agriculture has led to depletion and arsenic contamination. Climate-related hazards, such as erratic monsoons, glacial melt, and floods, add further strain, with the 2022 floods displacing millions. At the same time, upstream water control and infrastructure challenges continue to threaten the Indus River system, Pakistan's lifeline.

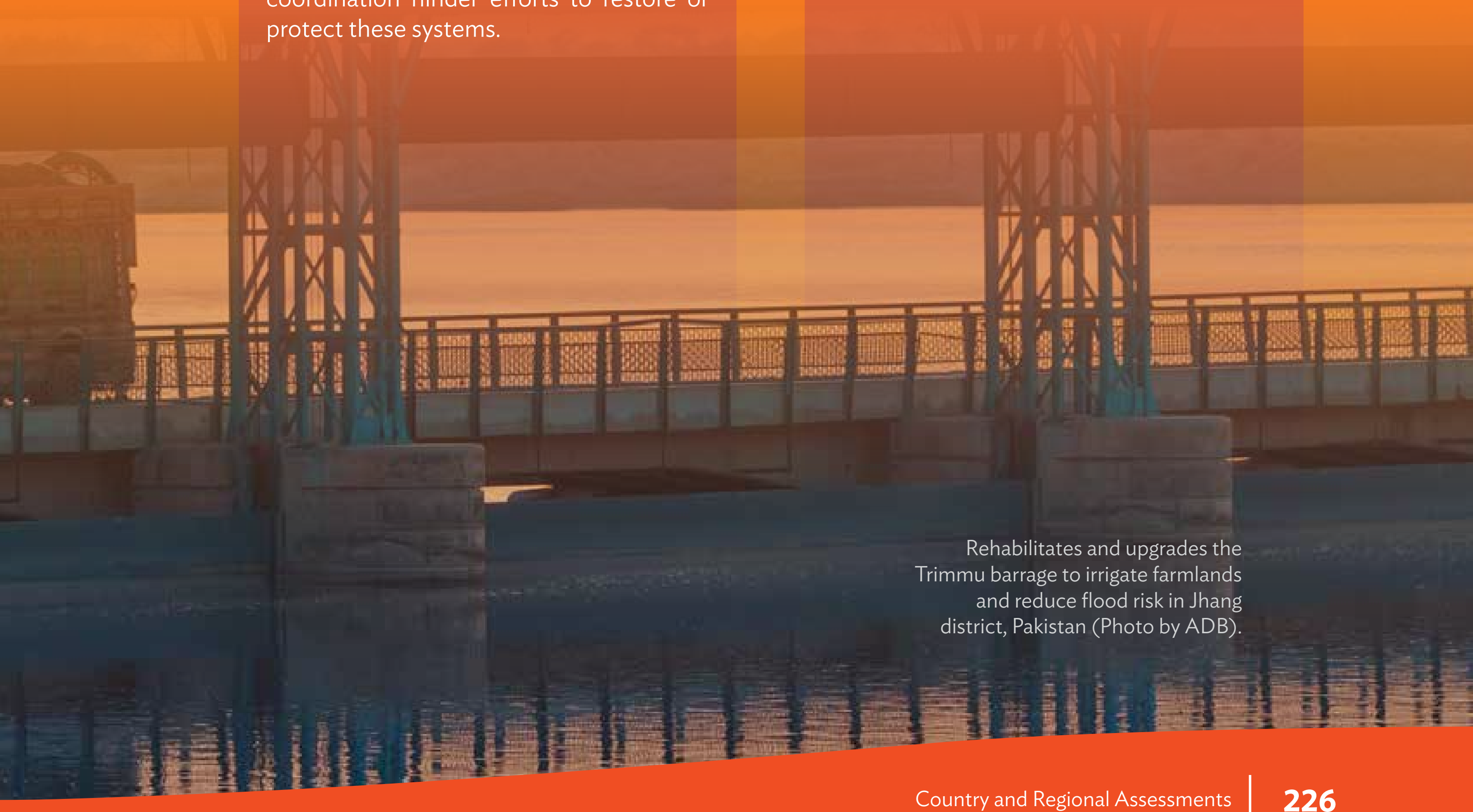
Rural household water security (KD1) improved from 4.1 in 2013 to 7.6 in 2025, but access to basic services remains low. The gains were mainly in hygiene and health outcomes, supported by targeted WASH programs and possibly reinforced by handwashing campaigns during COVID-19. However, rural water supply models remain ineffective, and surveillance is limited. Microbiological and geogenic contamination are widespread, and policies have not kept pace with growing rural demand.

Economic water security (KD2) remained almost unchanged, increasing slightly from 9.1 in 2013 to 10.0 in 2025. Despite some progress in broader economic resilience, gains were offset by water scarcity and inefficient systems. Agriculture, industry, and energy sectors all face water-related constraints. Industrial water use relies almost entirely on groundwater (PCRWR, 2018), while infrastructure gaps and poor surface water quality reduce reliability. Limited storage capacity and outdated irrigation practices compound water stress, leaving economic water users vulnerable to both drought and overextraction.

Urban water security (KD3) showed stronger gains, rising from 7.5 in 2013 to 9.2 in 2025. Access to services improved slowly, and urban utilities remain under pressure from a 10% annual increase in demand. Underlying issues, like weak infrastructure, low tariffs, and poor cost recovery need to be addressed continuously. Untreated wastewater and frequent urban flooding continue to impact health and service delivery. While environmental quality in cities remained stable, resilience remains limited, especially in low-income settlements.

Environmental water security (KD4) declined slightly, dropping from 9.6 in 2013 to 9.2 in 2025. Population growth, urban expansion, and untreated wastewater are placing fresh water ecosystems at risk. Despite stronger legal frameworks, enforcement remains weak. Aquatic ecosystems, including the Indus River, wetlands, and marine zones, face increasing degradation due to pollution and reduced environmental flows. Institutional gaps and weak coordination hinder efforts to restore or protect these systems.

Water-related disaster security (KD5) has improved slightly between 2013 and 2025, rising from 10.8 to 11.5, and crossing into a higher water security step. This modest gain comes despite severe events such as the 2022 floods, which affected over 24 million people and exposed critical gaps in resilience. Early-warning systems have strengthened, but investment in adaptive infrastructure and local risk reduction remains insufficient. Prolonged droughts continue to threaten food security, especially for smallholder farmers.



Rehabilitates and upgrades the Trimmu barrage to irrigate farmlands and reduce flood risk in Jhang district, Pakistan (Photo by ADB).

State of Pakistan's Water Governance

Pakistan has made progress in formalizing its water governance framework, but implementation remains uneven (Figure 54). The country's SDG 6.5.1 score for IWRM improved from 50% in 2017 to 63% in 2023 (SDG 6.5.1, 2023). This reflects a medium-high level of progress. However, all four dimensions of IWRM face persistent challenges.

Enabling environment. Pakistan's enabling environment is legally strong but operationally weak. The 2018 National Water Policy (NWP) promotes basin-scale planning, equitable access, and climate resilience. Other relevant policies include the 2021 National Climate Change Policy and the 2006 National Sanitation Policy. While these frameworks align with IWRM principles, they are rarely implemented in full due to the lack of operational guidelines and clarity (World Bank 2019). Sectoral silos and overlapping mandates limit coordination across water, climate, disaster, and urban sectors. Without integrated planning, the potential of these policies remains unrealized.

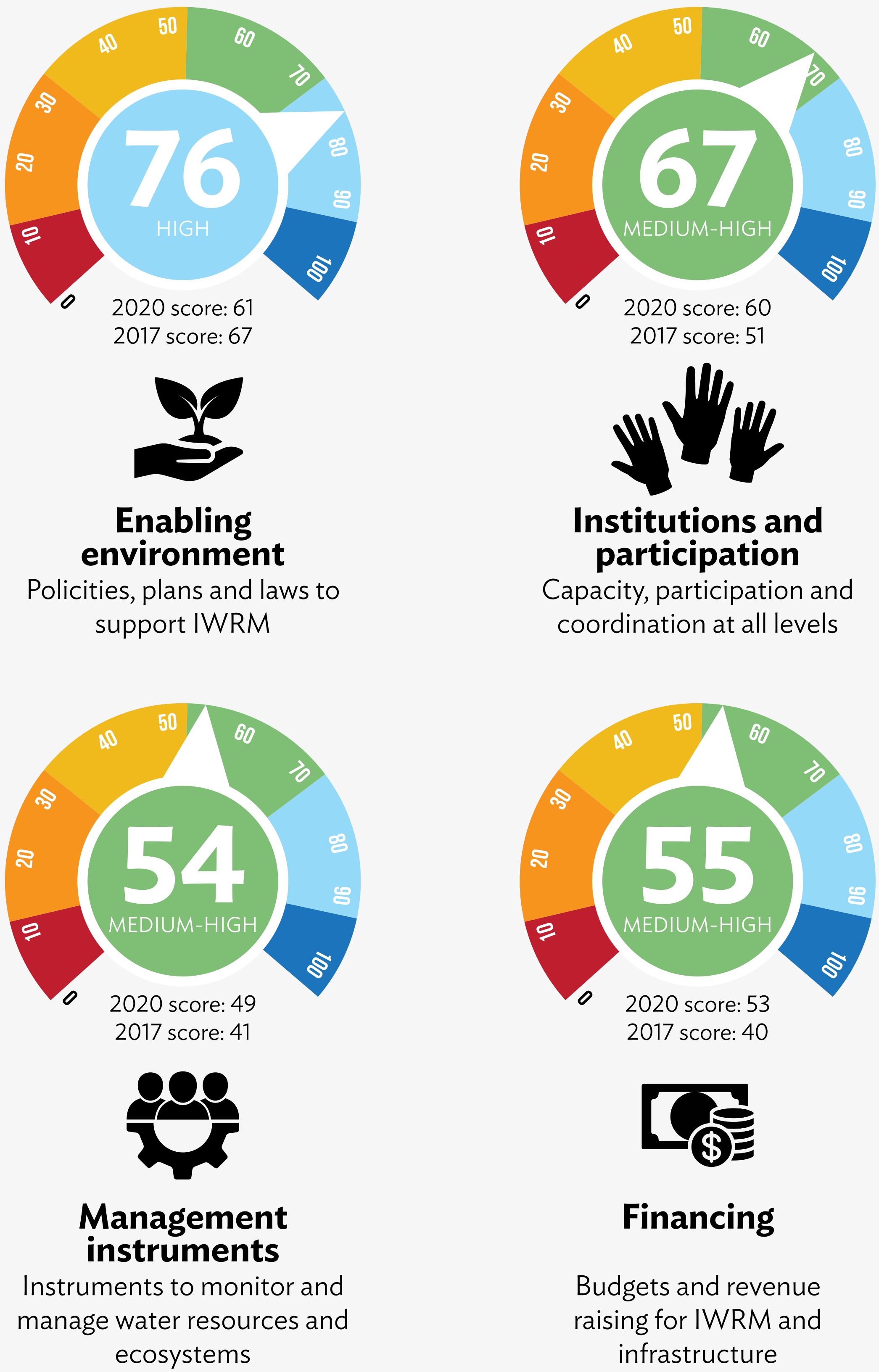
Institutions and participation. Institutional fragmentation undermines effective water governance. At the federal level, responsibilities are split across multiple agencies, including the Ministry of Water Resources (MWR), Ministry of Climate Change (MCC), Indus River System Authority (IRSA), Pakistan Council of Research in Water Resources (PCRWR), National Disaster Management Authority (NDMA). At the provincial level, irrigation departments, water and sanitation agencies, and environmental protection agencies lead implementation. However, coordination is weak and the National Water Council remains underutilized. This has led to duplication, inefficiency, and gaps in service delivery. While development partners and civil society groups have increased their involvement, local communities, women and marginalized groups remain underrepresented in decision-making and lack of technical capacity to influence planning.

Management instruments. Pakistan has introduced a range of management instruments, but their use is fragmented and inconsistent. Key national plans like Vision 2025, the NWP, and the Decade of Dams initiative aim to expand storage, improve agricultural efficiency, and promote basin-level planning. Monitoring tools and early-warning systems are also in place, led by the Pakistan Meteorological Department and NDMA. However, weak technical capacity and poor data sharing reduce their effectiveness. Urban utilities struggle with outdated systems, limited private investment, and high nonrevenue water.

Financing. Financing for water governance remains inadequate and poorly coordinated. While WASH funding increased by 152% between 2019 and 2023, the total allocation under the Public Sector Development Programme (PRs1.5 trillion or $5.3 billion) remains well below the estimated PRs10 trillion–PRs12 trillion ($35 billion - $42 billion) needed over the next decade (WaterAid 2020). Tariffs are set far below cost-recovery levels, especially in urban areas where high water losses and poor billing limit sustainability. Investment tends to favor large infrastructure projects, while institutional reform and climate adaptation remain underfunded. The absence of a coherent national water financing strategy limits the country's ability to build resilient and effective governance systems.

Overall, Pakistan has established the foundations for integrated water governance, but real progress depends on strengthening institutions and implementation. Without improved coordination, technical capacity, and financial planning, the gap between policy and practice will continue to slow gains in water security.

Figure 54. Status of Integrated Water Resources Management Implementation in Pakistan (2023)



IWRM = Integrated Water Resources Management, SDG = Sustainable Development Goal.
Source: SDG 6.5.1, 2023.

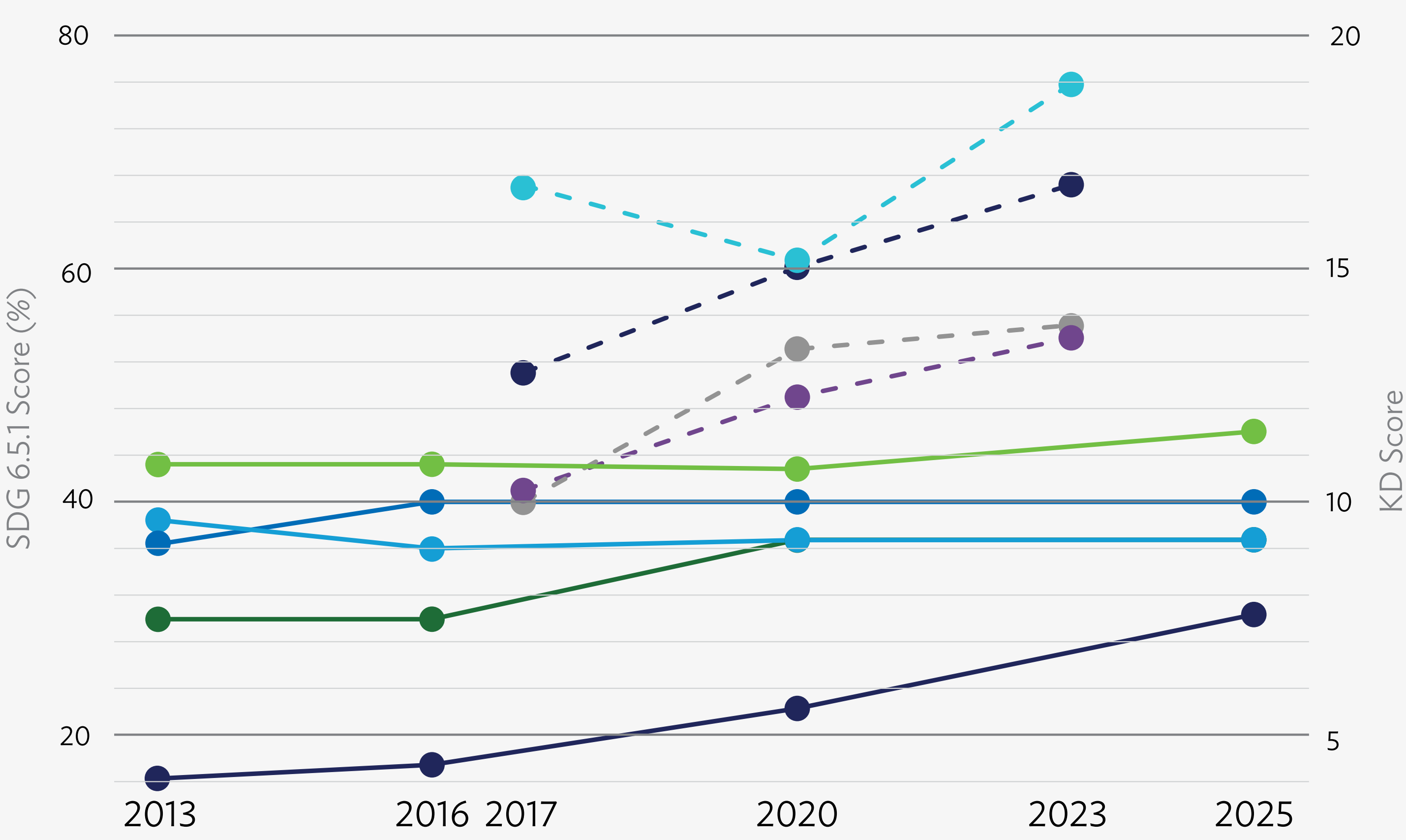
Relationship Between Pakistan's Water Security and Water Governance

Progress in water governance has not yet translated into consistent improvements in water security (Figure 55). Between 2017 and 2023, Pakistan's SDG 6.5.1 score for IWRM rose from 50% to 63% (SDG 6.5.1 2023). This increase reflects stronger policy frameworks, including the National Water Policy and provincial water acts. Yet, implementation remains fragmented. As a result, gains in water governance have produced only modest improvements in key water security dimensions.

