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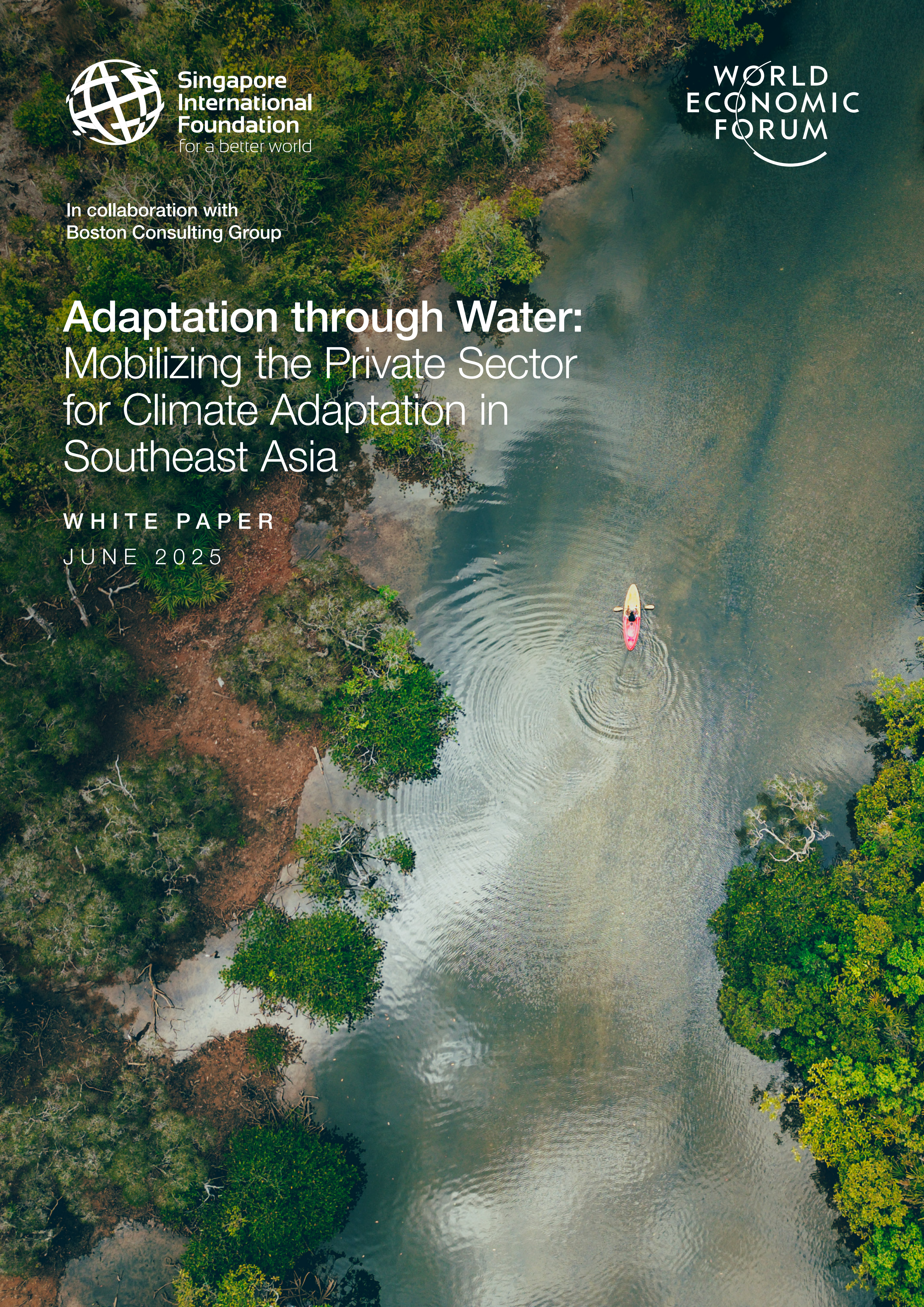
WORLD ECONOMIC FORUM

Adaptation through Water: Mobilizing the Private Sector for Climate Adaptation in Southeast Asia

WHITE PAPER

JUNE 2025



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Water is fundamental to life, ecosystems and economies, yet climate changes are profoundly altering the natural water cycle, leading to more frequent and severe extreme weather events. In Southeast Asia, one of the regions most vulnerable to climate change, the urgency to adapt to these intensifying climate hazards has never been greater, as the region faces escalating social, economic and environmental pressures. Yet adaptation efforts in Southeast Asia often remain fragmented and siloed, lacking a unified narrative that can effectively bring together public and private sector stakeholders to address interconnected adaptation challenges.

Water, as it relates to engineered drinking water and sanitation systems, is commonly classified as one of the core systems that needs to adapt to climate change. Others include agriculture, disaster risk management, infrastructure, urban environments, the financial system and the natural environment. But in reality, water, conceived of more broadly, underpins the climate vulnerabilities of all these systems and could therefore provide a tangible, investible and unified narrative for climate adaptation.

Hence, we introduce the concept of adaptation through water (AtW), an approach that places water at the centre of climate adaptation discussions. AtW allows for a unique and silo-breaking coalition of actors to come together to create solutions that address climate challenges by influencing the natural and engineered water cycles to protect populations, resources and economies.

AtW also allows for greater action by the private sector in climate adaptation. Businesses from all industries are increasingly finding it necessary to invest in efforts to protect against climate risks involving too much water, too little water or too dirty water. Adaptation through water helps businesses build on these actions to strengthen climate adaptation, by developing solutions and opportunities for other businesses, solution developers and investors to mitigate risks, safeguard supply chains, drive efficiency and seize economic benefits through innovative approaches. These range from nature-based solutions and efficiency technologies to AI-driven tools and creative funding mechanisms.

This report analyses the key water challenges Southeast Asian countries face, their wide-ranging impacts and the urgency of collective action. Then, based on extensive research, including the study of nearly two dozen innovative projects throughout the world, it offers an action framework, opportunity analysis and a set of cases from other regions. It aims to lay the groundwork for stakeholders across Southeast Asia to collaborate around water, encouraging increased investment and coordinated adaptation efforts.

Written by the World Economic Forum, in collaboration with Boston Consulting Group, the report serves as the position paper for the Southeast Asia Partnership for Adaptation through Water (SEAPAW), an initiative of the Singapore International Foundation (SIF), in collaboration with the World Economic Forum, and the first platform in the region to focus on water as an approach to climate change adaptation.

We extend our thanks to SEAPAW members and communities for their invaluable contributions to this report. We hope that this water-centred lens will accelerate region-wide actions on adaptation and can be exported to other parts of the world.

Executive summary

Adaptation through water is a starting point to reduce climate risks and pursue growth opportunities.

Climate change has already generated significant impact and is manifesting primarily through more frequent and severe extreme weather events. Severe weather events include floods, droughts, wildfires, heatwaves, storms and others. Their incidence has increased five-fold since the early 1990s and their costs have climbed to over $300 billion globally in each of the last five years.

Southeast Asia is already among the most vulnerable regions to extreme weather: for example, Viet Nam is among the most exposed countries in the world to flood risk and the frequency of drought in Thailand is higher than anywhere else. Overall, Southeast Asian countries could lose 18-25% of their GDP due to climate change. This region needs to prepare quickly for the impacts of climate change, yet these efforts are under-prioritized and under-supported.

A major reason for the lack of support is the difficulty in grasping adaptation. It is perceived as broad and all-encompassing, without resonating clearly with any specific constituency. Moreover, because it is difficult to measure, the returns on investment in climate adaptation are challenging to define.

Water as a proxy for adaptation

Water is the vector through which most climate impacts are felt. Firstly, it is self-evident that the supply and management of water is affected by climate change and that changes in water supply affect people. Rising temperatures dry out reservoirs, rising sea levels threaten freshwater systems with saline intrusion, and climate-driven floods or storms can overwhelm wastewater discharge systems. It is clear that interventions to strengthen freshwater and sanitation systems, known as the "engineered water cycle", can lessen the impacts of climate change.

Secondly and more broadly, climate change has negative impacts on people because it undermines or overwhelms key systems. These include agriculture, infrastructure, nature and the environment, health, energy and industries. With the exception of natural ecosystems, which are strongly affected by warming oceans and average surface temperature changes, the biggest threat to these systems from climate change in the immediate term comes from extreme weather. In its recent report, the Global Commission on the Economics of Water (GCEW) made clear that "90% of all extreme weather events are related to water".

The GCEW is referring to the natural water cycle – the continuous movement of water within the earth and its atmosphere. The commission argues that the natural water cycle should be treated as a public good to be managed in the service of minimizing the negative impacts of climate change.

This paper defines adaptation through water (AtW) as influencing the natural or engineered water cycles to minimize the negative impacts of climate change.

AtW as a uniting vision for adaptation in the region

Businesses are increasingly focused on water, whether through investments, business continuity planning or sustainability initiatives. Water is also an emerging topic of concern on international agendas. AtW provides a framework through which to unite public and private efforts on water in the service of climate adaptation. To that end, this paper describes a framework for action on AtW. It focuses on four key solution areas that can drive tangible impact. All are equally important and sector-agnostic; all apply to end-users and others in their value chains, as well as to solution providers and investors:

- **Flood damage reduction:** Reduce the physical asset damage and business interruption from flood and water-related hazards.
- **Water optimization and circularity:** Enhance alternative water sources, improve water-use efficiency across all ecosystems and develop holistic planning around water circularity.
- **Financing AtW:** Develop financial frameworks and tools that allow commercial capital to be deployed for AtW projects across industries and sectors.
- **Water and nature innovation:** Develop and promote innovative technologies across industries, and leverage advanced data analytics and AI applications in all water-related ecosystems.

The business opportunities in these areas are large. For example, fortifying Southeast Asia's adaptation and resilience to the various types of flooding beyond existing methods will take an investment of roughly $13 billion by 2030.

The paper then offers a series of case studies that illustrate what has been possible in these areas and that could hold lessons for the region. Public-private collaborations offer the most viable, effective way to deliver the resources, solutions and innovation that adaptation and resilience require. As the risks and magnitude of climate impacts continue to mount, the case for action is growing, and delayed response increases costs and complexities. Partnerships focused on AtW offer a pathway for Southeast Asia to accelerate and scale-up climate adaptation.

1 Adaptation is critical for Southeast Asia

Climate change is taking a huge toll on life, property and economies in the region. Annual flooding causes at least $2 billion in losses and precipitation is projected to increase 9%.

19 of the 25 cities most exposed to sea level rise are in Asia.

152

million

people in Southeast Asia (25% of the population) are at risk from flooding

Southeast Asia is experiencing the impacts of climate change to a greater extent than any other region in the world; and those impacts are worsening each year, according to the Intergovernmental Panel on Climate Change. Depending on the emissions scenario, temperatures in the region could rise by up to 3.5°C by the 2050s.[1]

In 2024 alone, as the global annual mean temperature exceeded 1.5°C above the pre-industrial baseline for the first time, the region experienced unprecedented extreme weather events. Flooding in Malaysia, Thailand and Viet Nam displaced hundreds of thousands of people (more than half a million in Thailand alone) and killed dozens. In less than a month, six cyclones struck the Philippines, while flooding and landslides resulting from a typhoon left more than 230 people dead in Viet Nam.

Sea levels throughout the region are rising faster than the global average and 19 of the 25 cities most exposed to a one-metre rise are in Asia. Beyond exacerbating coastal erosion, rising sea levels cause more frequent and severe flooding, threatening infrastructure and communities, particularly in low-lying areas and deltas.