Rural household water security (KD1) has benefited from WASH investments but lacks integrated planning. National policies support equitable access and climate resilience, but weak coordination between ministries and low local capacity continue to hinder service delivery. While external partners like UNICEF and the World Bank have supported rural WASH initiatives, local engagement remains limited. Despite a 152% increase in WASH funding between 2019 and 2023, Pakistan still faces a significant gap, falling short of the estimated $12.3 billion needed to meet SDG targets 6.1 and 6.2 (WaterAid 2020). Without stronger institutional frameworks and community participation, rural gains will remain uneven and fragile.

Economic water security (KD2) shows alignment with IWRM on paper but weak follow-through. The National Water Policy and draft National Water Conservation Strategy emphasize cross-sector coordination. Key institutions like IRSA and proposed provincial authorities support more equitable allocation. However, infrastructure remains underdeveloped and distribution systems inefficient. Storage capacity is critically low. Although over PRs1.5 trillion ($5.3 billion) in public funds and PRs200 billion ($700 million) in donor financing have been mobilized, these investments fall well short of long-term needs.

Figure 55. Status of Water Governance vs. Water Security in Pakistan

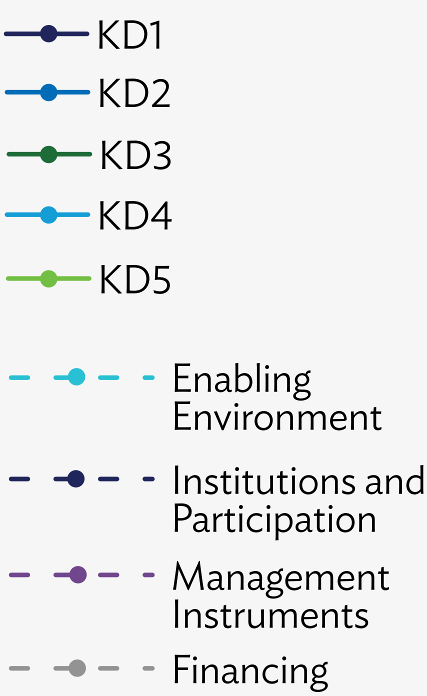


Without reforms in groundwater regulation, irrigation governance, efficiency incentives, and tariff systems, economic water use will continue to strain resources.

Urban water security (KD3) reflects fragmented governance and limited financial sustainability, with low KD3 scores despite relatively strong improvements. The NWP and Clean Green Pakistan campaign promote sustainable urban water services, and tools like the Clean Green Pakistan Index offer performance tracking. However, institutional responsibilities are split across multiple agencies with overlapping mandates and limited accountability. In Khyber Pakhtunkhwa, the creation of Water and Sanitation Services Companies shows potential for localized, utility-based services. Punjab's Aab-e-Pak Authority is another step toward coordinated planning. Yet, most urban utilities still operate under unsustainable financial models, characterized by low tariffs, high nonrevenue water, and aging infrastructure. Households often turn to private vendors, increasing the burden on low-income families. Policy intent exists, but without regulatory reform and cross-sector investment, urban governance will remain a bottleneck.

Environmental water security (KD4) is supported by national policies but constrained by weak enforcement. The NWP and Climate Change Policy both emphasize the importance of environmental flows and ecosystem protection. Institutions like IRSA and provincial irrigation departments are mandated to manage these flows, but coordination is poor and data gaps persist. Restoration initiatives, such as the Living Indus program, show rising engagement from civil society and international actors. However, implementation remains limited. The Environmental Protection Act provides a legal foundation for pollution control, but regulations are weakly enforced, with a wide gap in environmental protection and management. Sustainable financing and river health monitoring systems are still lacking, which limits progress.

Water-related disaster security (KD5) has policy backing but lacks integration with climate and water planning. Pakistan has adopted key instruments like the 2010 National Disaster Management Act, the National Flood Protection Plan, and the NWP. However, technical capacity is stretched, and coordination among NDMA, PDMAs, the Pakistan Meteorological Department, and water agencies remains insufficient. Financing is often reactive and short-term. Local preparedness is limited by poor infrastructure and weak stakeholder engagement. As climate impacts intensify, integrating disaster risk management into broader water governance will be critical to building resilience.



KD = Key Dimension.
Source: SDG 6.5.1 and AWDO 2025 data.

Overall, governance reforms have begun to reshape Pakistan's water management, but outcomes remain constrained by fragmented implementation and systemic underinvestment. Stronger alignment between national policies and subnational delivery, improved institutional capacity, and more inclusive planning will be essential to turning policy frameworks into sustained water security gains.

Findings and Recommendations

Pakistan has built a strong policy foundation, but systemic weaknesses continue to limit progress across all five dimensions of water security. The National Water Policy (2018) introduced IWRM principles and has been reinforced by climate and disaster frameworks. These strategies align with international best practices, covering allocation, resilience, disaster risk, and ecosystems. Yet implementation remains uneven. Responsibilities are fragmented across federal, provincial, and municipal levels, and key institutions often operate in isolation. The absence of a clear coordinating mechanism, particularly in rural service delivery (KD1) and urban water management (KD3), has resulted in low security scores despite improvements in recent years. Establishing a functional coordination platform under the National Water Council, supported by empowered provincial authorities with clear mandates, would improve integration and accelerate reform.

Financing shortfalls continue to constrain water governance. Although public investment has increased, particularly in WASH, funding remains far below the scale required. Urban utilities face low-cost recovery, high nonrevenue water, and limited capacity to maintain infrastructure. Informal settlements in major cities remain underserved, compounding water insecurity. Economic water security (KD2) and urban water management (KD3) are particularly affected, where structural and operational deficits persist. Introducing volumetric water pricing could improve efficiency in agriculture, generate revenues for reinvestment, and strengthen the sustainability of operations across sectors.

Environmental water security is deteriorating despite strong policy recognition. Freshwater and marine ecosystems are under pressure from pollution, flow reductions, and habitat loss. While legal instruments acknowledge ecological needs, enforcement is inconsistent, and monitoring systems are underdeveloped. The absence of dedicated financing further undermines progress. A national river health monitoring system, the implementation of environmental flow standards, and stronger pollution controls would help restore ecological balance. Scaling up coordination among water, environment, and planning agencies will be essential to ensure policy commitments translate into practice.

Water-related disaster security remains highly vulnerable. Pakistan faces repeated floods, and droughts, yet disaster management and water planning remain poorly integrated. Institutional overlap and reactive funding dominate, leaving communities exposed. While risk awareness is increasing, technical capacity and early action remain limited. Forecast-based financing, community preparedness, and integration of water considerations into disaster strategies could help reduce vulnerability.

Water governance needs to become more inclusive. Participation and representation remain limited, particularly for women, minorities, and marginalized groups. Embedding inclusion principles systematically across planning and decision-making would strengthen resilience, align investments with local needs, and reinforce the equity dimensions of water security. IWRM processes provide a clear opportunity to institutionalize this participation.

Independent oversight is required to strengthen accountability and service delivery. Water quality monitoring is uneven, and there is no single authority with the mandate to enforce standards nationally. Establishing an independent federal body for water quality monitoring could assess and regulate the performance of service providers, improve transparency, and build public confidence. Data-driven oversight would particularly strengthen KD1, KD3, and KD4 by ensuring safe drinking water, supporting enforcement, and guiding investment priorities.

In summary, Pakistan's strong policies provide a foundation, but progress depends on turning frameworks into action. Stronger coordination, sustainable financing, inclusive governance, ecological protection, disaster preparedness, and independent oversight are key to translating commitments into measurable improvements across all five dimensions of water security.

Boy refreshing himself from the heat at a community water (Photo by ADB).

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Tajikistan Country Assessment

Summary

Tajikistan's water security assessment provides an overview of progress between 2013 and 2025, alongside water governance performance from 2017 to 2023. It draws on the AWDO framework and SDG indicator 6.5.1 to explore the relationship between governance processes and water outcomes.

Tajikistan has made measurable progress in several dimensions of water security. Notable improvements were observed in rural household, economic, and water-related disaster security. In rural areas, expanded investment in water supply systems has contributed to increased access, though service reliability remains uneven. Economic water security also improved slightly, supported by reforms in basin planning and institutional arrangements. Tajikistan's capacity to manage water-related disasters has strengthened, with enhanced systems for flood and storm response contributing to greater resilience, despite ongoing vulnerability to glacial hazards and extreme weather.

However, progress has been uneven across dimensions. Urban water security has declined over the past decade, largely due to deteriorating infrastructure, high physical losses, and limited investment in operations and maintenance. Despite recent increases in water tariffs, service levels have not yet improved, a lag that often takes several years to resolve. Growing urban populations, coupled with aging systems, place significant pressure on already stretched resources. Environmental water security has also remained largely stagnant. Although regulatory frameworks have improved, ecosystems continue to degrade due to declining water quality, land degradation, and limited enforcement of environmental protections.

Water governance has strengthened since 2020, as reflected in rising scores under SDG indicator 6.5.1. Legal and policy frameworks increasingly reflect IWRM principles, and a national water information system is under development. Institutional coordination has

Tajikistan has made **measurable progress** in several dimensions of water security.

Reservoir for the first level of water liftingat the Khojabakirgan -2 Pump Station (Photo by ADB).

improved, particularly through the establishment of river basin committees, although they remain largely government-dominated and under-resourced. Financing for water infrastructure has increased, with more than $278 million committed across multiple projects. However, funding for governance components, operations, and cross-sectoral integration remains limited, with a continued dependence on development partners.

The relationship between water governance and water security in Tajikistan highlights both progress and gaps. Where governance improvements have been matched with investment and institutional capacity, as in rural water and disaster risk reduction, clear gains have followed. In contrast, urban and environmental dimensions show that legal and policy advances alone are not sufficient. Weak implementation, limited data, and underfunded systems continue to constrain outcomes.

To advance water security, Tajikistan will need to focus on delivering a more effective funding mix, especially in urban and rural supply systems. It will also need to accelerate reforms in agriculture to improve water productivity, invest in smarter technologies to reduce nonrevenue water, and update environmental regulations to better protect water-related ecosystems. Institutionalizing early-warning systems and increasing domestic capacity for disaster risk management will also be critical. Progress will further depend on strengthening transboundary water cooperation, which is vital across Central Asia but currently underdeveloped. In addition, glacial and snow melt, particularly during the summer season, will affect all Key Dimensions of water security and requires integrated planning. With continued commitment and support, Tajikistan can build on its governance reforms to deliver more inclusive, resilient, and sustainable water outcomes.

Review of Tajikistan's Water Security Score

Tajikistan's water security reflects a paradox of abundance and vulnerability. As the upstream source of over 60% of Central Asia's fresh water, the country plays a vital regional role. Yet it faces chronic domestic challenges, including aging infrastructure, limited access to safe drinking water, recurring rural water supply interruptions, and exposure to climate-related hazards. These pressures are compounded by glacial retreat, frequent floods and droughts, and widespread land degradation, threatening both national water security and sustainable development.

Rural household water security (KD1) improved from 6.3 in 2013 to 8.2 in 2025, driven by increased access to drinking water in rural areas and slight improvements in health outcomes. Progress reflects investment in rural water supply programs, although safe sanitation was already high and showed little change. However, weak infrastructure, growing water demand, and energy supply issues continue to limit reliable access in rural regions.

Economic water security (KD2) increased slightly from 9.6 in 2013 to 11.0 in 2025, but challenges persist. Water availability for economic use remains relatively strong, yet agricultural and energy indicators continue to lag. Low profitability, outdated infrastructure, and limited institutional capacity hinder efficient allocation. Fluctuations in the agricultural indicator may reflect climatic variability and shifting levels of project-based support. Industrial water use shows some improvement but remains underdeveloped.

Urban water security (KD3) increased from 12.1 in 2013 to 13.8 in 2025. Tariffs in urban water areas have recently increased. Recent results suggest that this could be a factor in improved urban water services. The Water Sector Strategy and supporting programs have set targets to increase urban service coverage and reduce losses.

Environmental water security (KD4) remained largely stable, decreasing slightly from 12.0 in 2013 to 11.8 in 2025. While Tajikistan scores relatively well on environmental governance, fresh water ecosystem health continues to deteriorate. Land degradation, declining water quality, and inadequate protection of aquatic systems are key concerns. The Catchment and Aquatic System Condition Index dropped slightly in 2025, while groundwater quality and connectivity indicators showed no significant improvement.

Water-related disaster security (KD5) showed the most significant improvement, rising from 8.8 in 2013 to 16.2 in 2025. This reflects reduced drought exposure and stronger national-level systems for managing floods and storms. However, Tajikistan's mountainous terrain makes it highly vulnerable to water-related disasters intensified by climate change, including glacial melt, landslides, and riverbank erosion. While national systems are in place, basin-level disaster risk management remains fragmented and heavily reliant on external support.

Electrician is working at the ANS-2 Pump Station (Photo by ADB).

State of Tajikistan's Water Governance

Tajikistan has made steady progress in implementing IWRM across all four governance dimensions between 2020 and 2023 (Figure 56). According to SDG indicator 6.5.1, the country's overall score improved from 46% in 2020 to 54% in 2023. This progress reflects a broader effort to strengthen the legal, institutional, and financial foundations for water governance, although significant gaps remain in capacity, coordination, and enforcement.