Meanwhile monsoons are intensifying, as the region copes with more frequent and intense rainfall ("rain bombs"). Overall precipitation in Southeast Asia is projected to increase 9% towards the end of the century.[2] In major Southeast Asian countries, the number of days with more than 20 mm of precipitation is expected to increase by between 25% and 50% in the next 25 years. Over the same period, single-day precipitation accumulation could exceed 2000 levels by 8%.[3]

Every year, flooding causes at least $2 billion in direct losses and 152 million people (25% of the region's population) are at risk. Shifting rainfall patterns are causing extreme dry weather, heatwaves and droughts. Record-high temperatures in 2024 triggered health alerts and school closures, while drought threatened Thailand's sugar and rice production, the nation's largest crop and key export respectively.

These climate effects extend across sectors, impairing everything from crop yields and fisheries production to water quality and hydroelectric power (crucial to the Mekong region's 100 million residents). By any measure – and there is no shortage of measures – the impacts on human safety, health and livelihoods, as well as on the region's resources and economies, are inordinately high.

What is less often calculated is the cost of inaction. According to recent World Economic Forum analysis,[4] companies face mounting physical risks that could harm up to 25% of their EBITDA within the next two decades if they do not prepare.

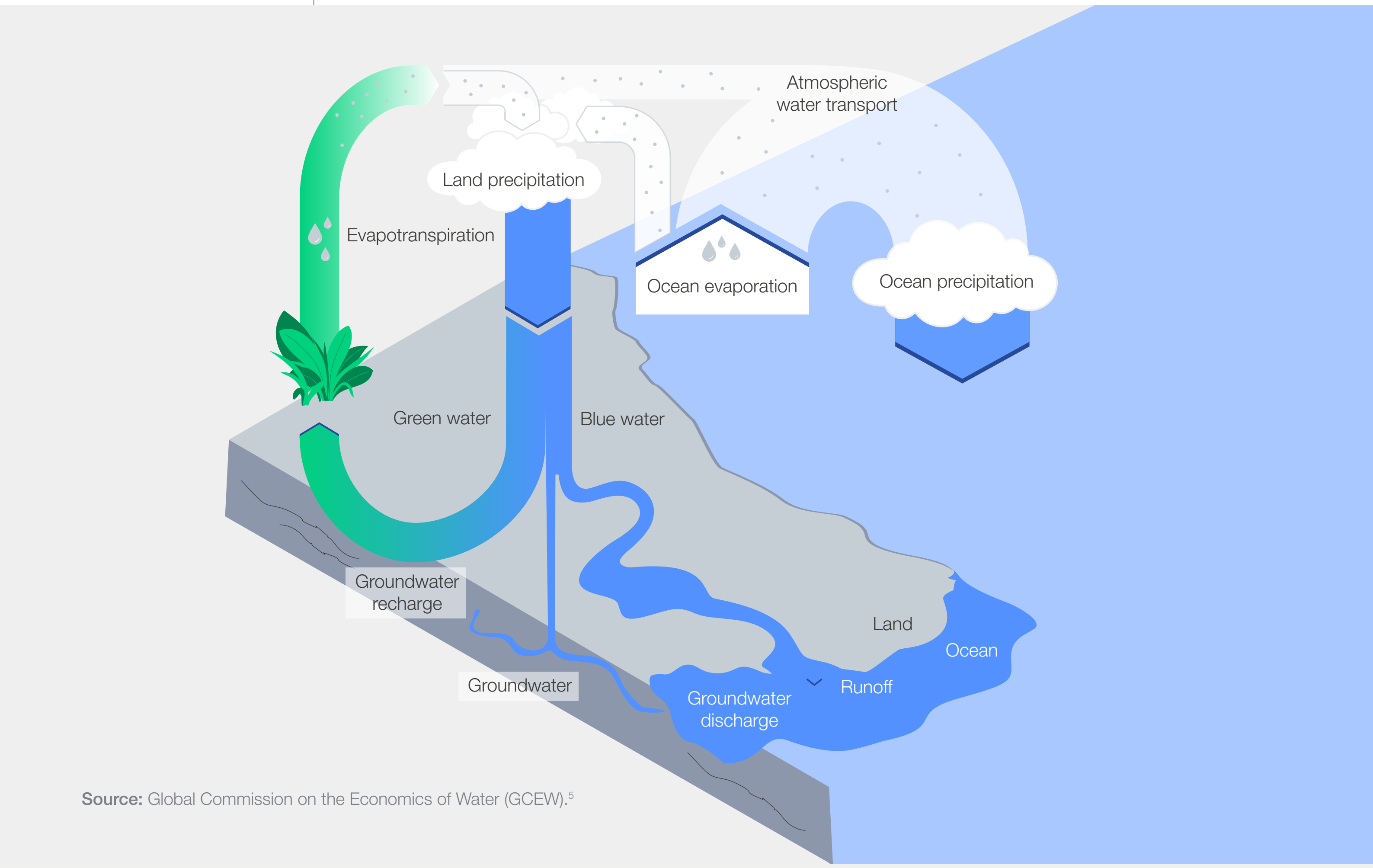
2 Why water is the ideal point of entry to adaptation

Addressing water-related adaptation needs could significantly advance Southeast Asia's overall adaptation and resilience agenda.

Water is essential to the natural and the man-made environments. It is how we experience climate change most directly – through varying levels of precipitation that produce floods or drought, and through rising sea levels. Water underpins all socio-economic development and virtually every human and natural system: whether food, agriculture and health, human settlements and infrastructure, or nature and its ecosystems. As such, it is well-suited to be the centre of and starting point for, adaptation efforts. More broadly, addressing water-related adaptation needs could significantly advance Southeast Asia's overall adaptation and resilience agenda.

The Global Commission on the Economics of Water (GCEW), a group of policy-makers and researchers dedicated to advancing how societies govern, use and value water, emphasizes water's role as a global public good. The commission holds the view that the water cycle includes not only "blue" water – the visible bodies of water that most water management approaches concentrate on – but also "green" water – the water stored as moisture in soil and vegetation that is a critical freshwater resource. Green water returns to the air through evaporation and transpiration and as it circulates, it creates about half of all the rain that falls on land (see Figure 1).

FIGURE 1 **The hydrological cycle: blue water and green water**



Source: Global Commission on the Economics of Water (GCEW).[5]

2.1 Three water challenges – too much, too little, too dirty

$3 billion
losses from drought in Thailand and Viet Nam during 2020

100 million
people: affected by poor water quality in Southeast Asia

Water challenges come in three forms: flood (too much), drought (too little) and pollution (too dirty). Other climate hazards are exacerbated by these challenges: larger amounts of water vapour in the atmosphere act as fuel for severe storms,[6] while heatwaves and wildfires are related to drought.[7] Southeast Asia is subject to all three types of water challenges. Several countries, such as the Philippines and Viet Nam, are prone to both coastal and riverine flooding, with Viet Nam more prone to riverine flood risk than any country in the world.[8] Droughts in Thailand and Viet Nam caused more than $3 billion of losses in 2020, including reductions in agricultural outputs of between 30% and 45%. Poor quality water affects 100 million people or 15% of the region's population, mainly in Indonesia and the Philippines. Addressing these challenges is a logical and effective starting point for climate adaptation.

The term "adaptation through water" refers to promoting solutions that influence the natural or engineered water cycles to minimize the negative impacts of climate change. The engineered water cycle, which encompasses the managed supply, distribution, treatment and efficient use of water, has historically ignored the natural water cycle. This is no longer tenable, given the pressures on water supply from population growth, development, agriculture and industry.

AtW calls for a change in the approach to climate-change adaptation: one that explicitly targets water cycles as the key to building resilience. The goals of AtW are as follows:

- Preserve and harness nature's power in regulating the water cycle.
- Expand water infrastructure.
- Cope with water scarcity by using water more efficiently and productively.
- Prepare for a changing climate by planning for floods and droughts.
- Improve water governance.
- Scale-up financing.

AtW entails action across all the major uses of water: agriculture, infrastructure, energy, industry and the environment (see Figure 2). Water's role at the heart of adaptation benefits is nowhere more evident than in Southeast Asia.

FIGURE 2 **Adaptation through water (AtW): addressing climate impacts through natural and engineered water cycles**

Source: BCG analysis.

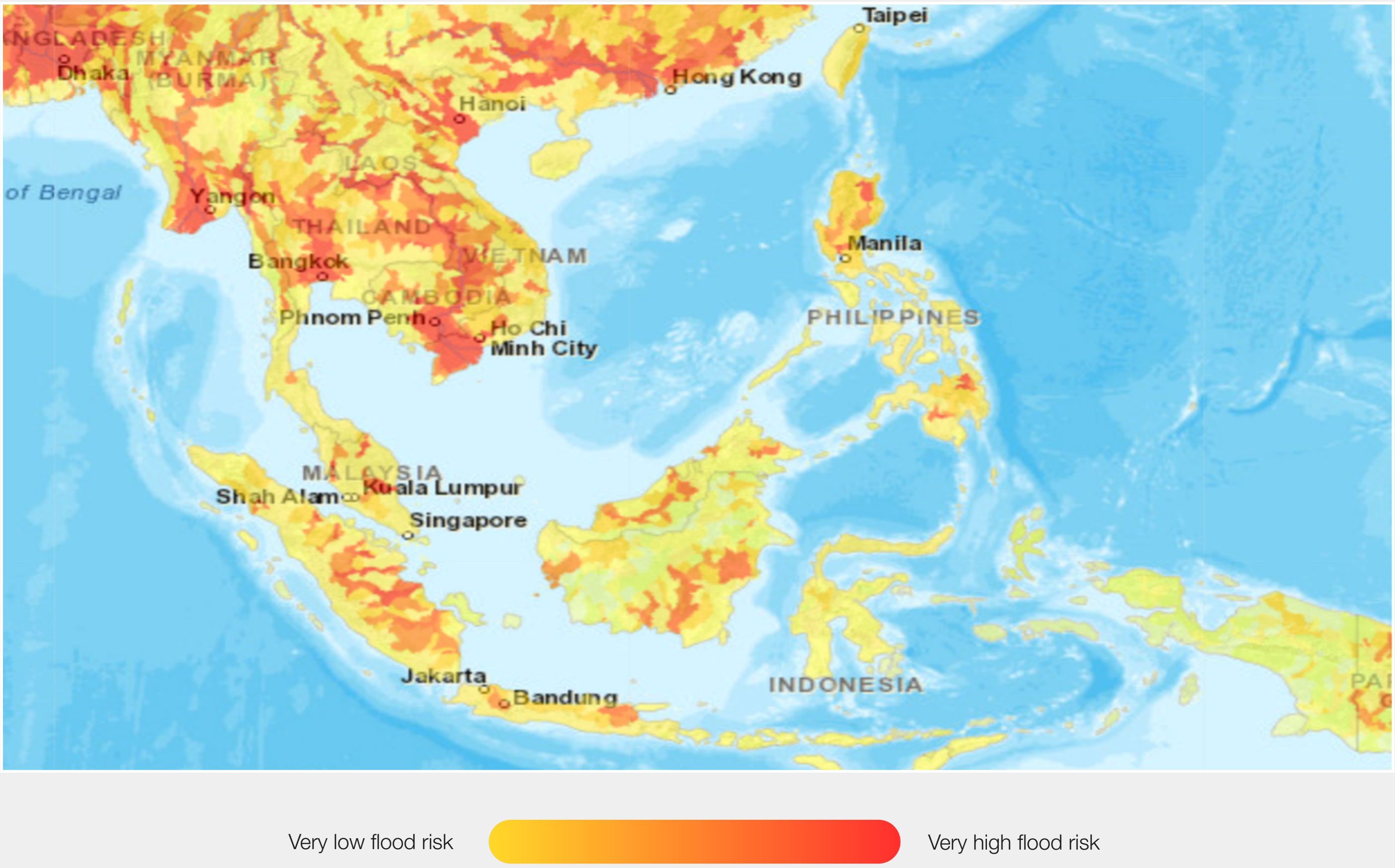
2.2 Too much

The first challenge – too much water – results from shifts in precipitation patterns. Excessive rainfall overwhelms rivers and storm surges threaten coastal areas. Globally, coastal and riverine areas are among the most severely affected, but urban areas are increasingly experiencing severe flooding.

Southeast Asia is among the most vulnerable regions on earth to flooding of all types: coastal, riverine and urban. Viet Nam tops the at-risk list for both coastal flooding (ranked 2nd most at-risk worldwide) and riverine flooding (1st worldwide). Others at great risk of coastal flooding include the Philippines (7th) and Indonesia (13th). Those most at risk of riverine flooding include Thailand (4th), Cambodia (10th) and Indonesia (15th) – see Figure 3.

FIGURE 3 **Coastal, riverine and urban flooding risks facing Southeast Asia**

Viet Nam is among the most exposed countries in the world to flood risk



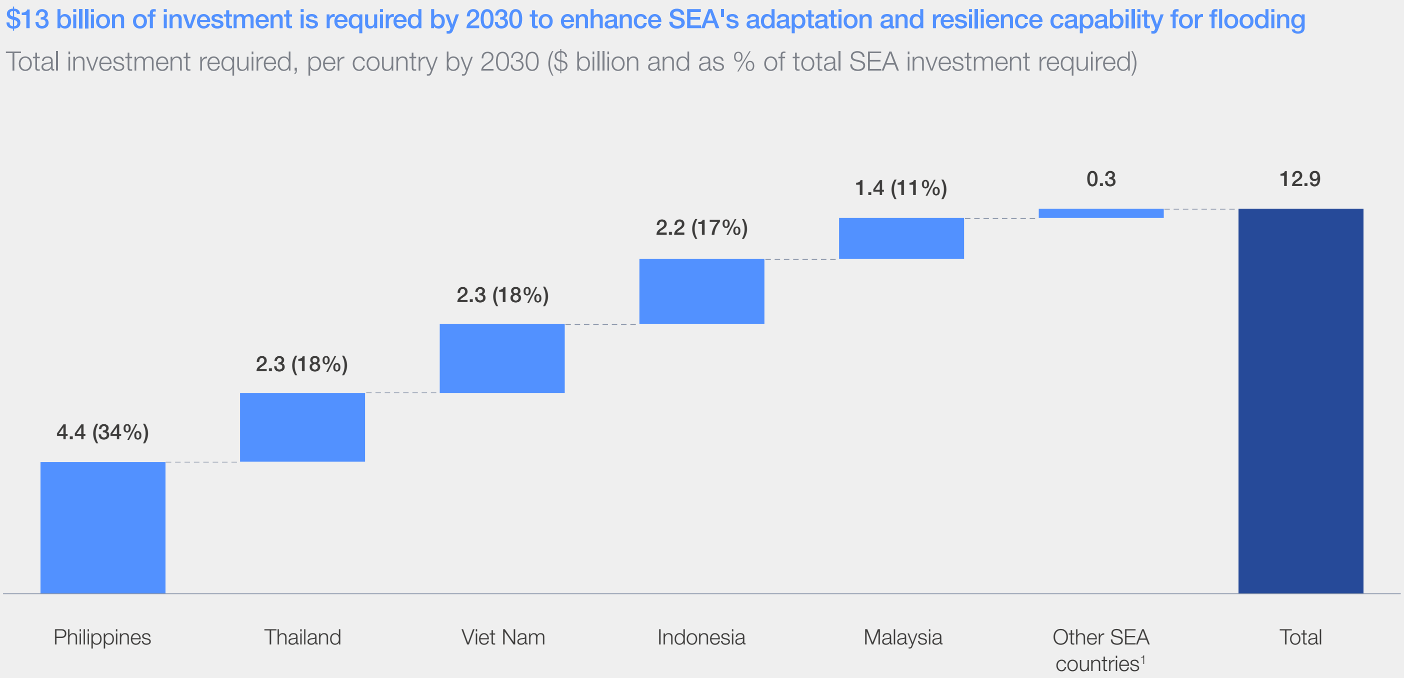
Sources: WWF Water Risk Filter, European Commission INFORM Risk Index, BCG analysis.[9]

> Fortifying the region's adaptation and resilience to all types of flooding will take a total investment of roughly $13 billion between now and 2030.

In most coastal areas in Viet Nam, the Philippines and Indonesia, coastal defence solutions, such as breakwaters, seawalls and mangrove restorations, are already required in order to protect key economic zones from storm surge. Viet Nam, Thailand and Cambodia mandate the real-time monitoring of river levels, floodplain restoration and modular flood barriers to safeguard sensitive sectors along river basins. Major Southeast Asian cities require such flooding solutions as stormwater storage and advance drainage systems, given their proximity to coasts and rivers and their irregular precipitation patterns.

Further fortifying the region's adaptation and resilience to all types of flooding will take a total investment of roughly $13 billion between now and 2030 (see Figure 4 and Box 1). The Philippines, for example, requires the largest investment in coastal defence and resilience-building, given the country's significant risk of coastal flooding from tropical cyclones. Thailand, Viet Nam, Indonesia and Malaysia deal primarily with riverine flooding and require hybrid infrastructure solutions.

FIGURE 4 | **Cumulative investment required to tackle flooding in Southeast Asia (SEA), 2025-2030**



Note: 1. Other SEA countries (Brunei, Cambodia, Laos and Myanmar) are extrapolated by GDP %. Flood impact for Singapore is negligible in the analysis; The estimation did not include long-term climate risk, e.g. from sea-level rise.

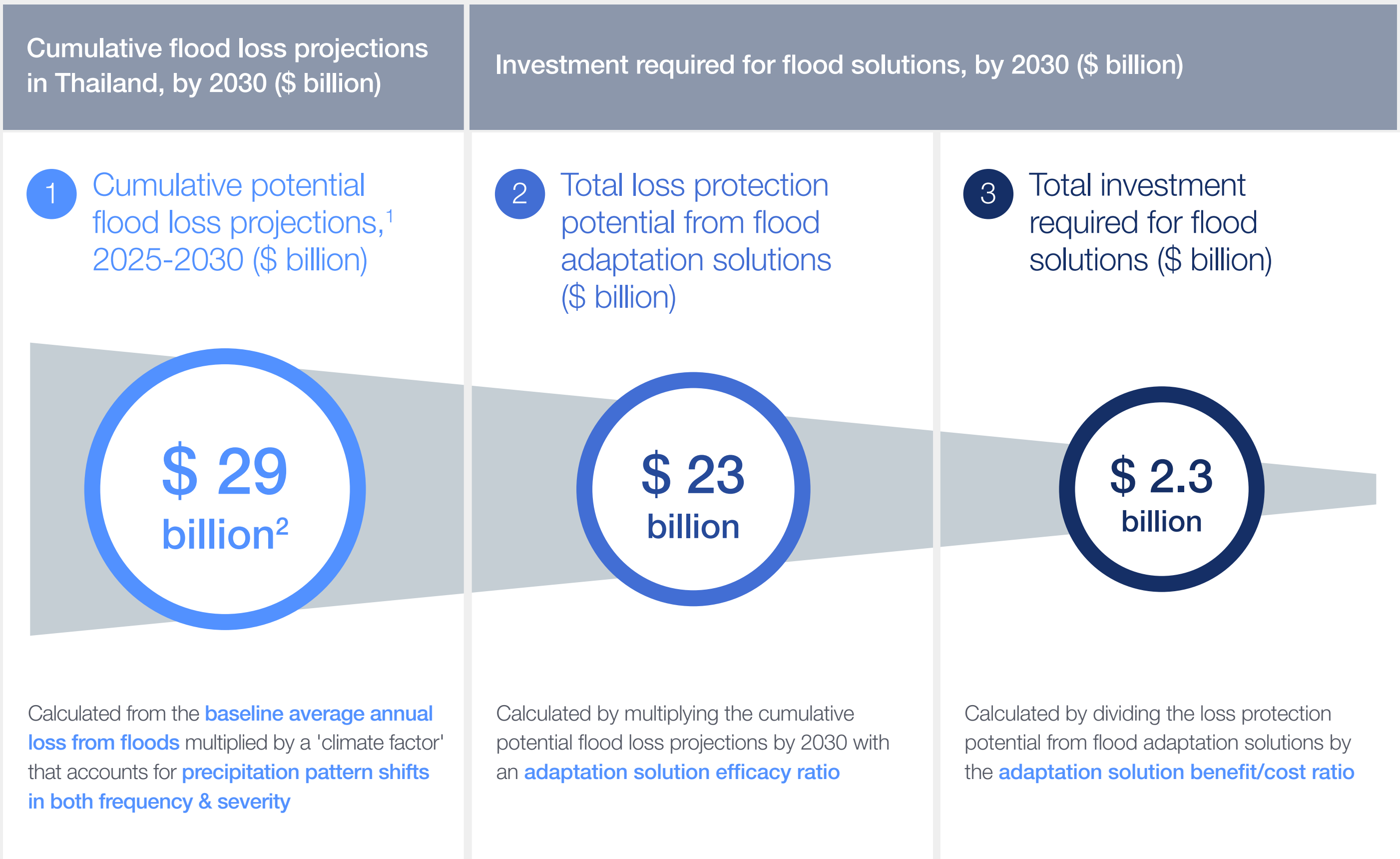
Sources: UNESCAP, World Bank, IMF, BCG analysis.[10]

BOX 1 | **Methodology to determine the potential market for flooding solutions in Southeast Asia**

To arrive at the $13 billion total in Figure 4, BCG analysts estimated losses due to flooding in six of the region's major countries (Indonesia, Thailand, Malaysia, Viet Nam, the Philippines and Singapore). Analysts multiplied each country's average annual loss by its "flood climate factor," a value representing both the projected change (increase) in the number of days with more than 20 mm of precipitation and the projected increase in precipitation events lasting at least five days. For the remaining countries in the region, analysts extrapolated loss estimates.

Next, for each country, BCG computed the cumulative loss over the six-year period 2025–2030, accounting for inflation. From there, analysts estimated the potential adaptation market size by 2030, both in terms of the market for total loss protection as well as the market for total adaptation solutions. Figure 5 provides an example of this approach, using data from Thailand.

FIGURE 5 | **Calculating the investment required by 2030 for flood solutions: Thailand example**



Note: 1. Based on the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report's shared socioeconomic pathway (SSP) 5-8.5 scenario, which represents a projected "fossil-fuelled development" pathway where greenhouse gas emission concentrations rise significantly throughout the 21st century. **2.** Adjusted for inflation, applying inflation rate of 1.32% (10-year average from 2016-2025 based on IMF data).