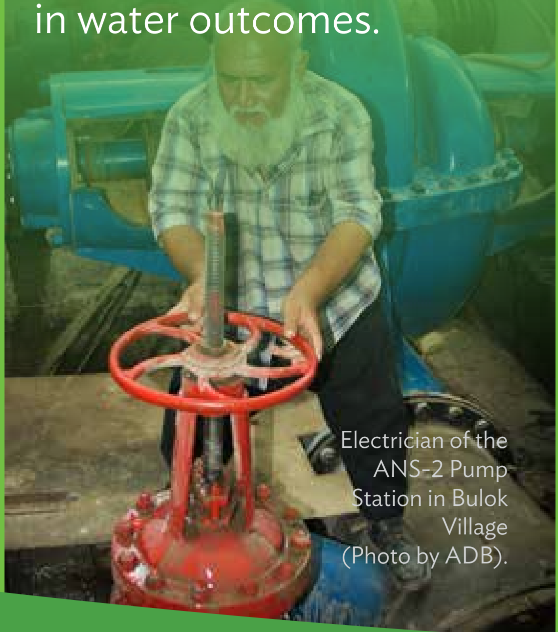
Enabling environment. The enabling environment dimension increased from 49% in 2020 to 61% in 2023. This reflects the adoption of comprehensive water-related laws and policies that align more closely with IWRM principles. Key national strategies, including the Water Code and the National Water Strategy to 2040, have helped create a stronger legal foundation. However, several areas still require enhancement, particularly the development of sub-decrees for reservoir use and the enforcement of legal frameworks. Awareness-raising among water users and beneficiaries at all levels about equitable water use also needs strengthening.

Institutions and participation. Institutional arrangements and participation improved from 43% to 48%. Government agencies have led IWRM implementation, and river basin committees have been formed at both national and subnational levels. These are intended to include a wide range of stakeholders, although they remain government-dominated in practice. Private sector engagement is encouraged but limited by financial constraints and weak coordination mechanisms. Overlapping institutional mandates and capacity shortages further complicate governance.

Management instruments. This increased from 48% to 54%. Progress includes the development of a National Water Information System within the national data center and the approval of basin water resource management plans, such as for the Zarafshon River. However, the data system is not fully operational, and information sources remain fragmented. Limited data integration and weak knowledge bases continue to hinder timely decision-making and risk-informed planning.

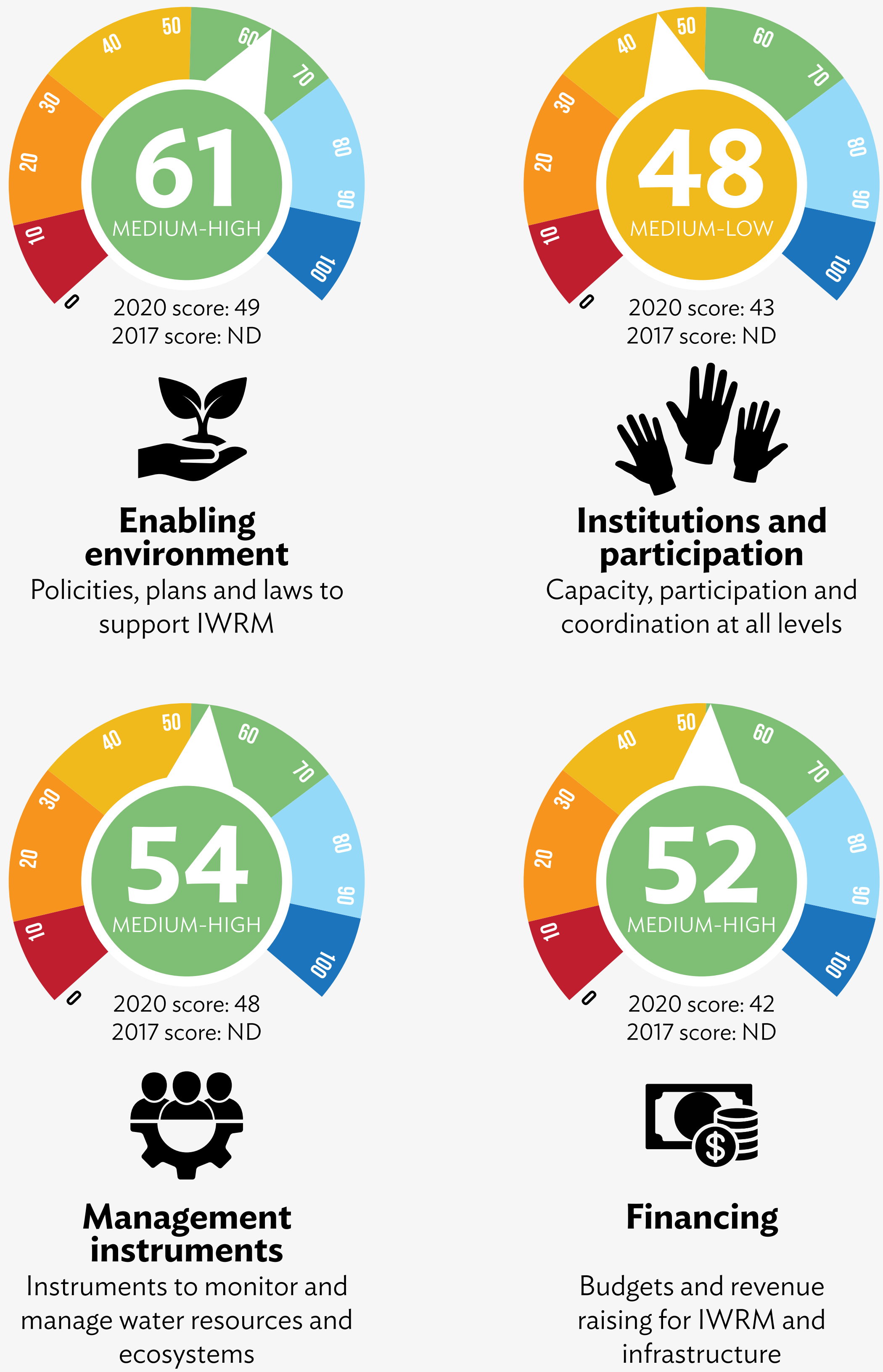
Financing. Financing improved from 42% to 52%. A growing number of projects are underway in the water supply and sanitation sector, with total investments of approximately $278 million. These projects focus heavily on infrastructure rehabilitation and construction. However, financing for governance components remains weak. Limited cross-sectoral integration and low returns from existing investments deter private participation and reduce the effectiveness of available funding.

Overall, while Tajikistan has made visible progress in aligning its water governance framework with IWRM, **further work is needed** to close the implementation gap. Institutional reforms, better data systems, and more sustainable financing will be key to delivering lasting improvements in water outcomes.



Electrician of the ANS-2 Pump Station in Bulok Village (Photo by ADB).

Figure 56. SDG Indicator 6.5.1 And Sub-Components For Tajikistan (2023)



IWRM = Integrated Water Resources Management, SDG = Sustainable Development Goal.
Source: SDG 6.5.1, 2023.

Relationship Between Tajikistan's Water Security and Water Governance

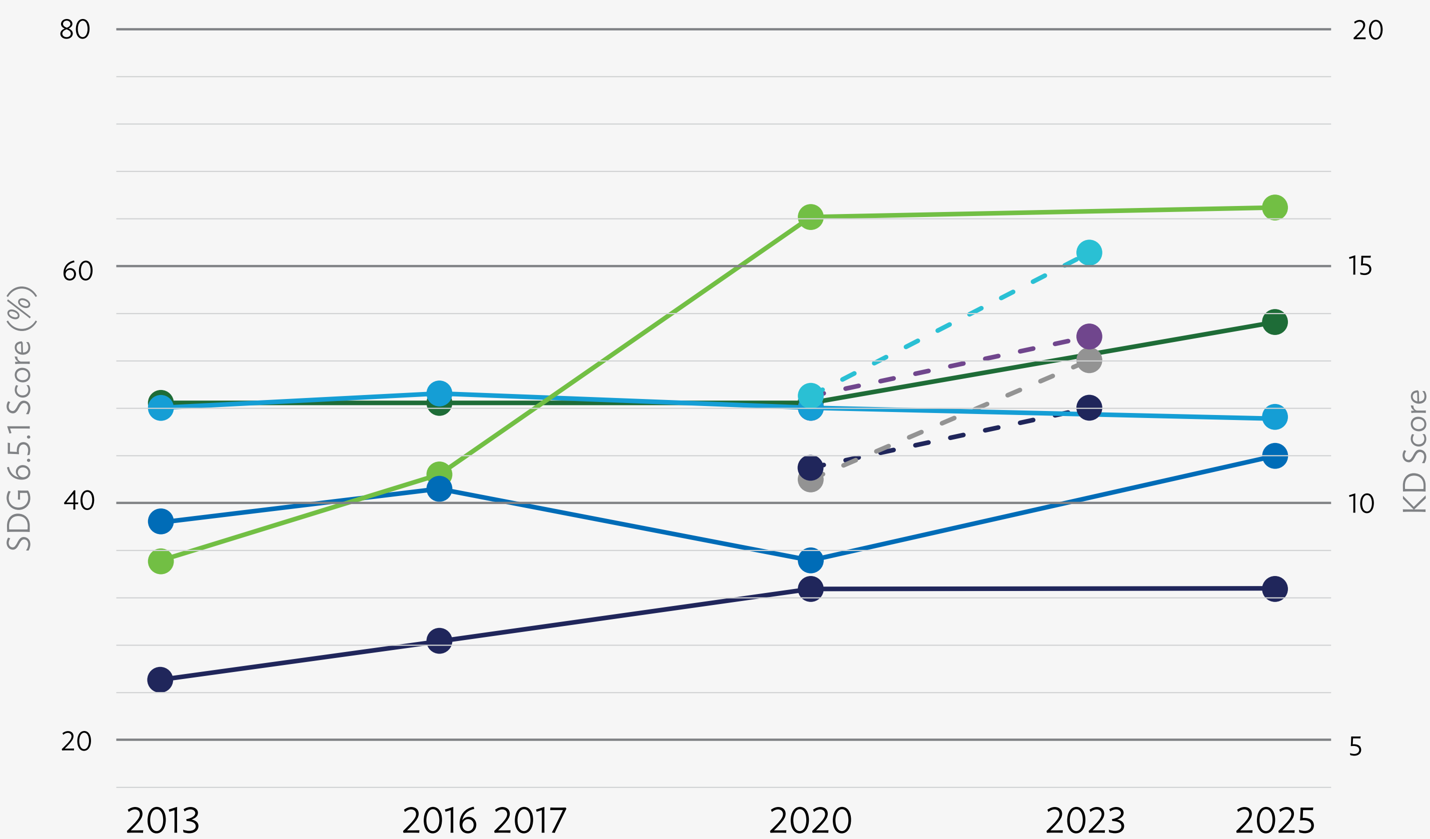
Tajikistan has made moderate but steady progress in both water governance and water security (Figure 57). While these trends show a positive direction, the relationship between improved governance and better water outcomes remains uneven across the five KDs.

Rural household water security (KD1) improved alongside clearer legal and institutional arrangements. Laws such as the Water Code and National Policy on Rural Water Supply Security have established a stronger framework for service delivery. Domestic and external investments have supported sectoral programs, and a monitoring system now tracks rural water availability and use. These gains are underpinned by improved management tools, like the National Water Information System, and participation processes. However, investment levels remain low relative to need, limiting the sector's ability to meet growing rural demand.

Economic water security (KD2) benefited from water sector reforms grounded in IWRM principles. Tajikistan has created basin organizations with mandates and financing plans for water management. While national and decentralized agencies now exist, many operate in silos, and water risks are not yet integrated into economic planning. A financing platform and increased public spending have supported infrastructure development, but private and non-government contributions remain limited. About 60% of sector investments still rely on loans and grants from development partners, underlining the need for more sustainable financial strategies.

Urban water security (KD3) has improved as policies and investments create a stronger enabling environment. Recent tariff increases have helped utilities strengthen services and expand coverage. The Water Sector Strategy

Figure 57. Status of Water Governance vs. Water Security in Tajikistan



and its supporting programs set clear targets to increase urban access and reduce losses. Public spending is also expected to attract more private and donor investment, which, if well directed, can help address remaining challenges.

Environmental water security (KD4) remains one of the weakest links between governance and outcomes. The 2022 Law on Environmental Protection and other sectoral programs have introduced better regulatory tools, but ecosystem management remains basic. Information systems are underdeveloped, and coordination across sectors is weak. Investments in environmental water management are increasing, yet they are not sufficient to reverse degradation trends. Freshwater ecosystems continue to face serious threats, limiting KD4 improvements.

Water-related disaster security (KD5) saw strong improvement, supported by a growing governance framework for disaster risk reduction. Regulatory tools, financial mechanisms, and a national mitigation system for water-related disaster management are in place. However, implementation is inconsistent. A water-related disaster mitigation system has been established at the national level, but it is still fragmented. While at the basin level, it is not yet institutionalized into a regular water governance framework and is therefore very dependent on external support. The absence of stable domestic funding and limited private sector engagement constrain resilience-building efforts. Institutionalizing early-warning systems and risk reduction planning will be critical to sustaining gains in KD5.

KD1
KD2
KD3
KD4
KD5

Enabling Environment
Institutions and Participation
Management Instruments
Financing

KD = Key Dimension.
Sources: SDG 6.5.1 and AWDO 2025 data.

Overall, Tajikistan's experience shows that stronger governance frameworks do not automatically translate into improved water security. Legal and institutional reforms **must be paired** with operational capacity, financing, and effective implementation. Where these elements align, progress has been visible.

ANS-2 Pump Station in Bulok Village (Photo by ADB).

Findings and Recommendations

Tajikistan's water security presents a mixed picture. National frameworks have improved and investments are increasing, but systemic challenges continue to limit progress across KDs.

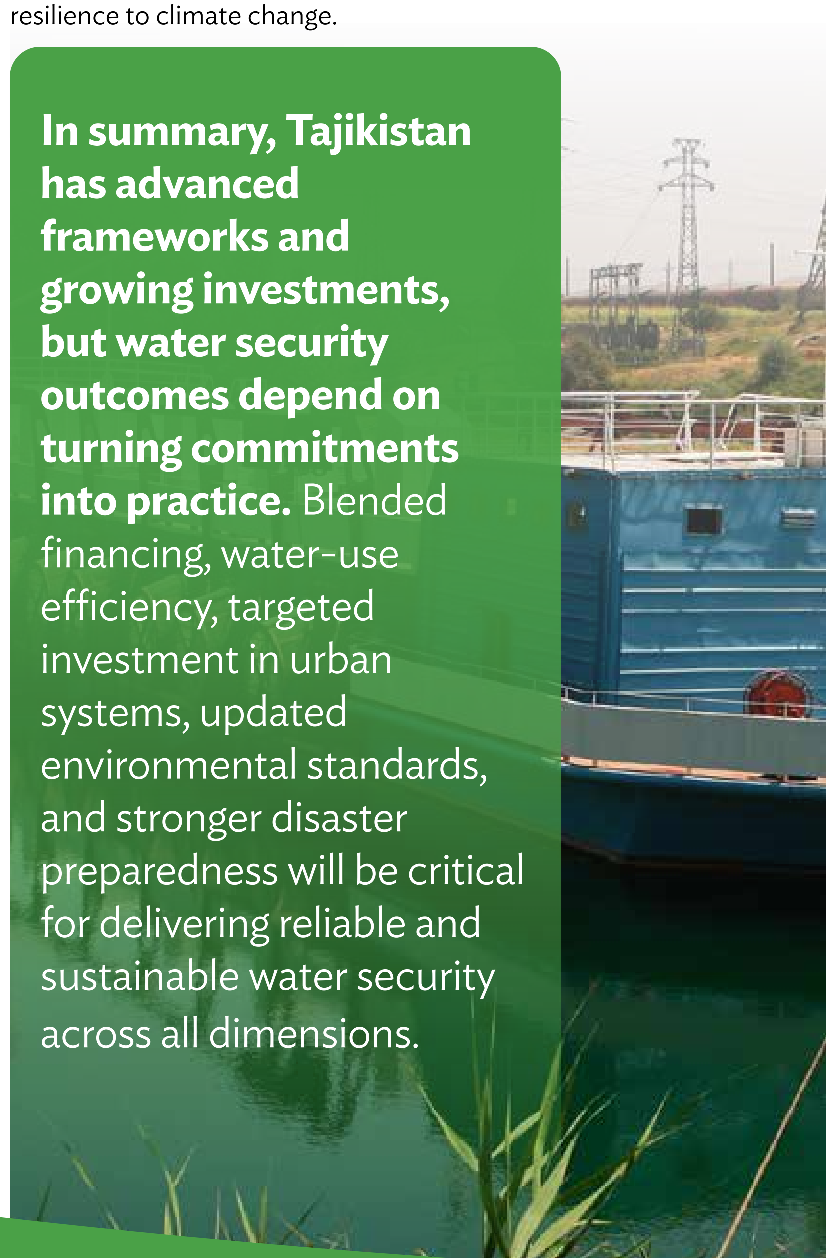
Rural household water security has improved but remains fragile. Many rural areas continue to face unreliable access due to outdated infrastructure, low energy supply, remote water sources, and limited financial resources. Seasonal water quality issues and population growth add further pressure. Expanding blended financing models that combine public and private sector financing could help reduce infrastructure gaps and improve service delivery. Sustainable tariffs and revised tax systems for water-using sectors would also support cost recovery, ensuring rural systems are more resilient and reliable.