Sources: IPCC, UNESCAP, World Bank, IMF, BCG analysis.[11]

2.3 Too little

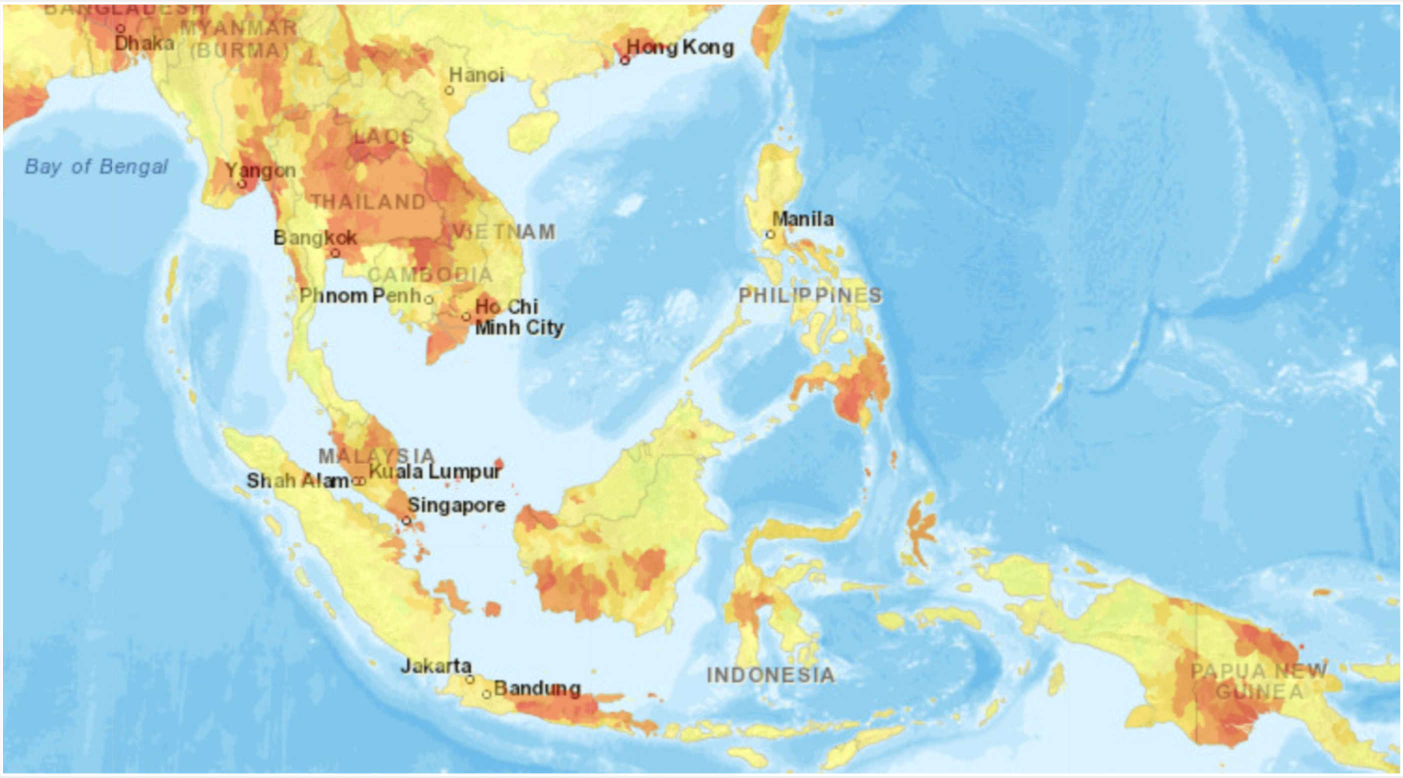
Thailand suffers the most frequent drought in the world, with one-third of its workforce at risk.

The second challenge – too little water – arises where demand exceeds supply. It often results from intense drought and is exacerbated by inadequate infrastructure. Climate change intensifies the severity and duration of drought, particularly in arid regions.

Global warming and irregular precipitation have increasingly subjected Southeast Asia to drought. Thailand, the Mekong Delta and Central Java are the areas most severely affected. Thailand suffers drought more frequently than any other country in the world. The country's central and north-eastern areas are most vulnerable. Most of its agriculture industry – which employs around one-third of the country's workforce – is at risk (see Figure 6).

FIGURE 6 | **Drought risks facing Southeast Asia**

Thailand, Mekong Delta and Central Java face the worst drought risks in the region



Very low drought risk — Very high drought risk

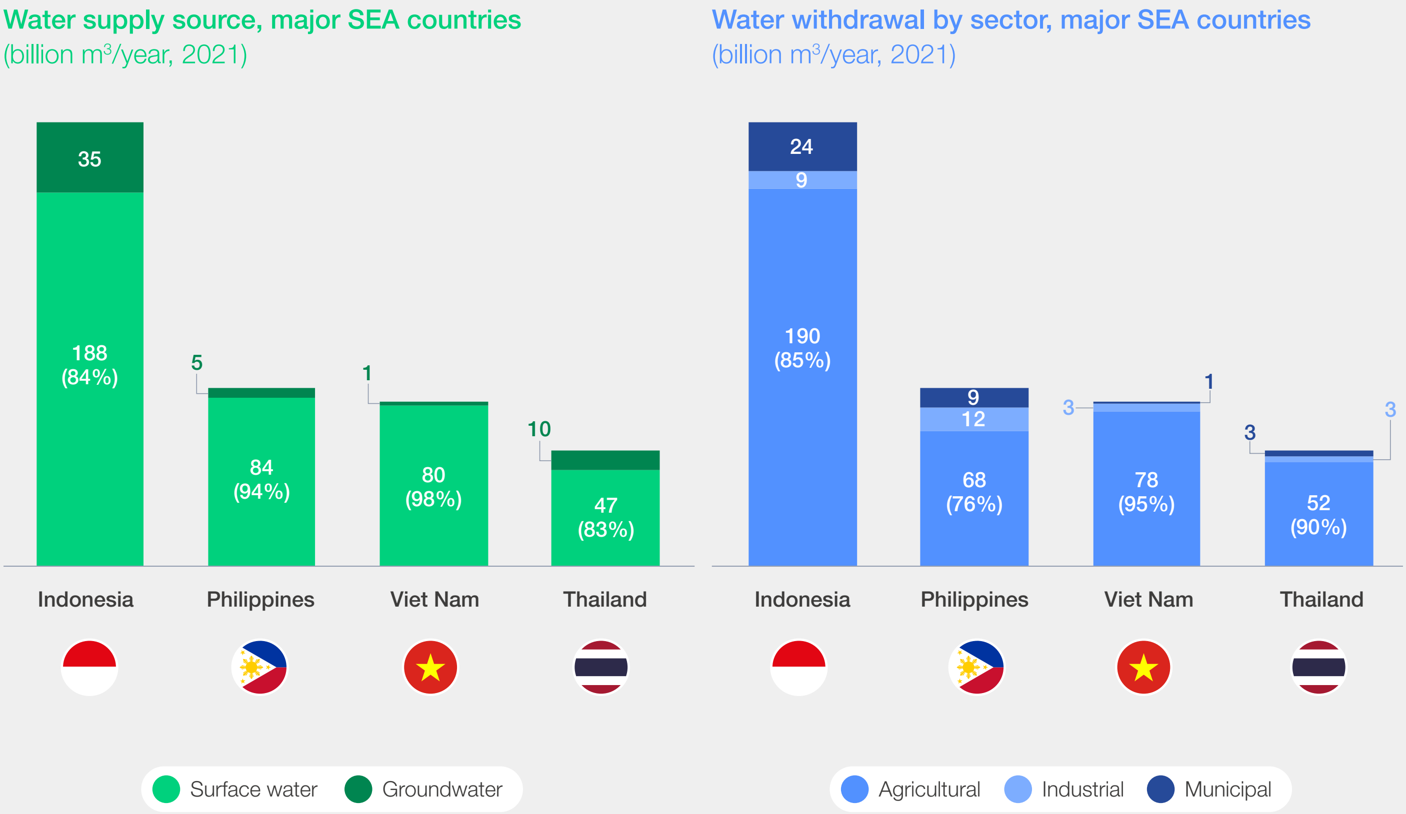
Sources: WWF Water Risk Filter, European Commission INFORM Risk Index, BCG analysis.[12]

“Agriculture’s heavy reliance on surface water for irrigation in Southeast Asia creates critical water risk and threatens food security.

Cambodia and Viet Nam face greater downstream water risk – especially to agriculture, which relies heavily on the Mekong River for irrigation. Cambodia is second only to Viet Nam in terms of the number of people in the region affected by drought. In both countries agriculture is a major employer, accounting for one-third or more of the workforce. Notably, Viet Nam is a top global producer of rice and coffee and the Mekong Delta accounts for more than 50% of rice production and around 90% of rice exports.

In most Southeast Asian countries, surface water represents more than 80% of the water source, most of it for agricultural use. Somewhere between three-quarters and 95% of water withdrawal in these countries is used in agriculture and irrigation accounts for the lion’s share of agriculture water use (more than 95%). This heavy reliance puts the entire sector – and the region’s food security – at critical risk of water shortage (see Figure 7).

FIGURE 7 | **Water supply by source and water withdrawal by sector, major Southeast Asian countries, 2021**



Source: Global Water Intelligence (GWI).[13]

However, water scarcity does not simply affect agriculture and other existing industries; it can stifle the expansion of Southeast Asia's tech sector too. Data centres, which power activities such as cloud computing, artificial intelligence (AI) and online banking, promise economic growth – but their voracious energy and water needs raise concerns in fast-growing Southeast Asian markets around the pressures they add to an already stressed water and energy supply (see Box 2).

BOX 2

Will water constrain data centre growth in Southeast Asia?

In recent years, particularly since the explosive growth of AI, data centres have been springing up everywhere. In Southeast Asia, their growth has been dizzying and for good reason: they bring not only direct investment, but also the potential to expand the local digital economy, foster technology advancement and spur job creation.

Malaysia has been a beneficiary of this growth and is well on its way to becoming the data centre hub of Southeast Asia. In the first 10 months of 2024, it attracted $31 billion in data centre investment, three times the investment of the previous year. There are now 101 data centres in the country. Counting projects already in the works, Malaysia is now the world's fifth-largest data centre market, after China, India, Japan and Australia.

However, the energy and water it takes to power and cool these data centres, which operate 24/7, is monumental. Public officials, water experts and business owners worry that fast-rising demand will cause water shortages in a country already prone to drought.

Even amid the record growth in investment, Malaysia has already begun reining-in data centre approvals. As of mid-2024, the country had approved less than 18% of the applications for water usage. Malaysia's Water Services Commission is now considering a number of proposals, including imposing stricter water management policies for the centres and instituting a requirement that data centre operators must secure alternative water sources (such as reclaimed water or desalination) before applying for operating approval.

Tighter regulatory requirements need not drive the industry away completely. After Singapore's three-year moratorium on data centre permitting, centre operators developed innovative ways to be more water and energy efficient.

Ironically, even ostensibly clean economic development, such as digital tech, comes at an environmental cost. In pursuing the data centre market, Malaysia and its Southeast Asian neighbours will need to proceed with caution. There is ample evidence that when the water resource of an emerging economy is not properly managed, the country's development trajectory can easily be undermined.

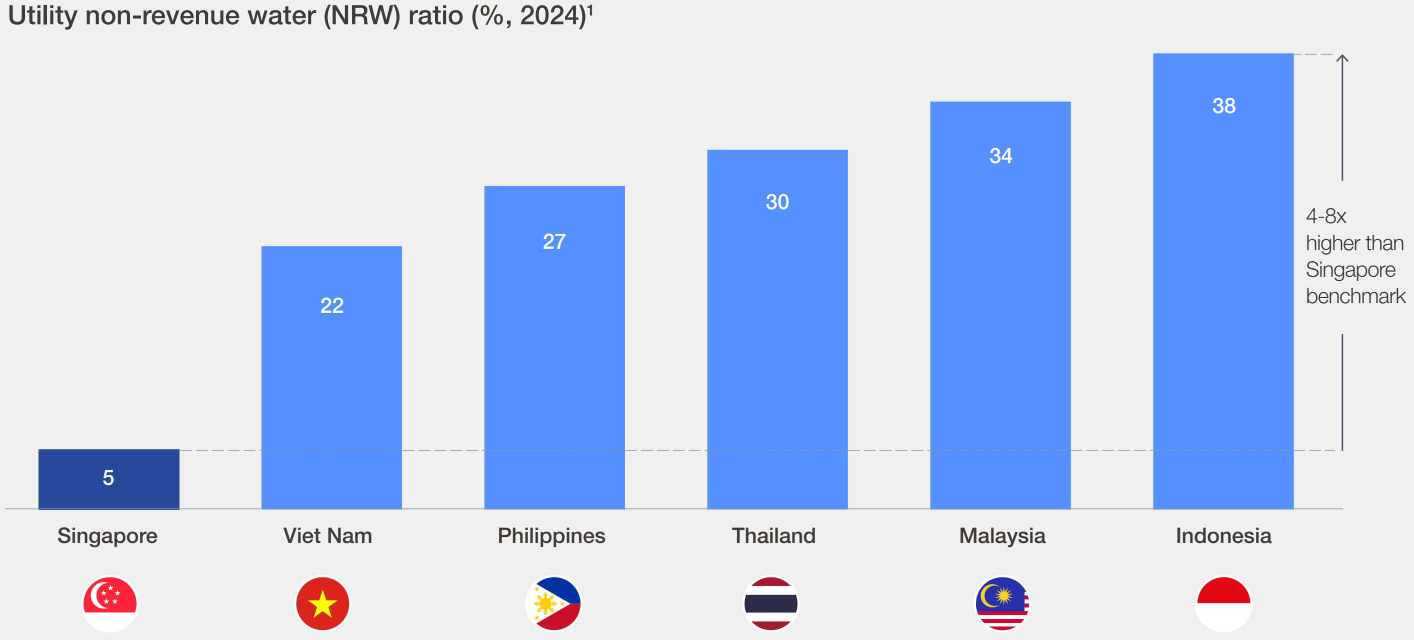
Sources: Fast Company, ISIS Malaysia, BCG, The Straits Times.[14]

Major Southeast Asian countries suffer between four and eight times the water loss in their distribution systems that regional leader Singapore experiences.

Weaknesses in water distribution systems are a serious source of waste. This inefficiency stems from two primary causes: ageing infrastructure (such as old pipes) and the lack of modern leak detection and pressure-monitoring tools. Major Southeast Asian countries suffer between four and eight times the water loss in their distribution systems that regional leader Singapore experiences (see Figure 8).

FIGURE 8

Water loss through inefficient distribution, major Southeast Asian countries, 2024



Note: 1. Non-revenue water (NRW) refers to the portion of water that is produced and put into a distribution system but does not generate revenue for the water utility, mainly due to leakages. NRW ratio is expressed as a percentage of all water produced and distributed by a utility.

Source: Global Water Intelligence.[15]

2.4 Too dirty

The third challenge – water that is too dirty – results from excess nutrients (for example, from agricultural runoff), salinity or elevated temperatures. Industrial activity is a major contributor to poor water quality worldwide, especially in regions that are less regulated.

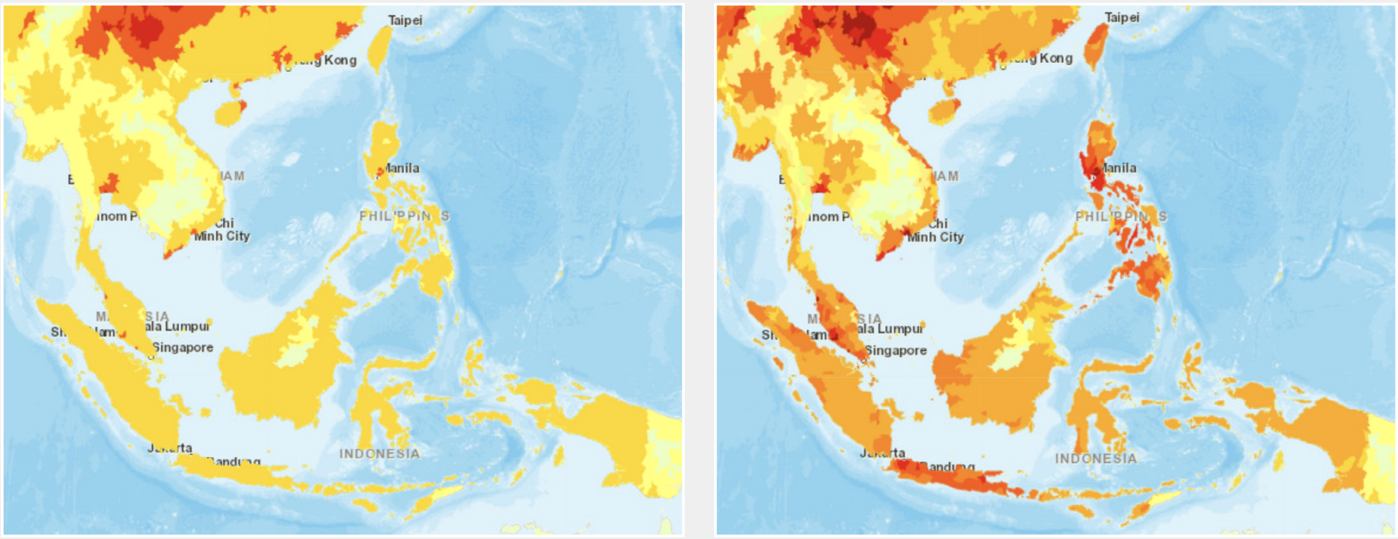
Of the three water challenges, water quality is more of an emerging problem. It is a growing concern in major cities such as Bangkok, Ho Chi Minh City and Manila; and it is projected to worsen over the next 30 years from the cumulative effects of agricultural runoff, industrial wastewater and salinity intrusion (see Figure 9). Analysts anticipate that several countries – including Thailand, Viet Nam, the Philippines, Indonesia and Malaysia – will increasingly face deteriorating water quality as a result of economic development and lax pollution controls.

FIGURE 9 **Water-quality risks facing Southeast Asia, 2020 vs. 2050**

Water quality is deteriorating from human activity and coastal intrusion – Thailand, Viet Nam, the Philippines, Indonesia and Malaysia are particularly at risk

2020 Baseline water-quality risk

2050 Projected water-quality risk (2°C warming scenario)



Very low water-quality risk — Very high water-quality risk

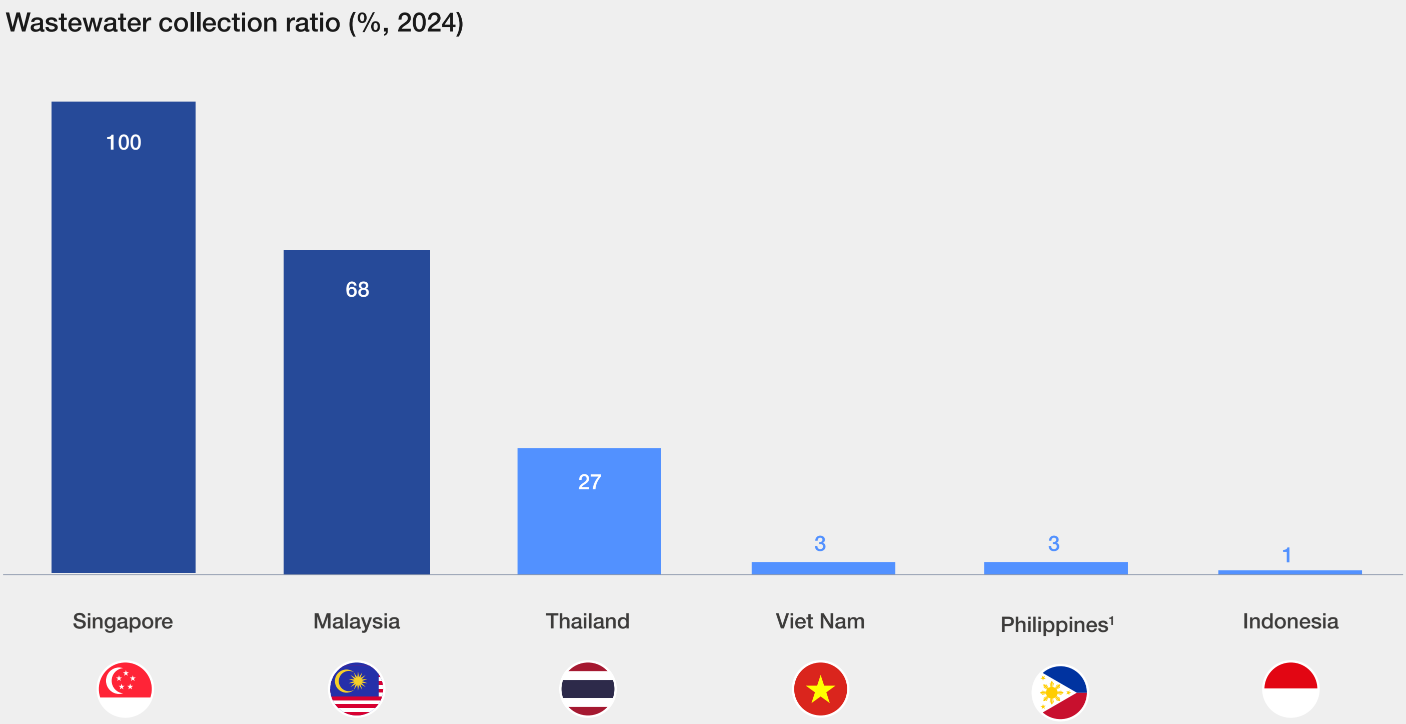
Note: 1. Human activity and coastal intrusion include the effects of agricultural runoff, industrial wastewater and salinization related to rising sea levels.

Sources: WWF Water Risk Filter, European Commission INFORM Risk Index, BCG analysis.[16]

Four of these five countries – Thailand, Viet Nam, the Philippines and Indonesia – collect very little wastewater as a percentage of their population compared to Singapore and Malaysia, the region's leaders in wastewater management, which collect 100% and 68%, respectively (see Figure 10).

However, all of these countries have water resilience strategies that include water circularity and integrated water-resource management. A key system improvement would be expanding the connections to treatment plants as well as their capacity.

FIGURE 10 | **Wastewater management, major Southeast Asian countries, 2024**



Note: 1. Data for the Philippines uses % of population connected to wastewater system as a proxy.

Source: Global Water Intelligence; BCG analysis.[17]

3 Five case studies to catalyse AtW

Five diverse projects from across the world highlight a variety of innovative solutions and opportunities relevant to Southeast Asia's water adaptation challenges.

Businesses and investors have a direct interest in backing AtW strategies: it reduces their exposure to risk and ensures business continuity when crisis strikes. Their own improvements and the positive impact on their business and community can also influence other businesses and stakeholders to take action. In addition, adaptation presents growth opportunities for a variety of businesses, sectors and investors, in the form of physical, digital and service products and solutions. Finally, by participating in adaptation measures, businesses can ensure compliance with regulation, opening the possibility of helping to shape smarter, more effective outcomes.