Economic water security remains constrained by inefficiency and weak incentives. Agricultural and industrial water use efficiency is low, limited by outdated infrastructure and insufficient finance. Institutional fragmentation and the absence of strong incentives for conservation further reduce productivity. Promoting water-efficient farming, drought-resistant crops, agroforestry, and green technologies would help reduce vulnerability. Inclusive and gender-sensitive approaches will be needed to ensure broad participation in agricultural water reforms.

Urban water security is under growing strain. Rapid urbanization and aging infrastructure have led to poor water quality, frequent leakage, and weak service reliability. Tariffs have increased in 2018, but improvements in service delivery have yet to materialize, reflecting the lag between investment and outcomes. Targeted investment to reduce nonrevenue water, leak detection, and improved water accounting could improve efficiency and align public expectations with future service improvements.

Environmental water security is stagnant and at risk. While river basin plans and environmental laws have strengthened the regulatory framework, ecosystems continue to degrade due to pollution, limited allocation for environmental needs, and weak monitoring. Many basin management rules date back to the Soviet era and no longer reflect current needs. Updating water quality standards, enforcing regulations, and improving monitoring would safeguard fresh water ecosystems. Incentives for compliance, penalties for polluters, and support for local eco-activists could also improve outcomes.

Water-related disaster security has strengthened nationally but remains weak locally. Tajikistan continues to face high risks from floods, glacial hazards, and droughts. Legal and institutional frameworks exist, but early-warning systems and protective infrastructure are uneven and heavily reliant on external support. Expanding and institutionalizing early-warning capacity, backed by legal, technical, financial, and institutional reforms, would reduce disaster risks and improve resilience to climate change.



In summary, Tajikistan has advanced frameworks and growing investments, but water security outcomes depend on turning commitments into practice. Blended financing, water-use efficiency, targeted investment in urban systems, updated environmental standards, and stronger disaster preparedness will be critical for delivering reliable and sustainable water security across all dimensions.

Floating pump station (Pontoon) located in Khojabakirgan, Bobojon Gafurov District (Photo by ADB).

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Pacific Regional Study

Summary

The Pacific currently lacks a robust, widely accepted framework for assessing water security, outside of the AWDO approach. Pacific island nations face distinctive challenges, including small landmasses, limited fresh water catchments, and high exposure to climate change impacts such as sea-level rise and extreme weather events. However, questions have emerged about how well AWDO reflects the actual water security situation in Pacific island countries. This study used expert consultations and a literature review to systematically assess the suitability of the AWDO 2025 methodology in Pacific island contexts, key findings are shown in Table 28.

Four key challenges were identified.

1. **Data reliability is low.** Expert assessments often diverged from AWDO scores across most KDs.

2. **Data availability is limited,** with data for over 20% of indicators missing in the countries assessed.

3. **Some indicators lack relevance**, as they do not reflect local realities.

   a. KD2 includes sectors like industry and energy, which are often less relevant or water-dependent in Pacific contexts. More important sectors, such as tourism and fisheries, are not adequately reflected.

   b. KD4 focuses only on fresh water ecosystems, even though the most critical water-related ecosystems in the Pacific are often saline, including lagoons and coastal areas.

   c. KD5 does not include geophysical hazards such as earthquakes, volcanic eruptions, or tsunamis, despite their significant impacts on water systems in the region.

4. The framework was assessed to be less suitable for small islands and atoll nations than for large islands.

Targeted adaptations are proposed to improve the method's validity and relevance.

- KD1 – Rural household water security is generally suitable but should continue to be reviewed to ensure cultural and contextual fit.
- KD2 – Economic water security sectoral indicators should reflect Pacific economies, allowing countries to adjust or weight sectors such as fisheries and tourism.
- KD3 – Urban water security poor reliability suggests a need for further investigation before changes are made.
- KD4 – Environmental water security should expand to include lagoon and marine ecosystems, with flexible weighting for fresh water and saline systems. Sub-frameworks could better represent different island types.
- KD5 – Water-related disaster security should be broadened to include hazards like earthquakes, tsunamis, and volcanic eruptions, which significantly affect water systems in the region.

These refinements would make AWDO more reflective of the actual needs of Pacific island countries to strengthen their water security, the first step toward improving operations and planning in the region. Although full regional comparability may not be achievable, a more flexible, inclusive framework would better support local decision-making and strengthen water security monitoring in the Pacific.

Table 28. Summary of Findings and Recommendations, Pacific

Key Dimension	Reliability (higher = less reliable)	Missing Data (%)	Relevance	Considerations for adaptation
Rural Household	**1.5**	**17**	• KD1 is the most valid AWDO dimension for the Pacific. • Health metrics may be biased by reporting quality or health care systems.	• No major changes needed; existing indicators are broadly valid for Pacific island contexts.
Economic	**2.0**	**31**	• KD2 is more valid for larger islands, less so for smaller ones. • Many Pacific nations lack water storage infrastructure. • Agriculture and industry are often less relevant than fisheries and tourism, particularly in atoll countries. • The water-energy nexus differs: energy is needed to produce water, not the reverse.	• Allow countries to adjust sector weightings based on national economic relevance. • Enable inclusion of other sectors, e.g., tourism or fisheries, when relevant. • Accept limited comparability due to country-specific sector selection.
Urban	**3.6**	**3**	• KD3 has good relevance and data availability but low reliability. • Reliance on desalination alters Pacific water security economics.	• Investigate reasons for low reliability in expert versus AWDO scores.
Environment	**2.6**	**35**	• KD4 has the poorest relevance and data availability for the Pacific. • Rivers and lakes focus is not suitable for many Pacific nations. • Marine and saline ecosystems are missing from current indicators.	• Include lagoon health and marine water quality indicators. • Enable flexible weighting between saline and fresh water environments. • Develop tailored assessments for large, small, and atoll island types.
Water-related disaster	**3.4**	**28**	• KD5 omits key hazards: earthquakes, landslides, tsunamis. • EM-DAT database lacks complete disaster data for Pacific nations. • Sea-level rise is underrepresented despite its high water security relevance.	• Expand indicators to include earthquakes, volcanic eruptions, and tsunamis. • Use regionally relevant geophysical hazard datasets for consistency. • Maintain comparability across Pacific countries facing similar disaster risks.

AWDO = Asian Water Development Outlook, KD = Key Dimension, KD1 = rural household water security, KD2 = economic water security, KD3 = urban water security, KD4 = environmental water security, KD5 = water-related disaster security.
Source: ADB.

Introduction and Method

AWDO's current method may not fully reflect the unique realities of Pacific island nations. AWDO is designed to assess water security across most ADB DMCs and prioritizes validity and comparability across the wider Asia and Pacific region. As a result, some methodological choices that work for the majority of DMCs may be less suitable for countries with unique geographical and cultural contexts. Pacific island nations face distinctive challenges, including small landmasses, limited fresh water catchments, and high exposure to climate change impacts such as sea-level rise and extreme weather events.

There is currently no robust, widely accepted quantitative water security assessment tailored to the Pacific. While there have been some global and regional water security assessments that have included the Pacific, these have had many gaps in their data and therefore have not been widely used. The challenges mentioned above highlight the need for a more contextually valid AWDO framework for the Pacific.

This study aimed to test the suitability of the AWDO 2025 method for Pacific island contexts. As a first step toward a more valid regional framework, the study focused on assessing whether the AWDO 2025 method accurately reflects Pacific water security conditions. Three sub-objectives guided this process:

1. Select a representative sample of Pacific island nations that capture the region's geographical, cultural, and economic diversity.
2. Evaluate the appropriateness of AWDO's methods, objectives, and definitions in those selected countries.
3. Assess the accuracy and relevance of AWDO 2025 water security results for the Pacific region.

Understanding the suitability of the AWDO 2025 method in the Pacific is a critical first step toward improving ADB operations and project planning in the region. This assessment helps identify where the current approach aligns with Pacific contexts and where it falls short. Building on these findings, more tailored quantitative methods can be developed to better inform water security planning, investment decisions, and long-term resilience strategies across Pacific island nations.

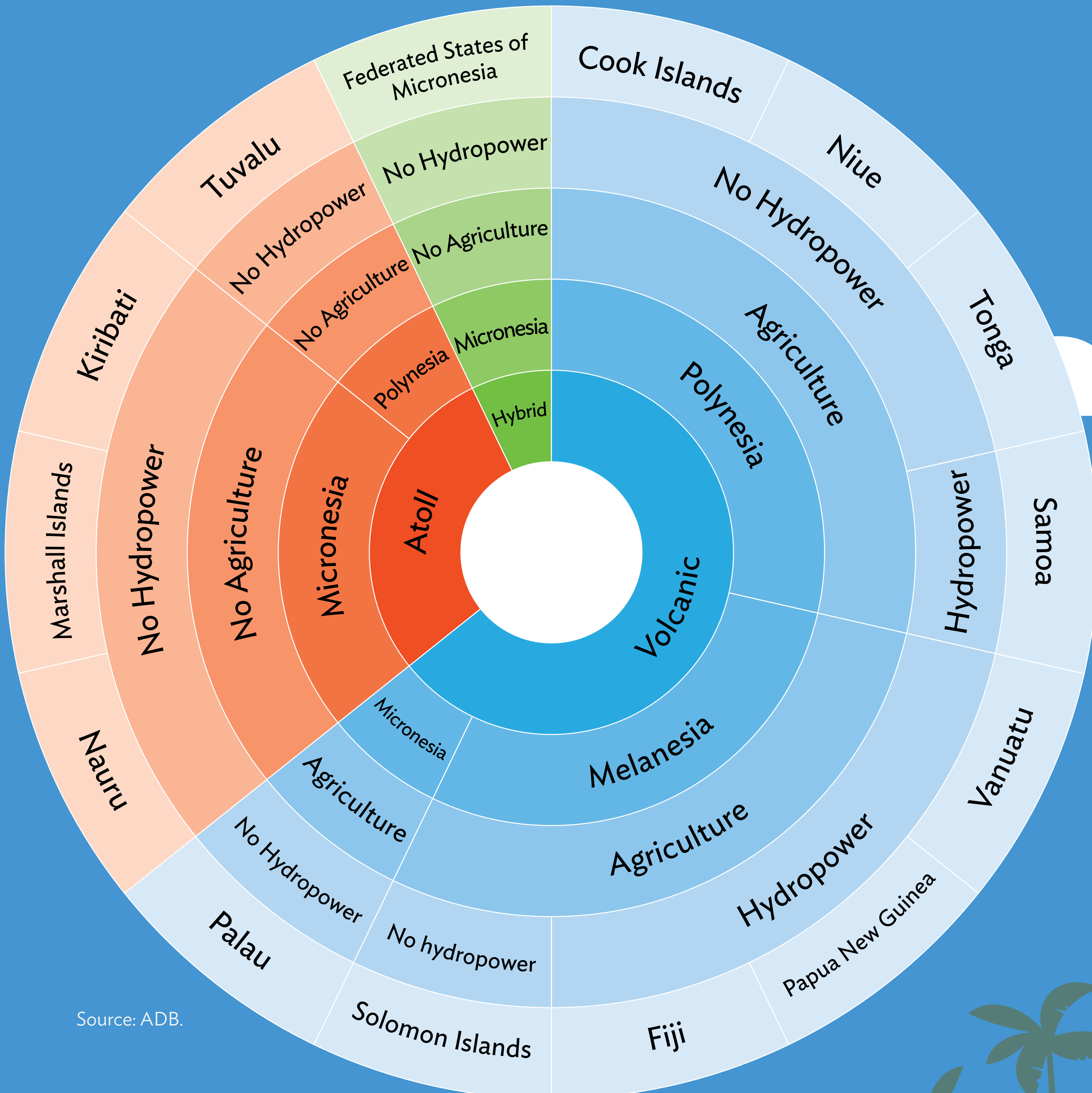
A structured approach was used to identify a representative sample of Pacific island countries. Countries were grouped into five categories based on shared characteristics, including ethnicity, topography, primary industries, and energy sources (Figure 58). A representative country was then selected for each category:

- Large islands with hydroelectricity, represented by Fiji
- Large islands without hydroelectricity, represented by Solomon Islands
- Small islands with agriculture, represented by Tonga
- Small islands with limited or subsistence agriculture, represented by the Cook Islands
- **Atoll nations**, represented by Kiribati and Nauru [9]

Expert consultation and literature review informed the assessment of AWDO's suitability. Following the selection of representative countries, consultations were held with key ADB experts to evaluate the performance of the AWDO indicators in Pacific contexts.[10] Experts provided numerical rankings for each indicator and offered qualitative rationale to explain their scores. They also identified data gaps and assessed the accuracy and relevance of available information for each KD of water security. In parallel, a targeted literature review was conducted to explore previous water security assessments in Pacific island countries, providing additional context and validation.

9. While Nauru is not an atoll, its very small size means that it has the same relevant characteristics.
10. Stephen Blaik, Xueliang Cai, Marc Casas, Edkarl Galing, Bronwyn Powell, Geoffery Wilson, and Allison Woodruff

Figure 58. Different Characteristics of Pacific Nations



Source: ADB.

Results and Discussion

Data reliability was assessed by comparing expert scores with AWDO scores across the KDs. To evaluate the reliability of data used in the AWDO assessment, the standard deviation between the differences between expert-assigned scores and AWDO scores was calculated for each KD. This approach focuses on the variability between scores rather than their absolute values, recognizing the influence of expert bias. A lower standard deviation indicates higher data reliability, while values above two suggest substantial disagreement and reduced confidence in the data. Based on this threshold, all KDs except KD1 showed low data reliability across the selected Pacific island nations, highlighting significant limitations in the current dataset. Figure 59 illustrates the standard deviation for each KD, providing a visual summary of data reliability across the assessment.