AtW is a new concept, but a number of AtW projects across the world are already completed or underway. To help businesses and investors understand the solutions and potential opportunities available to them, this report evaluates more than 20 cases. The following pages highlight five strong examples from across the world at various stages of development. Each focuses on a particular action area and each reflects innovative solutions, for example:

- **Adapting to "too much water":** how coastal defences can reduce damage from flooding.
- **Adapting to "too little water" and water that is "too dirty":** how water circularity and source diversification can reduce waste.
- **Funding:** how to leverage new sources of financing for AtW projects.
- **Technology:** how technology such as AI and data infrastructure can boost water resource optimization.

Whether an early-stage project, a work-in-progress or a recent implementation, each of these cases serves as a beacon to illuminate new possibilities. Each illustrates the many dimensions of the private sector's potential contributions to adaptation and the value of public-private partnerships in accelerating and scaling-up these strategies.

Figure 11 summarizes the five case studies and highlights the relevance of their solutions and innovations to Southeast Asia.

FIGURE 11 | Case study insights and their relevance to Southeast Asia

	Project	Solution	Location	Funding type	Why innovative	Opportunities for private sector investment or involvement	Relevance to Southeast Asia
Too much water	1 Belize Blue Cities and Beyond	Coastal defence	Belize	Development finance institution	Pioneered blue economy finance, linking urban resilience with wetland restoration	Carbon credits, blue bonds, modular seawalls, waste-to-energy	Lessons for blue economy governance & climate resilience
Too much water	2 Rebalance Earth Nature Restoration Fund	Riverine flood resilience	England	Private sector	Introduced NaaS[1]: monetizing wetland resilience through corporate green investment	Green bonds, wetland conservation financing, corporate ESG investments	Model for integrating corporate-backed nature-based solutions
Too much water	3 Fargo-Moorhead Flood Diversion	Urban flood resilience infrastructure	United States	Private and public sector	PPP-led flood diversion integrating natural flood storage and barriers	Innovative design and technologies, environmental assessments, compliance	Use of diversion channels, levees and retention basins in flood risk areas
Too little/dirty water	4 SERVIR-Mekong AI system	Water use optimization (demand)	Mekong River countries	Government, development finance institution	AI-powered irrigation optimization model with flood forecasting and precision agriculture	AI-powered crop yield forecasting, IoT-based sensors, climate insurance	Replicable in Thailand, Cambodia, Indonesia for smart agriculture
Too little/dirty water	5 Büyük Menderes Water Stewardship & Clean Production Support	Water circularity	Türkiye	Philanthropy, private sector	First circular water reuse model linking textile manufacturing with wastewater recovery	Industrial wastewater reuse, eco-certifications, blended finance	Model for sustainable water management in water-intensive industries

Note: 1. NaaS = nature-as-a-service.

Source: Global Water Intelligence; BCG analysis.[18]

CASE STUDY 1

Belize Blue Cities and Beyond Project: a multi-pronged strategy for coastal resilience and pollution abatement

Project brief:

With its abundant marine and terrestrial life, Belize has one of the most diverse ecosystems in the world. Its extensive coral reefs comprise what Charles Darwin called “the most remarkable [barrier] reef in the West Indies”. Belize is also highly vulnerable to climate change. Coastal erosion and flooding, along with land-based pollution, threaten the nation’s marine ecosystems, urban areas and blue economy.

In early 2025, the World Bank approved the Belize Blue Cities and Beyond Project, a multi-pronged five-year project designed to strengthen coastal resilience, reduce land-based pollution and wastewater discharge into the ocean, and protect the nation’s coral reefs and fisheries. The project also aims to enhance urban resilience, which will benefit coastal communities, tourism (a key industry, second to agriculture) and fisheries, through carbon market policy development and other infrastructure projects.

Funding for the project consists of the International Development Association’s $23.5 million in financing, along with grants from the Global Environment Facility ($3.76 million), the PROBLUE Multi-Donor Trust Fund ($4.0 million) and the Global Facility for Disaster Reduction and Recovery (0.92 million Euros), totalling $32.23 million.

Belize Blue Cities and Beyond Project will combine an array of solutions, such as mangrove planting and restoration and wetland-based filtration systems to improve wastewater treatment. The project will also prepare future investment in hard solutions, wherever required, such as reinforced revetments and integrated drainage and sediment control to stabilize shoreline erosion.

Why is this case innovative?

- Belize Blue Cities and Beyond Project is the first large-scale urban coastal adaptation project that integrates blue economy governance and climate resilience.
- Its carbon finance component enables the country to access the carbon market to validate blue carbon credits through coastal ecosystem protection.
- Its nature-based solutions approach combines mangrove restoration, wetlands and sustainable urban drainage to mitigate flood risk.

How is this example relevant to Southeast Asia’s water adaptation challenges?

- The project represents a scalable framework for climate-vulnerable coastal cities in the Philippines, Indonesia and Viet Nam.
- It demonstrates confidence in the effectiveness of coastal ecosystem restoration and green infrastructure to enhance flood resilience.
- It provides insights on carbon market readiness, blue economy investments and resilience financing.

What opportunities does this illustrate for the private sector?

- Companies can invest in a variety of coastal protection technologies, such as modular seawalls, geotextiles (used for filtering and drainage) and climate-resilient infrastructure.
- Its sustainable finance models offer opportunities for carbon credits, biodiversity credits and blue bonds, to finance the longer term protection of coastal ecosystems.
- Companies can participate in the circular economy and waste management activities, including in expanded private recycling initiatives and waste-to-energy solutions, which will also generate more and better jobs.

Source: World Bank.[19]

CASE STUDY 2

Rebalance Earth: funding nature-based solutions for riverine flood resilience

Project brief:

In 2025, Rebalance Earth, a UK fund manager, will launch its flagship fund to position nature restoration as critical infrastructure. This innovative financial vehicle will mobilize institutional capital from pension funds to finance large-scale land and river restoration projects across the UK. The projects are designed to mitigate flood risk, drought and water quality degradation through nature-based solutions (NbS) and natural flood management (NFM). Businesses will invest in environmental resilience to protect their assets, revenues and supply chains, with payments for ecosystem services structured through nature-as-a-service (NaaS) contracts.

The fund aims to raise £150 million (~$190 million) in the summer of 2025. Its primary focus will be identifying companies and infrastructure assets vulnerable to water-related risks. The fund plans to invest in restoring wetlands, riparian buffer zones and floodplains to help absorb excess floodwater. Additionally, it will support peatland conservation and reforestation as part of a broader climate adaptation and mitigation strategy.

The fund will adopt a source-to-sea approach to invest in sustainable urban drainage systems for managing runoff in cities and towns. In addition to focusing on river catchments, the fund will target underwater ecosystems such as oyster reefs, kelp forests and seagrass meadows. These efforts will aim to improve water quality, enhance biodiversity and reduce coastal erosion. The investments will provide multiple benefits, including ecosystem restoration, increased biodiversity, carbon sequestration and improved resilience to climate impacts.

As flood risks increase sharply due to climate change and land-use pressures, and as public budgets become more constrained, the Rebalance Earth fund presents a scalable model for private finance to address the adaptation gap. Incorporating NaaS contracts allows businesses to protect the infrastructure, assets and revenues that are most at risk.

Why is this case innovative?

- Linking resilience to business performance: through nature-based solutions (NbS), companies are integrating flood resilience into their risk management strategies and overall financial performance.

- Reframing flood resilience: the fund moves beyond traditional flood defences by restoring entire river basins, wetlands and forests upstream to help reduce flood impacts downstream.

- Shifting the investment model: instead of relying on government funding, this approach mobilizes long-term, patient capital to create scalable, nature-based infrastructure solutions.

How is this example relevant to Southeast Asia's water adaptation challenges?

- Corporate- or institution-backed wetland restoration can focus on natural flood barriers to reduce downstream flooding in the Mekong and Chao Phraya river basins, both of which face severe flooding risks.

- Government and business can develop NaaS contracts to fund urban green infrastructure (such as floodplain reconnection and riverbank afforestation) in industrial and urban areas.

- Companies reliant on agricultural supply chains can finance upstream watershed restoration to protect crops and supply chains from extreme flood events.

What opportunities does this illustrate for the private sector?

- Banks and impact investors can issue nature-based flood resilience bonds or green bonds that fund river restoration, wetland conservation and green infrastructure for flood mitigation.

- Industrial parks, manufacturers and real estate developers can enter into NaaS contracts to fund floodplain reconnection and watershed conservation, thus reducing their exposure to flood risk.

Sources: Rebalance Earth, West Yorkshire Pension Fund.[20]

CASE STUDY 3

Fargo-Moorhead Diversion Project: combating chronic metro-area river flooding

Project brief:

The Red River, whose basin spans the midwestern US states of North Dakota and Minnesota and Canada's Manitoba province, has a long history of flooding. The Fargo-Moorhead Diversion Project, begun in 2007, is a major infrastructure initiative – and the first public-private partnership flood-control project in the US. It is designed to mitigate persistent flooding challenges and prevent catastrophic flooding in the metropolitan area encompassing Fargo, North Dakota and its neighbouring city, Moorhead, Minnesota.

The project, targeted for completion in 2027, entails constructing a 30-mile (48-kilometre) diversion channel that will reroute the river's floodwaters. In doing so, it will safeguard more than 235,000 residents and 70 square miles of urban infrastructure.

The Metro Flood Diversion Authority, US Army Corps of Engineers and the Red River Valley Alliance (RRVA) have partnered with a private sector consortium led by ACCIONA, Shikun & Binui USA and the North American Construction Group in a 30-year agreement. The RRVA is responsible for financing, designing, constructing, operating and maintaining the channel and its associated infrastructure, including bridges, railway crossings and an aqueduct.

The diversion channel and levee system feature a 22-mile temporary flood containment system that includes automated flood gates and embankments, pump stations and diversion infrastructure. In addition, 30 miles of natural floodplain will absorb overflow before a controlled release, while wetlands and upstream retention areas are designed to slow floodwaters during a release.

Why is this case innovative?

- The public-private partnership model has succeeded in securing the necessary capital and expertise for a large-scale infrastructure project, and is an effective way to ensure efficient delivery and long-term maintenance.
- The model shifts flood protection from being a solely government-funded undertaking to a sustainable, private sector-backed solution, thereby reducing the burden on taxpayers.
- The project combines hard infrastructure and natural flood management methods.

How is this example relevant to Southeast Asia's water adaptation challenges?

- The project's planning process has brought together local communities, businesses and government agencies to ensure that strategies are comprehensive and address the needs of all affected stakeholders.
- The project's engineered approaches – diversion channels, levees and water-retention basins – can protect urban and rural communities from the devastating effects of floodwaters.

What opportunities does this illustrate for the private sector?

- Businesses can assist with environmental impact assessments and regulatory compliance, as well as with implementing sustainable practices in flood mitigation.
- Civil engineering and environmental services firms can provide innovative designs and technologies tailored to the unique hydrological challenges of a particular river.
- Companies can participate in financing, constructing or operating flood-control projects to achieve sustainable returns.

Source: Metro Flood Diversion Authority.[21]

CASE STUDY 4

SERVIR-Mekong AI system: a high-tech, decentralized approach to water resource optimization

Project brief:

Some 245 million people live in the Mekong River Basin, the broad area served by Southeast Asia's longest river. In recent years, the basin has suffered more frequent droughts and erratic rainfall. These patterns, along with inefficient water use, affect agriculture, food security and reservoir management.

In 2014, with $11.2 million in funding, the US Government and the Asian Disaster Preparedness Center (ADPC), a regional organization specializing in building disaster and climate resilience, launched SERVIR-Mekong to help governments, farmers and water managers throughout the basin optimize irrigation and water resource planning. The Asian Disaster Preparedness Center (ADPC), US Agency for International Development (USAID), NASA, the Mekong River Commission, local Vietnamese governments and the Stockholm Environment Institute partnered with the Spatial Informatics Group and Deltares to develop the system, which leverages satellite data, geospatial analytics and AI-powered forecasting.

Specifically, the SERVIR-Mekong AI system uses an array of technologies, including smart water metres with IoT-based monitoring, AI-driven hydrological forecasting models for drought and flood prediction, and cloud-based decision support tools.

Since its implementation (finalized in 2022), the system has aided more than 60,000 households in Viet Nam's Ninh Thuan province by improving irrigation efficiency and reducing water loss. It has improved flood risk management for the millions of people residing in the region. By integrating AI-based analytics into national water strategies, the project has enabled cross-border water coordination among the countries within the Lower Mekong Region, including Cambodia, Laos, Myanmar, Thailand and Viet Nam.

Why is this case innovative?

– It is the first large-scale, AI-powered water management initiative in Southeast Asia. It combines AI, satellite imagery and hydrological modelling.

– The project uses decentralized, cloud-based decision support tools that local governments, NGOs and water managers can access.

– The project is a prime example of a public-private-research organization collaboration.

How is this example relevant to Southeast Asia's water adaptation challenges?

– This approach can be replicated in Thailand, Cambodia and Indonesia, where precision irrigation can bolster food security.

– It demonstrates how AI and geospatial tools can improve regional water governance.

– It provides a framework for integrating AI and satellite data into national drought policy development.

What opportunities does this illustrate for the private sector?

– Providers can expand AI-powered crop yield forecasting and water efficiency systems.

– Real-time hydrological data collection and IoT-based sensors can be scaled-up for more widespread use.

– AI-driven weather-based insurance models would be a boon to small farms.

Source: SERVIR Southeast Asia.[22]

CASE STUDY 5

The Büyük Menderes water stewardship and cleaner production support programme: a circularity strategy for addressing pollution and shortage

Project brief:

The Büyük Menderes River Basin is an industrial and agricultural hub in southwestern Türkiye. Denizli Province supplies 60% of the nation's home textile exports, while Aydın Province accounts for 14% of its cotton production. However, intensive water use, untreated industrial discharge and declining groundwater levels have threatened the region's water security and ecosystems.

WWF-Türkiye's Water Stewardship Programme in the Büyük Menderes Basin began by raising awareness of water risks in the textile supply chain and the need for cleaner production. It then fostered strong regional partnerships to reduce environmental impacts and restore freshwater ecosystems. By 2030, the goal is to scale-up successful pilot projects and secure long-term policy, financial and technical support for a more sustainable textile supply chain in the region and beyond.

WWF-Türkiye, in partnership with Denizli's Chamber of Commerce and the South Aegean Development Agency, launched the "textile cleaner production programme" in Denizli in 2018. Initially, the programme focused on raising awareness and enhancing technical capacity in cleaner production. WWF-Türkiye created a Cleaner Production Guide for the Textile Sector and trained over 30 textile companies. Feasibility studies at 14 textile companies demonstrated the economic viability of cleaner production technologies.

Building on this, the South Aegean Development Agency launched a "cleaner production investment support programme", offering grants covering up to 50% of investment costs in 2019. The programme led to a total investment of 17.8 million TL (€3 million), enabling six textile companies to save 570,000 cubic metres of water and 200,000 kWh of energy. Additionally, five textile dyehouses achieved up to 75% water recycling through their joint wastewater treatment facility.

In 2022, The Chamber of Commerce launched the "Denizli's future is in cleaner production" project, supported by Turkey's Ministry of Industry. Out of 42 textile companies in Denizli's dyeing and finishing sector, 40 participated, reflecting strong interest in sustainable practices. Feasibility analyses conducted at these 40 companies showed that an investment of €15.5 million could save €12.2 million annually, highlighting the economic benefits of cleaner production.

With the launch of a new support programme by the Ministry of Industry in 2024, development agencies are now able to subsidize the interest on bank loans obtained by companies.

Building on this opportunity, WWF-Türkiye, Denizli's Chamber of Commerce and the South Aegean Development Agency are exploring the potential of a blended finance model for the 40 textile companies. This model would aim to reduce financial barriers for companies investing in cleaner production technologies. The initiative will be piloted in Denizli, leveraging the region's strong industrial base and commitment to sustainability. If successful, the blended finance scheme could be scaled-up and adapted to other textile-producing regions, paving the way for broader adoption of sustainable practices across Türkiye's textile value chain.

Why is this case innovative?

- The programme adopted a blended finance approach, leveraging public-private funding for green investments in cleaner production.
- It featured a multi-stakeholder approach to governance, in which brands, manufacturers and local authorities collaborated on water security.

How is this example relevant to Southeast Asia's water adaptation challenges?

- The textile industries in Viet Nam and Indonesia are similarly water-intensive and this approach could prove beneficial to those countries.
- This project demonstrates how public-private funding can support investment in cleaner production.
- The project illustrates the possibilities and benefits of industrial water reuse and sustainable supply chain transformation.

What opportunities does this illustrate for the private sector?

- Wastewater reuse and a circular water economy work – more models for these approaches can be developed.
- There is a promising market for smart water monitoring, AI-driven treatment systems and compliance enforcement tools and services.
- Financing opportunities include green credit and sustainability-linked loans for textile manufacturers.

Source: WWF.

4 Taking action: four directions for the private sector

A simple, sector-agnostic framework can guide businesses, solution-providers and investors in approaching AtW.

This chapter presents a two-part framework for action to accelerate AtW. It draws on the report's analysis of water adaptation needs in the Southeast Asian market, insights from the global case studies above, and the conclusions of the Global Commission on the Economics of Water (GCEW).

GCEW challenges organizations to tackle five missions to address the global water crisis:

1. Launch a new revolution in food systems.
2. Conserve and restore natural habitats critical to protect green water.[23]
3. Establish a circular water economy.
4. Enable a clean energy and AI-rich era with much lower water intensity.
5. Ensure that no child dies from unsafe water by 2030.

GCEW targets these five missions at existing communities in six global sectors: agriculture, energy, health, industries, infrastructure, and nature and environment.

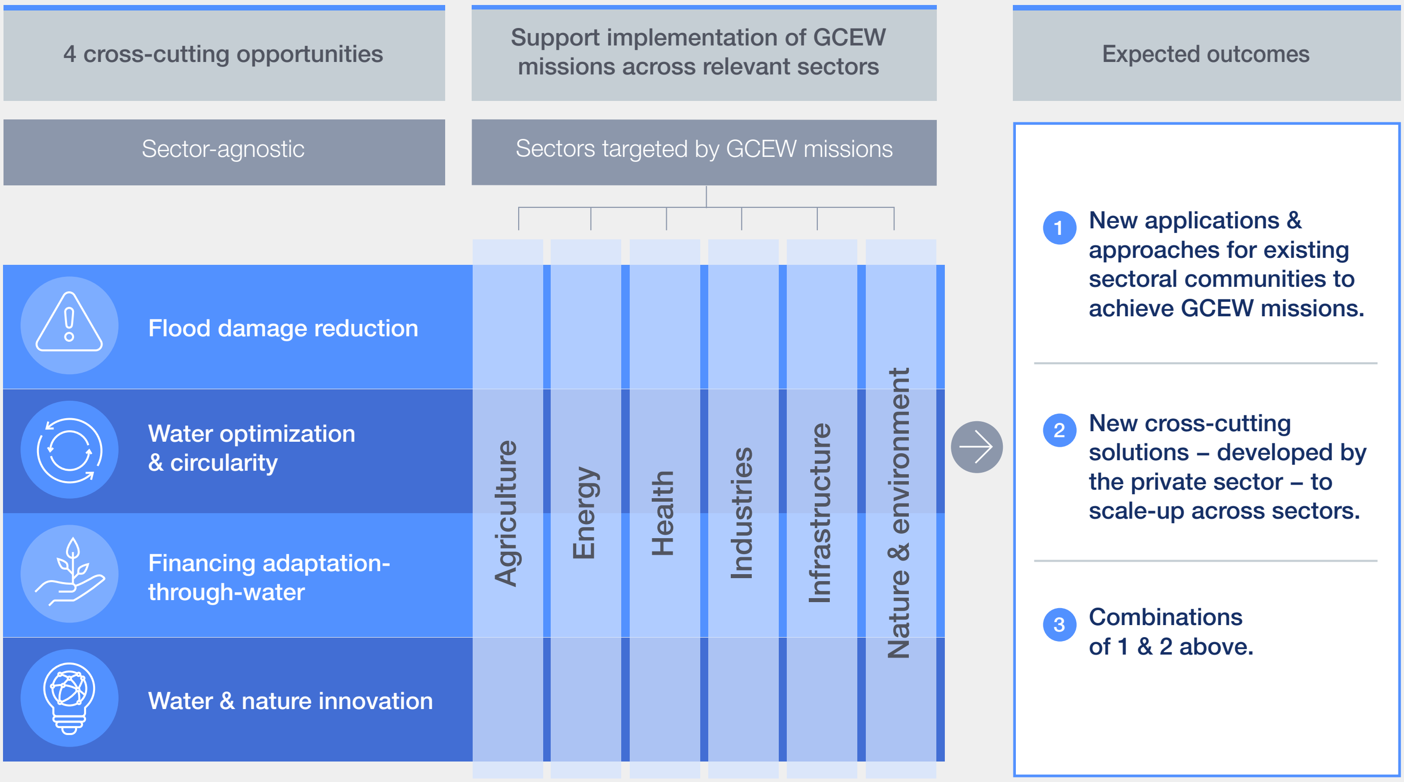
The Forum's framework for action on adaptation-through-water – presented in Figure 12 – identifies four cross-cutting opportunities that can help these existing communities collaborate across sectors and silos to implement GCEW's five missions. These opportunities offer the greatest possibilities for social and business value creation:

1. Flood damage reduction.
2. Water optimization and circularity.
3. Financing AtW.
4. Water and nature innovation.

In addition, the Forum's framework for action aims to encourage the private sector to develop new AtW solutions, based on these four cross-cutting opportunities, that both the private and public sectors can deploy quickly and at scale across the six sectors mentioned above.

Together, the GCEW's five missions and the four cross-cutting opportunities represent a framework for action on AtW. The framework focuses on solutions that are applicable to existing sectors and ecosystems, in which an AtW approach could convene a critical mass of stakeholders. Each of the four opportunities is sector-agnostic and applies to end-users and others in their value chains, as well as to solution providers and investors. Each is of equal importance, but together they can create a multiplier effect on adaptation strategies.

FIGURE 12 | **Framework for action on adaptation through water**



Source: BCG analysis.

Opportunity #1: Flood damage reduction

Nearly all sectors or ecosystems (e.g. agriculture, nature, manufacturing, infrastructure) with assets at risk of water-related damage would want to consider this opportunity. As the Fargo-Moorhead flood diversion case study described earlier shows, there are ample opportunities for infrastructure engineering firms, environmental services firms, construction companies and related providers to develop solutions to recurrent and severe flooding of all types. Technology tools, such as machine learning for real-time hydrological prediction, can also play an important part.