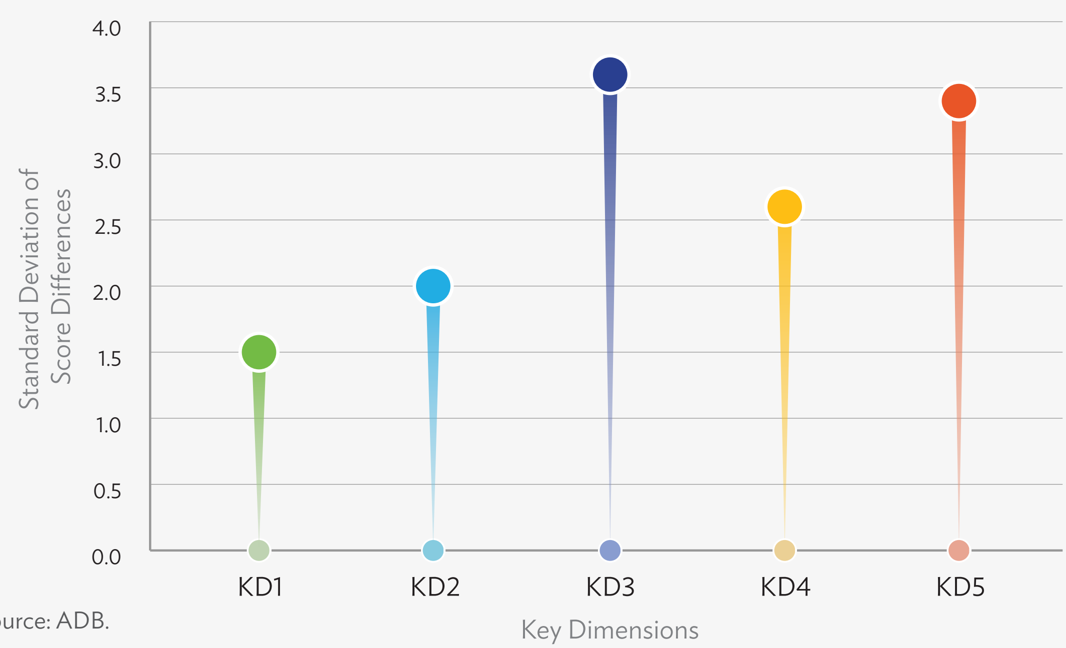
Data gaps were found across all KDs in the Pacific island nations studied. For all but KDs 1 and 3, the average percentage of missing data points exceeded 25%. This indicates a consistent lack of data availability across the key indicators, which limits the applicability of the AWDO method in the Pacific context. These data gaps reduce both the validity of the assessment and the confidence in resulting scores. Figure 60 shows the percentage of missing data points for each KD, highlighting the extent of data availability challenges.

KD1 is the most valid part of the AWDO assessment for the Pacific. Among all five KDs, KD1 was identified as the most applicable to the Pacific context. Expert feedback suggested that the indicators were meaningful, and data availability was strong. However, some concerns were raised regarding health-related metrics. In particular, variations in mortality rates may reflect differences in health care systems or reporting accuracy, rather than the actual performance of WASH infrastructure. This could introduce bias into the assessment and reduce its precision.

KD2 faces major relevance issues in smaller Pacific island countries. While KD2 was found to be somewhat valid in larger island nations, its relevance decreased significantly for smaller islands and atolls. Several challenges were identified:

- Water storage, a major focus of this dimension, is often significantly reduced in smaller countries that often cannot rely on stored surface water. Further, aquifer storage that is at risk of saline intrusion is not a consideration in the current method.

Figure 59. Standard Deviation of the Difference Between Expert Scores and Asian Water Development Outlook Scores



Source: ADB.

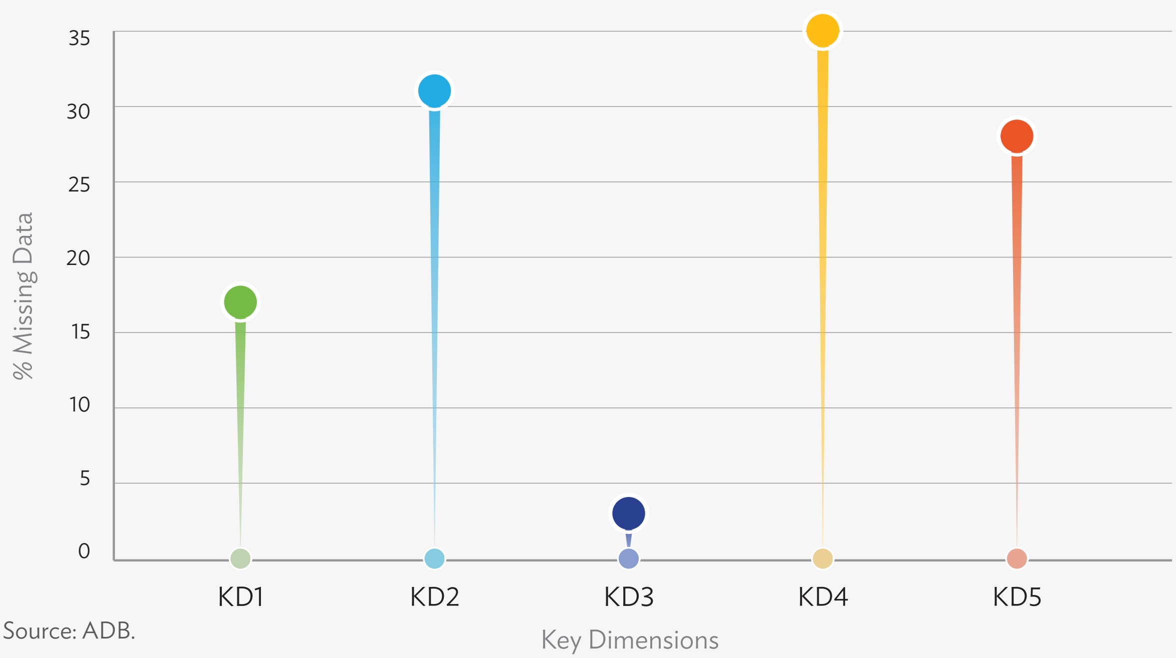
- Agriculture and industry are not major economic sectors in many Pacific nations. Instead, water-related sectors such as fisheries and tourism are more relevant but not captured.
- The water-energy nexus also should be framed differently in the Pacific. While thermal electricity generation (which relies heavily on water) is common in much of Asia, it is rare in the Pacific. Instead, diesel, solar, and hydroelectric sources are the primary sources. Energy remains essential for water production, particularly in atolls and small islands where desalination and groundwater pumping are common. This suggests a need to reframe the nexus for the Pacific: rather than water being needed to generate energy, energy is often needed to produce potable water.

KD3 presents an unusual pattern of low reliability despite good relevance and data availability. KD3 stood out as having relatively high data availability and moderate relevance, yet it showed the lowest reliability when comparing expert and AWDO scores. In several Pacific island countries, reliance on desalination as a primary source of safe drinking water further alters the economics and sustainability of water security, compounding the region's already complex challenges. While these issues reduce KD3's reliability, they are not necessarily unique to the Pacific and may indicate broader limitations.

KD4 had the greatest challenges in both relevance and data availability. KD4, which focuses on environmental water security, is heavily oriented toward rivers, lakes, and fresh water ecosystems, features that are either minimal or absent in many Pacific countries. This leads to substantial misalignment with the ecological realities of the region. Marine and saline ecosystems, which are vital to Pacific island environments, are not included in the current framework. As expected, these relevance issues become more pronounced in smaller island nations, where fresh water systems are limited or nonexistent.

KD5 does not adequately account for the disaster risks relevant to Pacific island nations. KD5 assesses water-related disaster security but overlooks several major hazards critical to the Pacific, including earthquakes, landslides, volcanic eruptions and tsunamis. This omission severely limits its relevance for the region. Additionally, the primary data source for hazard exposure, EM-DAT, has notable gaps for Pacific countries; several significant, well-documented disasters were not captured. Sea-level rise, arguably the most pressing long-term water security threat for many Pacific nations, is only lightly considered in KD5, despite its growing importance.

Figure 60. Percentage of Missing Data in All KDs



Source: ADB.

Case Studies

To explore how the AWDO 2025 methodology may overlook key aspects of water security in Pacific island nations, a series of case studies were developed. Each highlights an issue that is central to the Pacific context but absent from the current quantitative assessment. These cases illustrate important gaps in relevance, particularly for island nations where environmental and disaster-related factors play a major role in determining water security.

Tuvalu is located in the Pacific Ocean (Photo by ADB).

Lagoon Pollution

Lagoon ecosystems are shallow coastal water bodies that support biodiversity, provide natural filtration, and contribute to climate stability. In the Pacific, they also underpin fisheries and tourism, making them central to both livelihoods and food security. However, pollution in lagoons can lead to sharp declines in fish stocks and habitat degradation, affecting subsistence and commercial fishing. Coastal tourism also suffers as the aesthetic and recreational value of beaches and reefs diminishes, while governments often face rising costs related to erosion control, water treatment, and imported food when local systems are compromised.

AWDO does not include lagoon or marine ecosystems in its environmental indicators. KD4 focuses on terrestrial water systems such as rivers and lakes, excluding marine and coastal environments. This exclusion limits the framework's relevance for Pacific nations where lagoon systems are central to human and ecological well-being. It also overlooks the close interconnection between fresh water and marine systems in island contexts.

For atoll nations, lagoon integrity is fundamental to water security. In many Pacific countries, marine territory far exceeds landmass, and rivers may be entirely absent. In these contexts, water security must consider the health of lagoon ecosystems that support food production, cultural practices, and resilience to climate impacts. The current AWDO framework does not reflect this reality.

Earthquakes

In December 2024, a magnitude 7.3 earthquake struck Port Vila, Vanuatu, causing widespread damage to buildings and infrastructure. The city's two main water reservoirs were destroyed, cutting off clean water supplies for thousands of residents. Landslides and aftershocks damaged additional water infrastructure, and long queues formed for bottled water. A boil water notice was issued, but many households lacked the resources to comply.

The public health impacts of the earthquake were immediate and severe. As access to clean water deteriorated, the risk of disease increased. A spike in cases of diarrhea, especially among children, was reported by UNICEF. The main medical facility in Port Vila was also damaged, forcing patients to be moved to a military site and placing further strain on emergency health services.

AWDO does not currently include earthquakes in its assessment of disaster resilience. While KD5 covers water-related disaster security, it primarily addresses floods, droughts, and storms. Seismic hazards such as earthquakes are not included, even though they can destroy water infrastructure, contaminate supplies, and trigger major public health emergencies. For countries located in seismically active zones, like many in the Pacific, this is a critical gap.

Tsunamis and Volcanic Eruptions

Between December 2021 and January 2022, the Hunga Tonga–Hunga Ha'apai submarine volcano erupted three times. The final eruption triggered a tsunami that caused widespread destruction across Tonga, with waves reaching up to 20 meters and affecting more than 80% of the population. Homes were destroyed, infrastructure was damaged, and access to essential services was severely disrupted.

The tsunami contaminated key water sources and compromised long-term water supply. Most Tongan communities rely on rainwater harvesting systems for drinking water. These systems were inundated with saltwater during the tsunami, rendering stored supplies unsafe. Volcanic ash also contaminated catchment areas and collection surfaces. Coastal aquifers experienced saltwater intrusion, and the recovery of these groundwater sources was expected to take between six and 24 months, depending on rainfall and other environmental factors.

The exclusion of geophysical hazards from AWDO limits its relevance for island nations. Despite the scale of the event and its prolonged effects on water quality and availability, AWDO does not include tsunamis or volcanic eruptions in its assessment. The framework's disaster risk indicators are limited to hydrometeorological events, even though geophysical hazards can have equally severe impacts on water systems. This omission is especially problematic for small island states, where the consequences of such disasters are amplified by geographic isolation and limited infrastructure.

Conclusions and Recommendations

While the AWDO framework offers a valuable regional benchmark for water security assessment across Asia and the Pacific, this study found that it does not adequately represent the unique contexts of Pacific island nations. These countries face distinct challenges, such as small landmasses, reliance on marine ecosystems, and frequent exposure to geophysical hazards, that are not captured within the existing structure. As a result, key elements of water security remain under-assessed for much of the region.

Four major issues emerged during the evaluation:

- **Low data reliability**, especially evident in the divergence between expert scores and AWDO results across most KDs.
- **Poor data availability**, with more than 20% of indicators missing in the Pacific countries assessed.
- **Relevance gaps**, particularly in KDs 2, 4, and 5, where indicators did not reflect regional priorities or conditions.
- **Disconnect from lived realities**, as the framework fails to capture key aspects of water security for small island and atoll nations.

To strengthen AWDO's applicability to the Pacific, the following adaptations are proposed for each KD:

KD1: Household water security is largely valid in the Pacific. No significant adaptations are required for KD1 , although ongoing review is encouraged to ensure metrics remain culturally and contextually appropriate.

KD2: Sector relevance must be adjusted for Pacific economies. The method should allow countries to select or weight economic sectors based on relevance. For example, fisheries and tourism may be more important than agriculture or industry in some Pacific contexts. These sectoral adaptations will improve validity but may reduce comparability between countries, and it is unlikely that a comparable assessment in the Pacific can be developed.

KD3: Further investigation is needed to understand reliability issues. Although no immediate changes are proposed for KD3, it had the lowest reliability across all dimensions. A focused investigation is needed to find out whether the metrics or underlying assumptions are misaligned with Pacific realities.

KD4: Marine and lagoon ecosystems must be included. KD4 should be expanded to incorporate lagoon health, marine water quality, and coastal ecosystem services. These indicators are central to environmental water security in the Pacific. Further recommendations include:

- Allowing variable weighting between fresh water and saline environments, based on national context
- Creating three comparable sub-frameworks tailored to large islands, small islands, and atolls
- Recognizing intranational variation, particularly in countries with both large main islands and remote outer islands

KD5: Geophysical hazards should be added to disaster resilience metrics. KD5 should be broadened to include earthquakes, volcanic eruptions, and tsunamis, which have significant and well-documented impacts on Pacific water systems. This adapted approach is likely to remain comparable across the region, given the shared exposure to these types of risks.

By incorporating these targeted adaptations, AWDO can evolve into a more inclusive and context-sensitive assessment tool. A revised method will more accurately reflect the diverse water security challenges of Pacific island nations and contribute to stronger regional and global monitoring of water resilience.

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Water distribution system in Chuuk, the Federated States of Micronesia (Photo by ADB).