As seen in Chapter 2, the market opportunity in flood damage reduction in Southeast Asia is estimated at $13 billion.

Opportunity #2: Water optimization and circularity

Multiple ecosystems with direct operations and/or critical supply chains tied to water supply, water use and water quality (e.g. agriculture, textile fabrication, infrastructure) can benefit from water optimization and circularity, as Turkiye's Büyük Menderes case study demonstrates.

A circular water economy is perhaps the most potent approach for achieving greater efficiency in water usage. It entails three strategies:

- Fix leakage ("non-revenue water" that is responsible for around 40% of the water wasted in municipal water supplies worldwide).
- Recycle wastewater.
- Recover other resources (e.g. nutrients, minerals, heavy metals, energy) during wastewater treatment.

Circular industrial water reuse includes methods such as zero-liquid discharge and closed-loop systems that reduce water waste.

Meanwhile, water optimization includes water conservation in business processes and water source diversification to boost water efficiency for communities and regions, which in turn ensures food resilience and water security.

Opportunity #3: Financing AtW

Despite headwinds in other regions, sustainable finance has continued to demonstrate rapid growth in Asia. The Asian Development Bank reports that in the ASEAN+3 countries (10 ASEAN member states plus China, Japan and the Republic of Korea), sustainable finance grew 29.3% in 2024, as opposed to 21% globally.

Yet while the frameworks are in place to drive sustainable finance into emissions reduction and the conservation and restoration of nature, the financial infrastructure for water remains underdeveloped. Collaborating to develop this infrastructure in the region presents a significant opportunity to unlock large amounts capital for high-return projects. Demand is strong. According to a recent report by the World Economic Forum, *Water Futures: Mobilizing Multi-Stakeholder Action for Resilience*, water-related green bonds grew 30 percentage points faster than the overall green bond market from 2020 to 2023.

As case studies such as the Belize Blue Cities and Beyond Project show, there are also opportunities to combine traditional commercial finance with innovative mechanisms to accelerate nature-related project development, such as blended finance, micro loans, PPPs, and blue and green bonds.

Other approaches include outcome-based financing approaches that tie investment to measurable water conservation results, carbon credits for water-smart farming and private funding. Meanwhile, taking a nature-based solutions approach to adaptation-through-water would align more easily with existing financing frameworks.

Opportunity #4: Water and nature innovation

Solution providers in each ecosystem can utilize a range of novel technology tools to develop new AtW solutions These range from drought-resilient seeds and flood prediction tools to advanced irrigation systems and wastewater recovery.

Such technologies, tools and techniques aid governments, communities, planners, farmers and businesses. For example, the SERVIR-Mekong AI project highlighted earlier has already helped thousands of households to preserve water and millions more to benefit from flood risk management.

Conclusion

Water is a good starting point for private sector companies to evaluate their climate adaptation strategies – accelerating action is crucial.

Throughout Southeast Asia, the worsening effects of climate change, most of them water-related, demand action. Besides ongoing mitigation efforts, complementary adaptation actions are increasingly necessary for both public and private sectors. Water deserves the attention of all stakeholders who use it and benefit from it as a common good.

Because water underpins all socio-economic development and almost every adaptation system, AtW is a logical and effective approach to minimizing climate impacts and building resilience. Looking at adaptation and resilience through the lens of water provides an accessible and actionable approach for the private sector. Beyond reducing companies' exposure to risk and ensuring business continuity when extreme events occur, AtW offers compelling commercial opportunities for solution providers and investors alike.

This report has presented a number of projects across the world – either underway or recently completed – that showcase opportunities to innovate technologies, services and other solutions in four broad areas: flood damage reduction; water optimization and circularity; financing adaptation-through-water; and water and nature innovation.

As the risks and magnitude of climate impacts continue to mount, the case for action is growing, and delayed response increases costs and complexities. Through public-private partnerships, Southeast Asia can accelerate and scale-up AtW action. The successes these partnerships can achieve will spark broader commitment across industries and stakeholders. Importantly, the aggregate impact of multiple adaptation strategies will not only help protect the region's communities and environment from intensifying water challenges, but also enable both people and planet to thrive in the face of economic growth.

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Endnotes

1. Intergovernmental Panel on Climate Change (IPCC). (2023). *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf.
2. Ona, B.J. et al. (2024). Changes in Future Rainfall over Southeast Asia Using the CMIP6 Multi-model Ensemble. *Bilingual Publishing Group.* https://journals.bilpubgroup.com/index.php/jasr/article/view/6335.
3. Copernicus. (2025). *Copernicus Interactive Climate Atlas: CMIP6.* https://atlas.climate.copernicus.eu/atlas.
4. World Economic Forum. (2024). *The Cost of Inaction: A CEO Guide to Navigating Climate Risk.* https://reports.weforum.org/docs/WEF_The_Cost_of_Inaction_2024.pdf.
5. Global Commission on the Economics of Water (GCEW). (2024). *The Economics of Water: Valuing the Hydrological Cycle as a Global Common Good,* p.12. https://economicsofwater.watercommission.org/report/economics-of-water.pdf.
6. U.S. Geological Survey (USGS). *How can climate change affect natural disasters?* https://www.usgs.gov/faqs/how-can-climate-change-affect-natural-disasters.
7. Mukherjee, S. et al. (2023). Interaction between dry and hot extremes at a global scale using a cascade modeling framework. *Nature Communications,* 14, Article number: 277. https://www.nature.com/articles/s41467-022-35748-7.
8. Statista. (2025). *Countries most exposed to river floods worldwide in 2025, by risk index score.* https://www.statista.com/statistics/1306264/countries-most-exposed-to-floods-by-risk-index-score/.
9. Sources:
   - WWF. (2025). *Water Risk Filter* [Flooding]. https://riskfilter.org/water/home. [Data accessed in March 2025].
   - European Commission. (2025). *INFORM Risk Index.* https://drmkc.jrc.ec.europa.eu/inform-index/INFORM-Risk.
   - BCG analysis.

   Note: a company's operations and value chain may face physical risk if: a) located in river basins prone to either water scarcity, flood, low water quality and/or ecosystems degradation, in turn negatively impacting water ecosystem services (basin water risk); b) if heavily dependent upon or impacting on water resources for their activities (operational water risk).
10. Sources:
    - United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). *Risk and Resilience Portal: Thailand.* https://rrp.unescap.org/country-profile/THA.
    - World Bank: "Climate projection data is modelled data from the global climate model compilations of the Coupled Model Inter-comparison Projects (CMIPs), overseen by the World Climate Research Program. Data presented is CMIP6, derived from the Sixth phase of the CMIPs. The CMIPs form the data foundation of the IPCC Assessment Reports. CMIP6 supports the IPCC's Sixth Assessment Report." Source: World Bank. *Climate Change Knowledge Portal*. https://climateknowledgeportal.worldbank.org/.
    - International Monetary Fund (IMF). *Inflation rate, average consumer prices: Annual percent change.* https://www.imf.org/external/datamapper/PCPIPCH@WEO/OEMDC/ADVEC/WEOWORLD.
    - Benayad, A. et al. (2025). *Why Investing in Climate Action Makes Good Economic Sense.* BCG. https://www.bcg.com/publications/2025/investing-in-climate-action.
    - Chau, V. et al. (2023). *Financing Climate Adaptation and Resilience Is Good for Business and the World.* BCG. https://www.bcg.com/publications/2023/financing-climate-resilience-and-adaptation-is-good-for-business-and-the-world.
11. Sources:
    - Intergovernmental Panel on Climate Change (IPCC). (2023). *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf.
    - United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). *Risk and Resilience Portal: Thailand*. https://rrp.unescap.org/country-profile/THA.
    - World Bank: "Climate projection data is modelled data from the global climate model compilations of the Coupled Model Inter-comparison Projects (CMIPs), overseen by the World Climate Research Program. Data presented is CMIP6, derived from the Sixth phase of the CMIPs. The CMIPs form the data foundation of the IPCC Assessment Reports. CMIP6 supports the IPCC's Sixth Assessment Report." Source: *World Bank. Climate Change Knowledge Portal.* https://climateknowledgeportal.worldbank.org/.
    - International Monetary Fund (IMF). *Inflation rate, average consumer prices: Annual percent change*. https://www.imf.org/external/datamapper/PCPIPCH@WEO/OEMDC/ADVEC/WEOWORLD.
    - Benayad, A. et al. (2025). *Why Investing in Climate Action Makes Good Economic Sense*. BCG. https://www.bcg.com/publications/2025/investing-in-climate-action.
    - Chau, V. et al. (2023). *Financing Climate Adaptation and Resilience Is Good for Business and the World.* BCG. https://www.bcg.com/publications/2023/financing-climate-resilience-and-adaptation-is-good-for-business-and-the-world.

12. Sources:

– WWF. (2025). *Water Risk Filter* [Drought]. https://riskfilter.org/water/home. [Data accessed in March 2025].

– European Commission. (2025). *INFORM Risk Index*. https://drmkc.jrc.ec.europa.eu/inform-index/INFORM-Risk.

– BCG analysis.

13. Global Water Intelligence. https://www.globalwaterintel.com/.

14. Sources:

– Fast Company. (2025). *Malaysia is looking to data centers to boost its economy, but experts warn of risks.* https://www.fastcompany.com/91281193/malaysia-looking-data-centers-boost-economy-but-experts-warn-risks.

– Zaikariah, Z. (2025). *EXPLAINED: Why Malaysia's data center boom faces water sustainability concerns.* Institute of Strategic & International Studies (ISIS) Malaysia. https://www.isis.org.my/2025/02/25/explained-why-malaysias-data-center-boom-faces-water-sustainability-concerns/.

– BGC. (2024). *How to Manage AI's Thirst for Water.* https://www.bcg.com/publications/2024/how-to-manage-ai-thirst-for-water.

15. Global Water Intelligence. https://www.globalwaterintel.com/.

16. Sources:

– WWF. (2025). *Water Risk Filter* [Water Quality]. https://riskfilter.org/water/home. [Data accessed in March 2025].

– European Commission. (2025). *INFORM Risk Index*. https://drmkc.jrc.ec.europa.eu/inform-index/INFORM-Risk.

– BCG analysis.

17. Sources:

– Global Water Intelligence. https://www.globalwaterintel.com/.

– BCG analysis.

18. Sources:

– Global Water Intelligence. https://www.globalwaterintel.com/.

– BCG analysis.

19. World Bank. (2025). *Belize Blue Cities and Beyond Project.* https://projects.worldbank.org/en/projects-operations/project-detail/P181064.

20. West Yorkshire Pension Fund. (2024, 9 September). *Press release 9 September 2024. Our pioneering investment in Rebalance Earth* [Press release]. https://www.wypf.org.uk/news/press-release-9-september-2024/.

21. Metro Flood Diversion Authority. (2024). *Permanent, Reliable Flood Protection for the Future of the Fargo-Moorhead Area.* https://fmdiversion.gov/.

22. SERVIR Southeast Asia. *Connecting Space to Village in Southeast Asia: SERVIR Southeast Asia (2023 – 2025).* https://servir.adpc.net/.

23. "Freshwater on land can be differentiated into blue water and green water. Water found in rivers, lakes, and aquifers is known as blue water. And under out feet, soils holds moisture essential for plants to grow. We call this green water. These plants release green water vapour back into the atmosphere." Source: Global Commission on the Economics of Water.

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