5 CONCLUSIONS

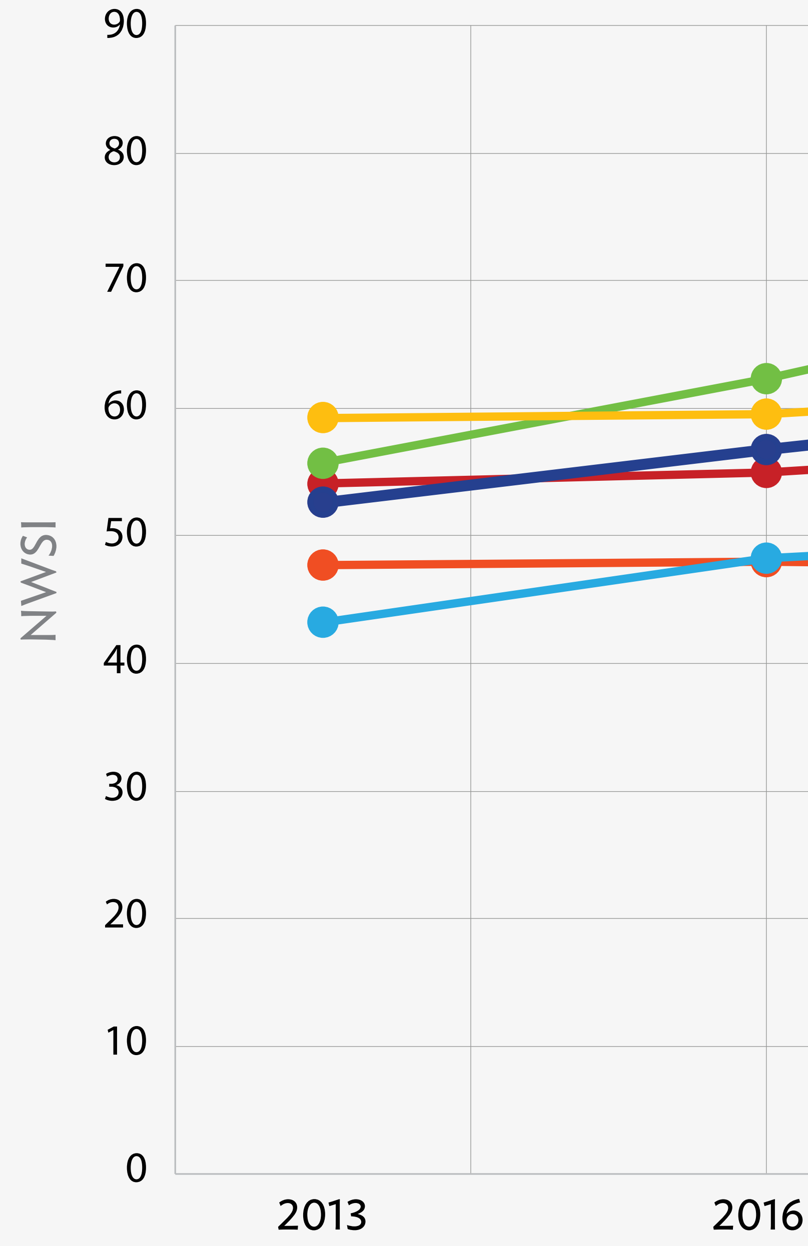
Quantitative Results Across All Key Dimensions

Water security has steadily improved across the Asia and Pacific region over the past 12 years. The National Water Security Index (NWSI) increased during each reporting period: 2013–2016, 2016–2020, and 2020–2025. The largest gain occurred between 2016 and 2020, largely driven by improvements in the PRC. Despite this peak, progress has been relatively steady across all periods. Most subregions showed similar patterns of gradual improvement. The Pacific was the exception, with little change until 2020–2025.

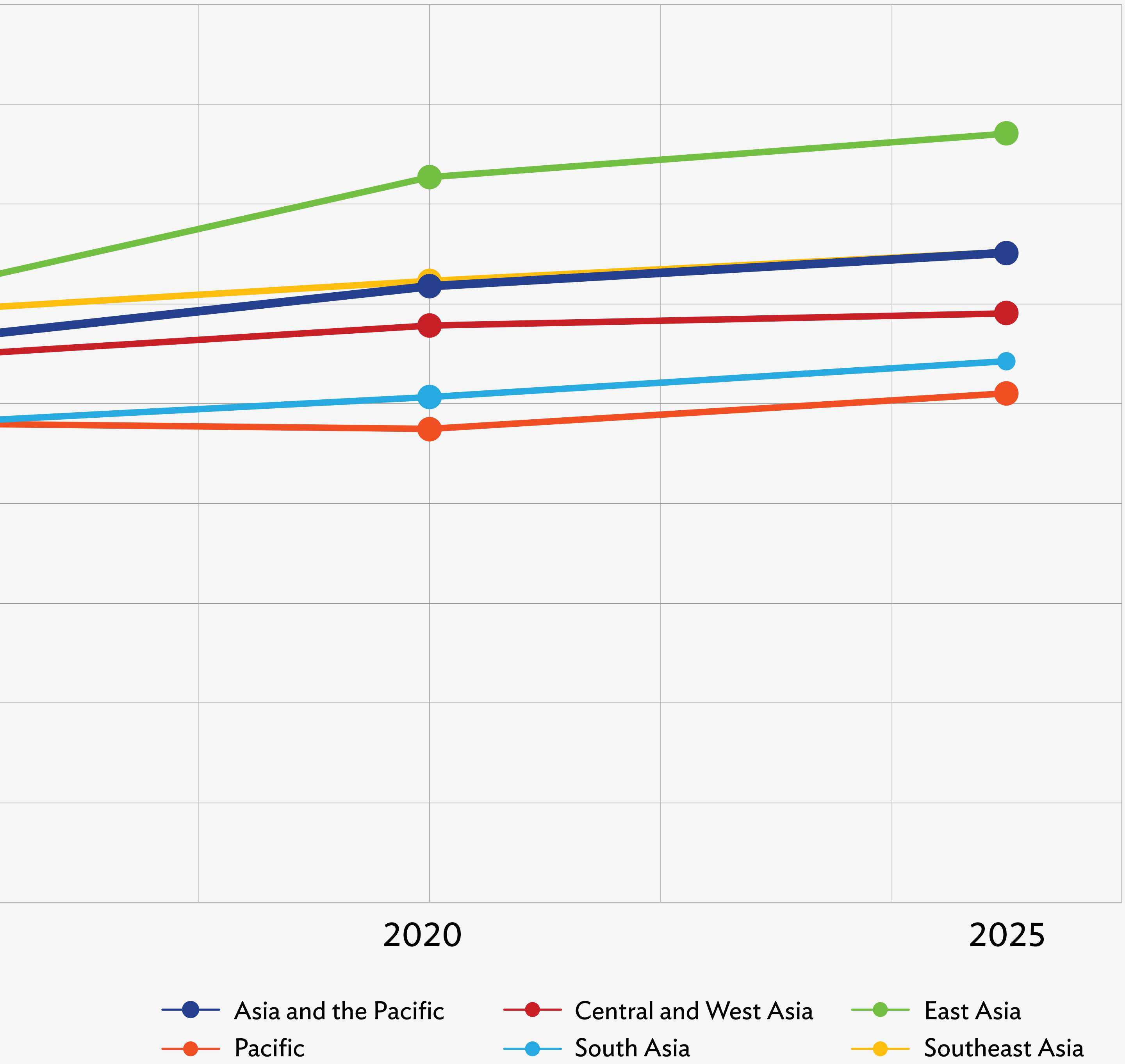
Progress across the five KDs has varied. KDs 1, 3, and 5 broadly mirrored the overall NWSI trend. KD2 improved during 2013–2016 but has remained flat since. KD4 showed no significant change across all three reporting periods. The NWSI scores are shown in Figure 61.

The PRC has shown the **most substantial** overall improvement, followed by the Lao PDR, Cambodia, and India. However, it is important to consider where countries started. Gains made by countries rated as *Nascent* or *Engaged* in 2013 represent **larger leaps** from a lower baseline.

Figure 61. National Water Security Index Scores



Source: ADB.



2020
2025
Asia and the Pacific
Central and West Asia
East Asia
Pacific
South Asia
Southeast Asia

Table 29 highlights the top three improvers for each KD and the overall NWSI, including notation for countries that started from lower security categories in 2013.

Table 29. Top Performers for each KD and the National Water Security Index

KD1	KD2	KD3	KD4	KD5	NWSI
PRC	Lao PDR (N)	Lao PDR (N)	Tonga (E)	PRC (N)	PRC
Nepal (N)	PRC	Cambodia (N)	Cook Islands (E)	Tajikistan (E)	Lao PDR
Philippines (E)	Bangladesh (E)	Timor-Leste (N)	Niue (N)	Thailand (N)	Cambodia
India (N)	Vanuatu (N)	Azerbaijan	Kazakhstan (E)	Cambodia (E)	India

PRC = People's Republic of China, E = *Engaged* in 2013, KD1 = Key Dimension 1 (rural household water security), KD2 = Key Dimension 2 (economic water security), KD3 = Key Dimension 3 (urban water security), KD4 = Key Dimension 4 (environmental water security), KD5 = Key Dimension 5 (water-related disaster security), Lao PDR = Lao People's Democratic Republic, N = *Nascent* in 2013.
Refer to the Pacific Regional Study for more details on AWDO data for the Pacific.
Source: ADB.

While overall water security scores provide a useful summary, it is also important to examine where countries are most vulnerable. Until now, the analysis has focused on the total score across the five KDs. However, looking at the lowest-scoring KD in each country highlights areas of persistent insecurity. KD4 (environmental water security) is the most common weakest KD across the Asia and Pacific region. This pattern is especially clear in Central and West Asia, where every country had KD4 as its lowest or equal lowest-rated dimension.

Table 30. Definitions of the Water Security Steps for each Key Dimension

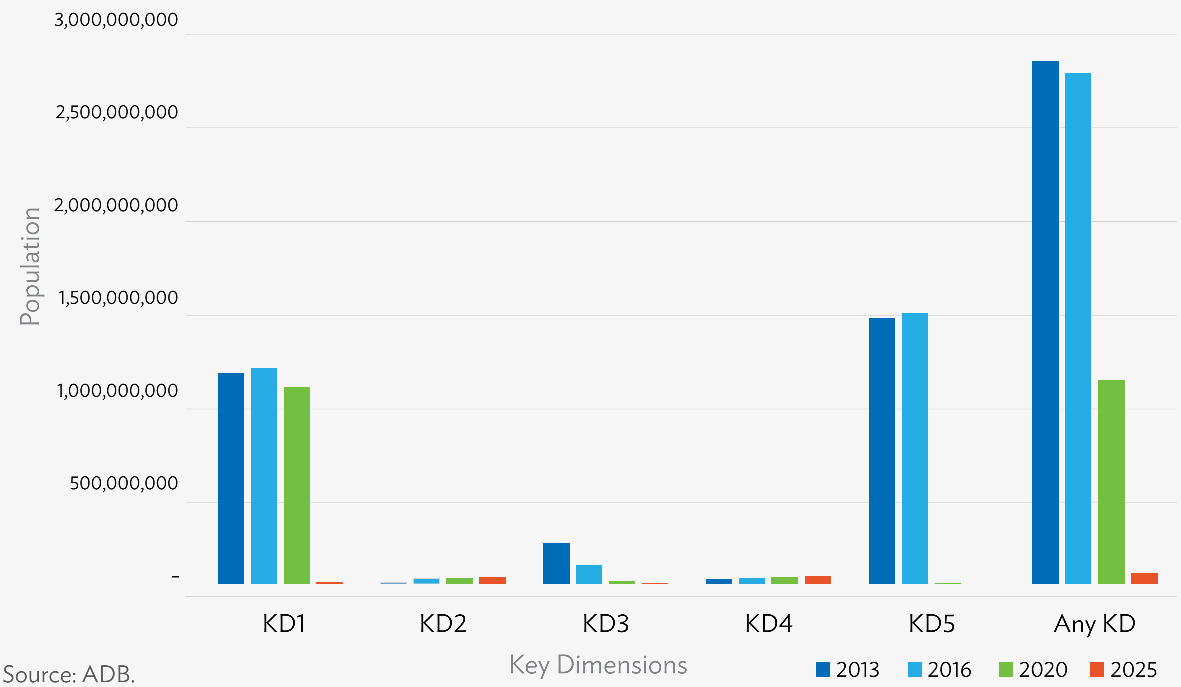
Step	KD1	KD2	KD3	KD4	KD5
Model	Nearly all rural households have safe water, toilets, and hygiene.	Water is well-managed and used efficiently across sectors.	Cities have safe, inclusive services and low flood risk.	Ecosystems are healthy with strong protections.	Disaster risks are well-managed across all levels.
Effective	Most rural people have safe water and toilets; health is improving.	Most needs are met; systems manage risks well.	Most people access basic, inclusive services.	Environmental rules work in most places.	Strong disaster policies are in place and used.
Capable	Basic services are common but not always safe or reliable.	Some systems work, but big gaps remain.	Basic services exist; one area may lag.	Some protections exist, but pressure remains.	Risk planning exists but is not yet widespread.
Engaged	Access is common, but service quality is poor.	Water is poorly managed with major gaps.	Many struggle to access services.	Protections are weak and ecosystems under strain.	Some efforts made, but many at risk.
Nascent	Few have safe water or sanitation; disease is common.	Water systems are mostly absent or failing.	Most lack access to services.	Ecosystems are in crisis with little protection.	Little or no action; most are unprepared.

Note: The national water security step is the lowest of any Key Dimension step.
Source: ADB.

Despite challenges and population growth, the number of people facing the highest level of water insecurity is **falling dramatically.**

Despite challenges and population growth, the number of people facing the highest level of water insecurity is falling dramatically. In 2013, 2.8 billion people in the Asia and Pacific region were exposed to the highest level of risk on one or more Key Dimensions of water security, and by 2025, this number has decreased to 55 million, a reduction of 98%. Figure 62 shows a sharp decline in the population exposed to the most severe insecurity in any single KD, especially during the most recent reporting period. This positive trend has been driven largely by India's progress in KD1 (rural water security) and the PRC's progress in KD5 (water-related disaster security). The results highlight a steady shift, with fewer people living in countries where any KD remains at the lowest water security step. Not only have billions of people moved from *Nascent* to *Engaged*, but the *Capable* and *Effective* levels are also increasing. However, much work remains. Of the region's 4.4 billion people, around 4 billion still live in countries rated at the *Engaged* step. Further gains in overall water security will require improvements in environmental water security. In 2013, it was rural household water security and water-related disaster security that kept many countries stuck in the *Nascent* step. Today, it is environmental water security (KD4) that is holding most countries in the *Engaged* step.

Figure 62. Population in the Asia and Pacific Region Exposed to Nascent Water Security



Source: ADB.

Summary of Progress

Most economies have targeted improvements in their weakest areas. While few have made gains across all five KDs, most have improved in the dimensions where water insecurity was most acute. This suggests that both domestic efforts and development support are being directed toward areas of highest need, helping to close the gap between low- and high-performing KDs.

Table 31 provides the full summary of changes across all five KDs for every economy from 2013 to 2025.

Table 31. Increase in Scores (2013–2025)

Economy*	Key Dimensions of Water Security					NWSI
	KD1	KD2	KD3	KD4	KD5	NWSI
	Index 1–20					Out of 100
Armenia	2.2	–0.1	–0.4	–1.4	1.6	**1.9**
Australia	–	0.3	0.4	0.8	0.6	**2.2**
Azerbaijan	3.4	–1.1	5.4	0.6	1.8	**10.1**
Bangladesh	2.1	2.8	1.7	0.0	2.1	**8.6**
Bhutan	4.0	1.9	3.3	–1.4	1.4	**9.2**
Brunei Darussalam	0.3	0.2	3.2	–0.2	1.3	**4.8**
Cambodia	3.0	–0.9	8.3	0.2	5.1	**15.8**
China, People's Republic of	5.6	4.1	3.3	0.6	9.0	**22.6**
Cook Islands	–1.1	2.7	0.0	4.5	3.2	**9.3**
Fiji	2.2	0.8	–0.8	–1.7	0.4	**0.8**
Georgia	3.0	1.3	1.3	0.3	–1.4	**4.5**
Hong Kong, China	–	0.5	0.0	–0.3	2.0	**2.2**
India	4.6	2.2	5.0	0.6	2.6	**15.0**
Indonesia	3.4	1.0	2.9	0.0	–0.2	**7.2**
Japan	–	0.0	0.0	0.7	0.9	**1.6**
Kazakhstan	2.0	0.7	0.0	1.5	0.3	**4.6**
Kiribati	2.7	2.8	1.7	0.0	0.9	**8.0**
Korea, Republic of	–	0.2	0.4	–0.2	1.5	**1.9**
Kyrgyz Republic	3.7	–0.5	1.7	–0.9	3.8	**7.8**
Lao People's Democratic Republic	4.4	4.3	9.2	0.5	–0.9	**17.4**
Malaysia	–0.1	0.6	0.0	0.9	0.3	**1.6**
Maldives	1.7	2.2	0.0	0.0	0.1	**3.9**
Marshall Islands	2.9	2.3	–0.4	–0.5	–4.8	**–0.5**

Economy*	Key Dimensions of Water Security					NWSI
	KD1	KD2	KD3	KD4	KD5	NWSI
	Index 1–20					Out of 100
Micronesia, Federated States of	1.0	–1.3	3.3	–2.7	–3.6	**-3.3**
Mongolia	3.3	1.1	5.0	0.6	1.8	**11.7**
Myanmar	1.4	1.7	2.9	–1.4	0.4	**4.9**
Nauru	–	1.4	0.0	–2.5	0.4	**-0.7**
Nepal	5.5	0.3	3.3	0.8	1.2	**11.1**
New Zealand	–	–0.2	–0.8	–1.9	0.9	**-1.9**
Niue	0.4	4.7	0.0	4.4	4.5	**9**
Pakistan	3.5	0.9	1.7	–0.4	0.8	**6.4**
Palau	–0.1	0.7	–0.4	1.5	–4.4	**-2.7**
Papua New Guinea	2.0	2.0	0.0	1.5	1.1	**6.6**
Philippines	5.4	0.0	3.3	–1.1	2.6	**10.2**
Samoa	1.7	2.4	5.4	–0.1	0.5	**9.9**
Singapore	–	0.8	0.0	0.2	0.3	**1.3**
Solomon Islands	–0.2	0.8	–0.4	–1.7	1.2	**-0.3**
Sri Lanka	1.7	1.9	3.3	0.8	3.6	**11.3**
Taipei,China	–	–0.4	0.0	–0.9	1.1	**-0.2**
Tajikistan	1.9	1.5	1.7	–0.2	7.4	**12.2**
Thailand	0.9	0.6	0.0	–0.5	7.1	**8.1**
Timor–Leste	4.3	0.4	6.3	–0.9	–1.0	**9.1**
Tonga	0.8	3.5	1.7	5.5	–0.6	**11.0**
Türkiye	2.0	0.9	2.1	0.0	0.7	**5.6**
Turkmenistan	3.9	2.4	1.8	–0.9	0.3	**7.5**
Tuvalu	2.3	4.7	–0.4	0.0	–7.3	**-0.7**
Uzbekistan	3.9	1.7	0.0	0.0	0.5	**6.1**
Vanuatu	0.2	2.8	–0.4	–0.4	1.1	**3.2**
Viet Nam	3.4	1.9	3.3	–2.3	3.7	**10.0**

**A full list of Asian Development Bank members and their region can be found at https://www.adb.org/where-we-work.*
Pakistan is categorized under Central and West Asia and Timor-Leste under Southeast Asia.
Experts have not been able to verify the data on Afghanistan, and therefore, the scores will not be presented in this table.
Source: ADB.

Correlation with ADB Projects

An exploratory review assessed the correlation between ADB projects and water security improvements. A total of 145 completed projects were reviewed, covering initiatives with start dates as early as 2003 and completion through to 2024, to determine whether a plausible relationship existed between project focus and trends in the relevant KD. For instance, a project targeting agricultural resilience in Thailand would be expected to affect KD2. Table 32 shows the number of projects and countries considered in the analysis.

Table 32. Number of Projects and Economies Considered in the Correlation Analysis

	KD1	KD2	KD3	KD4	KD5
Number of Projects	14	21	79	14	17
Number of Economies	9	9	22	3	8

KD1 = Key Dimension 1 (rural household water security), KD2 = Key Dimension 2 (economic water security), KD3 = Key Dimension 3 (urban water security), KD4 = Key Dimension 4 (environmental water security), KD5 = Key Dimension 5 (water-related disaster).

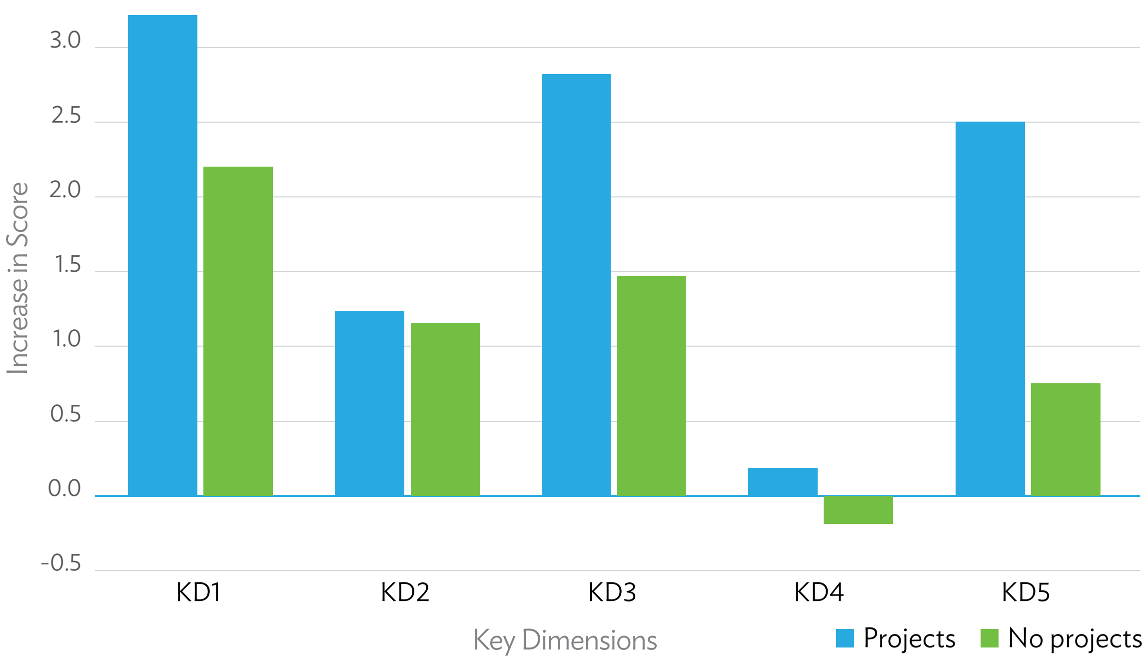
Source: ADB.

Children fetching water from an the Asian Development Bank supported kiosk in Sainshand (Photo by ADB).

This analysis identifies broad correlations but cannot determine causation. While some increases in water security scores may align with ADB project timelines, many external factors affect outcomes. Therefore, results should be interpreted as indicative rather than definitive.

Around 75% of projects showed a positive correlation between their focus and improvements in the relevant KD. Most ADB projects were associated with gains in national KD scores, but the strength of this relationship varied. KD1 (rural household water security) and KD5 (water-related disaster security) showed the clearest improvements in countries with ADB projects. KD3 (urban water security) and KD4 (environmental water security) also recorded progress, though more modestly. By contrast, KD2 (economic water security) showed little measurable change in both countries with ADB projects and those without (Figure 63).

Figure 63. Increase in each KD Score – Countries with ADB Projects and Countries Without



KD1 = Key Dimension 1 (rural household water security), KD2 = Key Dimension 2 (economic water security), KD3 = Key Dimension 3 (urban water security), KD4 = Key Dimension 4 (environmental water security), KD5 = Key Dimension 5 (water-related disaster).

Note: Due to concerns with robustness, in the analysis for KD2 and KD4, Pacific countries have not been considered. No Pacific countries hosted ADB projects relevant to these two KDs.

Source: ADB.

Another analysis examined the time lag between project implementation and the largest observed water security improvement. About 60% of projects reached their peak impact within 5 years of implementation, 30% between 5 and 10 years, and 10% after more than 10 years. On average, projects took 5 years before impacts were measurable.

KD3 and KD1 closely followed the average. KD2 had more delayed impacts, with a larger share of projects showing peak results over the longer term and an average of 7 years for measurable impacts. This may reflect that these dimensions involve more long-term "impact" indicators. By contrast, KD5 had a higher share of projects with immediate improvements and an average of 4 years before impacts could be measured, which supports the KD5 finding that capacity has the strongest correlation with water-related disaster security, as projects that improve capacity would typically deliver quick results. This analysis could not be completed for KD4.

Findings from Asian Water Development Outlook 2025

Water security in Asia and the Pacific is improving, but the region remains far from secure. Over the past 12 years, countries have focused on their weakest dimensions first, often rural household services or disaster resilience, and this strategy has delivered results. NWSI has increased in most countries, lifting billions of people from the lowest tiers of water insecurity.

The lesson is clear: water security improves when systems are inclusive, reliable, and well-governed, not just when infrastructure is built. Infrastructure without reliable services or ecosystem support often fails to deliver the anticipated outcomes. Bangladesh and Viet Nam have made steady gains in water security through investments in water-efficient agriculture, improved data use, and integration of water management with national planning. Tajikistan's experience reinforces that reforms ensuring tariffs cover service costs while remaining inclusive can drive sustained improvements in urban water supply and overall water security. Holistic service delivery, which integrates safe water, sanitation, and hygiene, is strongly linked to improved health, but many countries have not yet aligned systems to achieve this.

A Widening Investment Gap

The Asia and Pacific region faces an estimated $4 trillion water investment need for WASH infrastructure by 2040, about $250 billion per year. Current public spending covers less than half of this requirement, leaving a yearly shortfall of over $150 billion. MDBs approved just $19.6 billion globally to water infrastructure, including WASH in 2024.

This gap cannot be closed by infrastructure finance alone. MDB resources should be used to catalyze larger flows of private and domestic finance. Blended finance and green bonds show promise as potential models for bridging this gap and enabling a more water secure future for the Asia and Pacific region. Investment should prioritize efficiency, inclusivity, and governance alongside physical infrastructure.

Rising Climate Risks

Climate and disaster risks are outpacing readiness. From 2013 to 2023, the region experienced 244 major floods, 104 droughts, and 101 severe storms. Asia accounts for 41% of global flood events, affecting more than 1.2 billion people in the PRC and India alone. Small island nations in the Pacific are highly exposed to sea-level rise, storm surges, and saltwater intrusion.

Adaptation remains fragmented and underfunded. Early-warning systems often exist but are not integrated into finance or local planning. Budgets prioritize response over prevention, leaving resilience measures weak. Governance gaps, rather than data shortages, are the main barrier to progress. First responders, local governments and community organizations, require stronger mandates, resources, and support to act effectively.

Ecosystems and Trade-Offs

Environmental water security is the region's looming problem area in 2025. Rivers, wetlands, and aquifers are being degraded by unchecked development, pollution, and land conversion. If ecosystems collapse, infrastructure cannot compensate. Deforestation in Cambodia and riverbed mining in Nepal already show how environmental decline undermines broader water security.

Countries are also struggling with trade-offs. Gains in rural, urban, and economic water security risk being undermined by losses in ecosystem health and disaster resilience. Without careful balance, improvements in one dimension may lead to deterioration in another.

Governance as the Foundation

Governance determines whether investments deliver results. Many countries have policies but lack enforcement, data sharing, or local capacity to implement plans. Progress depends on institutional strengthening, social inclusion, and accountability at all levels.

Local governance is especially important. National strategies cannot succeed without empowered municipalities and communities. AWDO data shows that social cohesion explains more than half the variation in disaster resilience. Trust, participation, and inclusive leadership determine whether investments reach the last mile. In Bangladesh, youth-led groups have mobilized resources for flood relief; in the Philippines, women-led user groups are improving utility trust and performance. These are real-time models of effective governance.

The Way Forward

AWDO 2025 shows that water security progress is possible, but it is fragile. Future gains depend less on infrastructure expansion and more on whether systems are inclusive, resilient and sustainable. Aligning health outcomes, governance reforms, and catalytic finance with collective action will be key to ensuring a water-secure Asia and Pacific. Following are some steps toward the way forward:

- Shift objectives from infrastructure to water security. The focus must move from building systems to ensuring they deliver safe, reliable, and affordable services that improve health and water security outcomes.
- Catalyze MDB resources. MDB contributions are small compared with needs, but they can play a catalytic role in unlocking larger financial flows when designed with appropriate safeguards.
- Promote collective action. Governments, MDBs, and partners should develop a shared action plan to align investment, governance, and resilience.
- Strengthen governance and first responders. National reforms must be matched by empowered local governments and inclusive institutions capable of acting on climate and disaster risks.
- Introduce subnational assessments and more frequent updates. Subnational water security assessments can provide timely, targeted evidence to guide decision-makers and track progress.

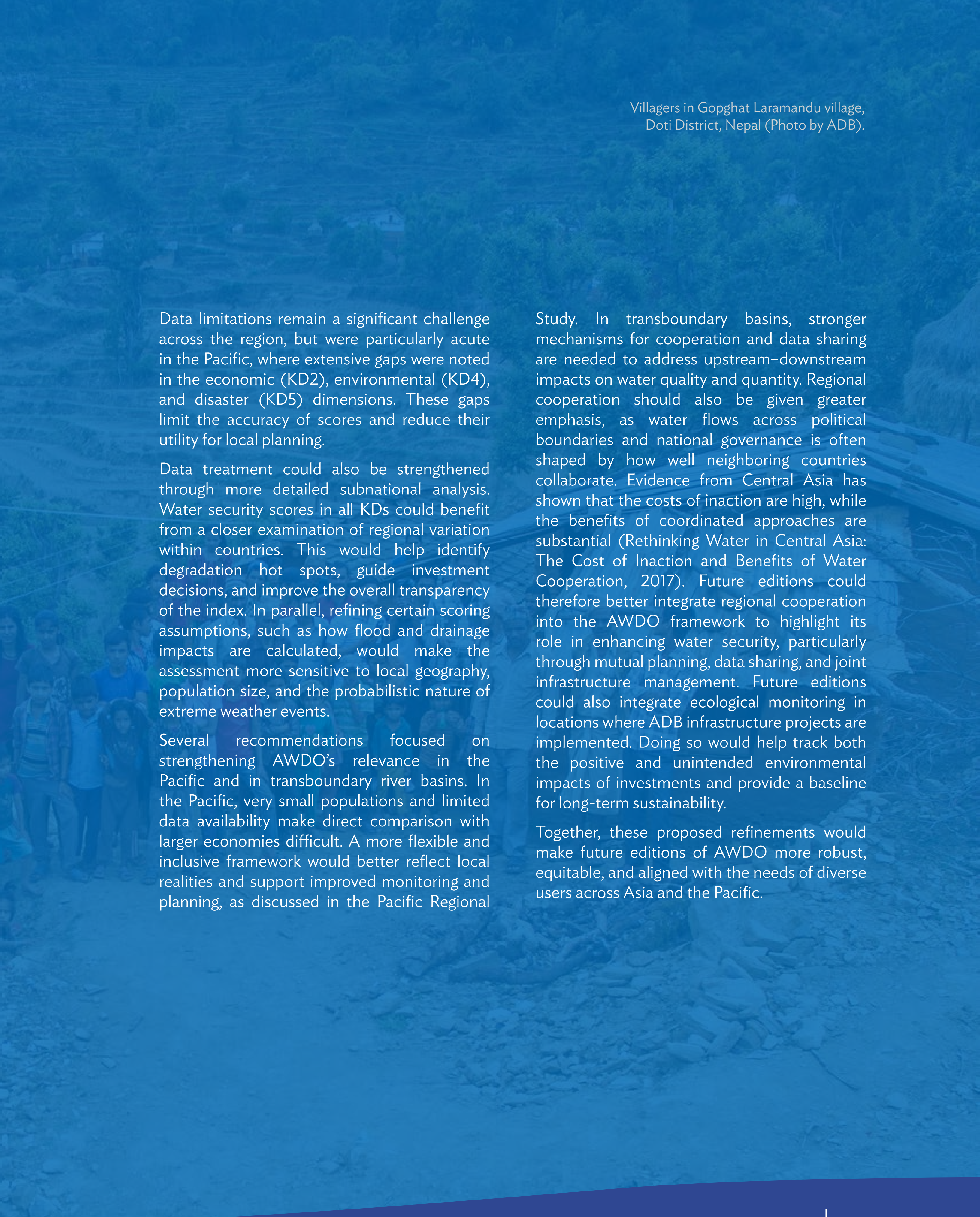
Directions for Asian Water Development Outlook

The AWDO method is a living approach that will continue to evolve. Future editions will build on lessons from this cycle, improve indicator coverage, and explore ways to further integrate climate risk, gender and social equity, and inclusivity more effectively. Authors contributing to AWDO 2025 have identified several areas for refinement to strengthen the accuracy, transparency, and relevance of the framework across diverse country contexts. These improvements will help ensure that the assessment remains credible and practical for decision-making.

It is important that this process does not stop with AWDO 2025. Stakeholders are urged to continue building on the method, both to address emerging challenges and to reinforce its role as a shared reference point. Sustained collaboration will be essential to build consensus and establish a more uniform approach to measuring water security, one that reflects the region's diversity while supporting a common understanding of progress.

A key improvement for AWDO is to better integrate future risks into the assessment. The current framework relies heavily on historical data, which limits its ability to capture emerging threats. Incorporating forward-looking indicators on climate change, ecological vulnerability, and disaster risk would strengthen its capacity to anticipate change and guide resilience planning. One approach is strategic foresight, which helps organizations think ahead and prepare for different possible futures rather than relying only on experience. It does this through methods such as spotting early-warning signs, testing "what if" scenarios, and examining how current trends may evolve. Applying strategic foresight would allow AWDO to identify risks before they escalate and to design plans that remain flexible under different future conditions.

Urban water affordability would be a beneficial inclusion in future versions of AWDO. However, due to its complexity, it can often be misleading. While water affordability is an important consideration, low water tariffs do not always reflect better water security. AWDO 2025 includes several examples of countries where service quality and coverage remain limited due to revenue linked to low tariffs. The current affordability narrative indicator captures what households pay, not whether utilities recover enough revenue to maintain services or expand infrastructure. Without consistent cost-recovery information, it is impossible to tell whether low tariffs support equity or lead to poor operations and maintenance. A more comprehensive indicator linking affordability and financial sustainability would strengthen future assessments.



Villagers in Gopghat Laramandu village, Doti District, Nepal (Photo by ADB).

Data limitations remain a significant challenge across the region, but were particularly acute in the Pacific, where extensive gaps were noted in the economic (KD2), environmental (KD4), and disaster (KD5) dimensions. These gaps limit the accuracy of scores and reduce their utility for local planning.

Data treatment could also be strengthened through more detailed subnational analysis. Water security scores in all KDs could benefit from a closer examination of regional variation within countries. This would help identify degradation hot spots, guide investment decisions, and improve the overall transparency of the index. In parallel, refining certain scoring assumptions, such as how flood and drainage impacts are calculated, would make the assessment more sensitive to local geography, population size, and the probabilistic nature of extreme weather events.

Several recommendations focused on strengthening AWDO's relevance in the Pacific and in transboundary river basins. In the Pacific, very small populations and limited data availability make direct comparison with larger economies difficult. A more flexible and inclusive framework would better reflect local realities and support improved monitoring and planning, as discussed in the Pacific Regional Study. In transboundary basins, stronger mechanisms for cooperation and data sharing are needed to address upstream–downstream impacts on water quality and quantity. Regional cooperation should also be given greater emphasis, as water flows across political boundaries and national governance is often shaped by how well neighboring countries collaborate. Evidence from Central Asia has shown that the costs of inaction are high, while the benefits of coordinated approaches are substantial (Rethinking Water in Central Asia: The Cost of Inaction and Benefits of Water Cooperation, 2017). Future editions could therefore better integrate regional cooperation into the AWDO framework to highlight its role in enhancing water security, particularly through mutual planning, data sharing, and joint infrastructure management. Future editions could also integrate ecological monitoring in locations where ADB infrastructure projects are implemented. Doing so would help track both the positive and unintended environmental impacts of investments and provide a baseline for long-term sustainability.

Together, these proposed refinements would make future editions of AWDO more robust, equitable, and aligned with the needs of diverse users across Asia and the Pacific.

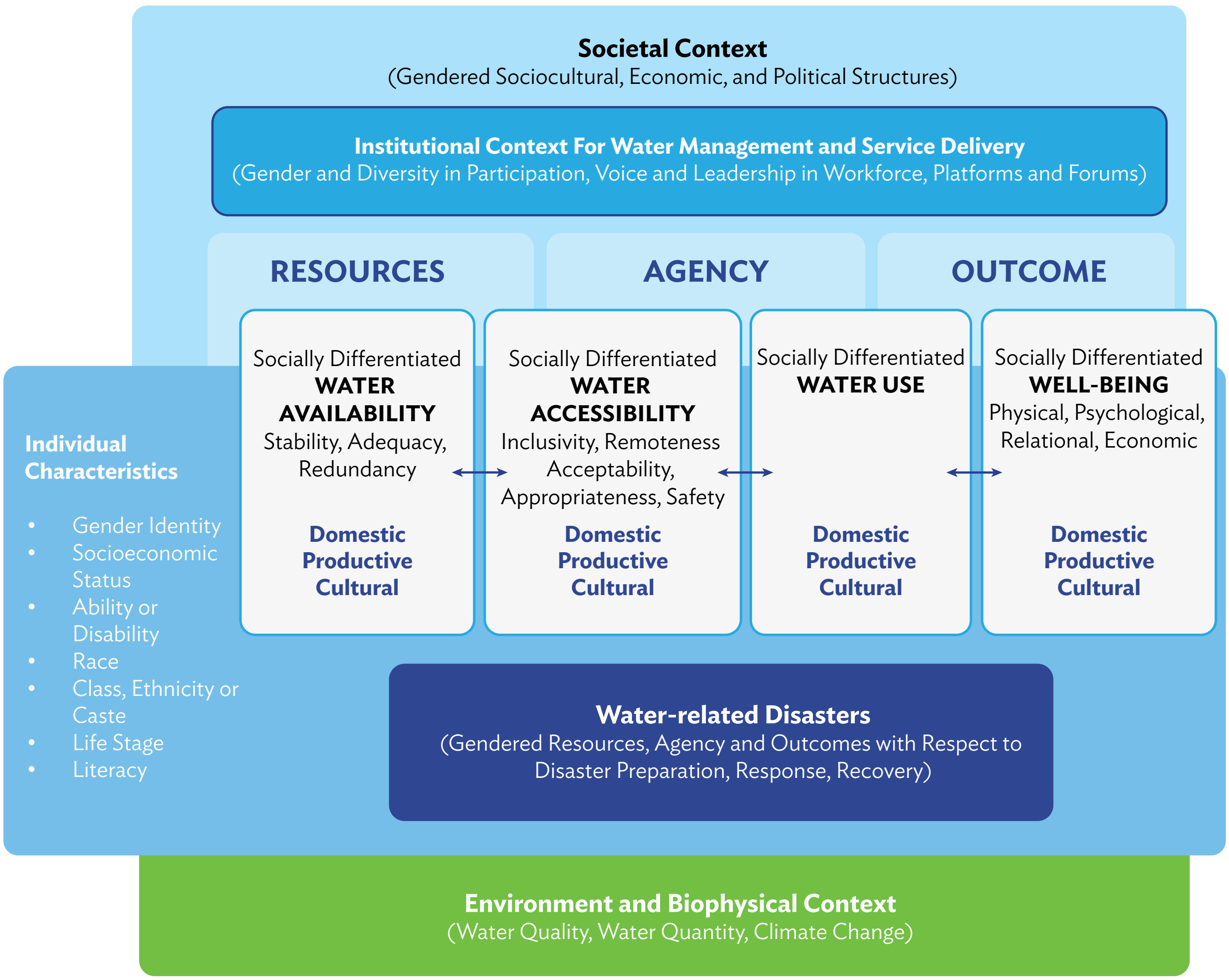
Expanding Water Security Measurement

AWDO's quantitative framework provides a structured, cross-country assessment of water security. However, efforts to improve inclusion remain limited by the nature of the indicators used. Most are provider-side, drawing from national-level infrastructure, economic, and climatic data. While useful, these metrics can miss how water insecurity is experienced differently by gender, age, income level, or location. A growing body of work provides guidance on how AWDO could evolve to better reflect the lived experiences of women, girls, and vulnerable populations.

Embedding Gender Sensitivity: A Conceptual Framework

The ADB-UTS publication *Gender Equality and Water Security: A Critical Framework for Asia and the Pacific* offers another important lens. It proposes a Gendered Water Security Framework (Figure 64) that expands beyond access and infrastructure to include themes like decision-making, safety, time burden, and empowerment. These themes are rarely quantified in existing water indexes, yet they are central to understanding how women and girls experience water insecurity.

Figure 64. Gendered Water Security Framework



Source: ADB and University of Technology Sydney (2024).

AWDO could integrate aspects of this framework into its indicator set or scoring logic. For example, safety concerns during water collection, particularly at night or in informal settlements, are a known barrier to equitable access. Time poverty, where women and girls spend hours each day collecting water, also limits educational and economic opportunities. These issues could be partially addressed through proxy indicators or included in complementary qualitative chapters, but ideally would be directly measured.

Additionally, the framework calls for more gender-disaggregated data and stronger linkages between water policy and broader gender equality objectives. This aligns closely with Individual Water Insecurity Experiences' (IWISE) individual-level data model and could inform future iterations of AWDO to ensure that gender differences are not only acknowledged but quantitatively assessed.

Priority Gender Indicators for WASH Monitoring

The recent Emory–WHO/UNICEF report highlights the growing attention to gender-specific water indicators. It identifies a shortlist of priority measures, including safety, dignity, autonomy in decision-making, and menstrual hygiene access. These indicators were developed through expert consultation and are being incorporated into global SDG monitoring efforts, particularly under Targets 6.1 and 6.2.

In 2024, the short-form IWISE Scale was noted by the WHO/UNICEF Joint Monitoring Programme (JMP) as one possible gender-specific WASH indicator. The IWISE framework focuses on how people personally experience water insecurity, for example whether they worry about having enough water, whether water is acceptable and reliable, and whether water-related challenges affect daily life. These experiential and individual-level questions contrast with the supply-side measures currently used in AWDO.

AWDO and IWISE measure different but complementary aspects of water security. AWDO assesses country-level conditions through physical, infrastructural, and economic indicators, while IWISE captures people's lived experiences, including reliability and use. Together, they provide a fuller picture: AWDO allows comparisons across countries and over time, while IWISE reveals how water insecurity is experienced differently by individuals depending on factors such as gender, income, age, and whether they live in rural or urban areas. Early investigations comparing IWISE data with AWDO 2020 results in five Asian countries showed patterns not reflected in conventional indicators, as well as disparities that national-level scores alone cannot capture.

Incorporating elements of experiential and gender-sensitive measurement could strengthen AWDO's ability to identify exclusion, capture lived experience, and support more inclusive approaches to water governance. However, further work is needed to validate whether experiential measures can be integrated into existing AWDO indicators. AWDO could also draw on broader gender-related indicators, such as women's participation in national parliaments, to explore regional relationships between gender equality and water security. Linking water security results with wider measures of gender empowerment would help clarify how progress in one area supports outcomes in the other.

AWDO's technical rigor and region-specific focus remain its core strengths. However, expanding the framework to include experiential, disaggregated, and gender-sensitive data would significantly enhance its relevance and equity impact. As the water security agenda evolves, AWDO can lead the way in gender-responsive measurement. Doing so will not only sharpen its analytical value but ensure it remains a relevant tool for delivering on inclusive, resilient development.

Foresight to Emerging Megatrends

Emerging megatrends are reshaping water security across Asia and the Pacific. These trends reflect not only accelerating environmental change but also shifting demographics, economies, and technologies. Climate change stands out as the most urgent and systemic challenge. Altered rainfall patterns, glacial retreat, sea-level rise, and increasingly frequent droughts and floods are disrupting water availability and exacerbating risks across all sectors.

Rapid urbanization is another defining megatrend. By 2030, 56% people in the region will live in cities (ESCAP 2016). This transition places enormous pressure on aging urban water systems, many of which already suffer from high leakage, pollution, and unequal access. Water demand is rising fastest in cities, where informal settlements often lack basic services and infrastructure expansion struggles to keep pace. At the same time, higher incomes are changing water consumption patterns, further stressing supply and creating new forms of inequality.

Economic expansion and growing water competition are closely linked. Agriculture remains the largest water consumer in the region, but demand is growing across sectors, from energy production and manufacturing to domestic supply. This intensifies competition over limited water resources, particularly during dry periods or in transboundary basins. Groundwater depletion and overextraction are already threatening long-term supply reliability.

Environmental degradation continues to undermine water system resilience. Pollution from untreated wastewater, agricultural runoff, and industrial discharge is a major threat to both human and ecosystem health. The loss of wetlands and forests further weakens the ability of natural systems to buffer climate impacts. At the same time, fresh water biodiversity is declining sharply, with many communities losing vital food and livelihood sources.

Disaster risks are intensifying, often overlapping with social and health vulnerabilities. Floods, storms, and droughts are becoming more frequent and destructive. These impacts are not evenly distributed: poorer communities, women, and children face greater risks and slower recovery. Urban flooding and coastal storm surges are especially concerning as development pushes more people into hazard-prone areas.

Against this backdrop, AWDO 2025 offers a way forward. The report includes, for the first time, a dedicated focus on climate change and forward-looking risk. This is a first step toward integrating a more strategic outlook into water security assessment. Future iterations can build on this foundation to better support long-term decision-making in an increasingly uncertain world.

Emerging Technologies for Water Security Assessments

Emerging technologies are already reshaping how we understand and manage water security. Remote sensing tools are now integral to environmental monitoring, providing critical data for assessing ecosystem health under KD4. Similarly, artificial intelligence and machine learning are being used in KD5 to help fill key data gaps in disaster risk assessment, including early-warning systems and vulnerability mapping. These tools are enhancing the scope, accuracy, and timeliness of water-related data. However, their full potential is only beginning to be realized. Advances in satellite imaging, big data analytics, and predictive modeling could soon allow real-time water security assessments and forward-looking stress tests across all KDs.

As these technologies evolve, so will the capacity of AWDO to deliver more dynamic, integrated, and forward-looking guidance. Embracing this technological transformation will be essential to ensure that AWDO remains a relevant and effective tool for shaping water policy in an increasingly complex world.

Suva Nausori Water Supply and Sewerage Project in Fiji (Photo by ADB).

Asian Water Development Outlook 2025

The Index of Water Security for Asia and the Pacific

The Asian Water Development Outlook (AWDO) assesses water security in Asia and the Pacific, evaluating 50 economies across five dimensions—rural, economic, urban, environmental, and water-related disaster security. This 2025 edition highlights significant progress: since 2013, 2.7 billion people have moved out of extreme water insecurity. Yet growing ecosystem stress and rising climate risks threaten these gains. With new analyses on investment needs, governance, and gender, the AWDO 2025 provides an evidence base for smarter, more inclusive policies and investments toward a water-secure, climate-resilient Asia and the Pacific.

About the Asian Development Bank

ADB is a leading multilateral development bank supporting inclusive, resilient, and sustainable growth across Asia and the Pacific. Working with its members and partners to solve complex challenges together, ADB harnesses innovative financial tools and strategic partnerships to transform lives, build quality infrastructure, and safeguard our planer. Founded in 1966, ADB is owned by 69 members—50 from the region.

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