



BHUTAN CLIMATE ADAPTATION INVESTMENT PLAN FOR THE WATER SECTOR

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Abbreviations

ADB	Asian Development Bank
ADF	Asian Development Fund
BCF	Bhutan Climate Fund
BOT	build-operate-transfer
CAIP	climate adaptation investment plan
CMIP6	Coupled Model Intercomparison Project Phase 6
DHI	Druk Holding and Investments
DRM	disaster risk management
EIRR	economic internal rate of return
EU	European Union
EWS	early warning system
FIRR	financial internal rate of return
GCF	Green Climate Fund
GEF	Global Environment Facility
GFDRR	Global Facility for Disaster Reduction and Recovery
ICT	information and communications technology
IFI	international financial institution
IWRM	integrated water resources management
KPI	key performance indicator
LDC	least developed country
MDB	multilateral development bank
MOENR	Ministry of Energy and Natural Resources
NAP	national adaptation plan
NCCC	National Climate Change Committee
NCHM	National Centre for Hydrology and Meteorology
NDC	nationally determined contribution
NEC	National Environment Commission
PES	payment for ecosystem services
PFM	public financial management
PPP	public-private partnership
RMA	Royal Monetary Authority of Bhutan
SSP	Shared Socioeconomic Pathway
TA	technical assistance
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme

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This climate adaptation investment plan is the culmination of the collaborative endeavors of the Inter-Agency Technical Working Group (IATWG), established by the Royal Government of Bhutan to develop an investment plan for the country's Water Sector. It was led by the Department of Water under the Ministry of Energy and Natural Resources (MOENR) with the Ministry of Finance (MOF), serving as the focal for the Asian Development Bank's (ADB) Regional Technical Assistance on Identifying Climate Adaptation Investment Priorities (TA 6933-REG).

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Cover photo taken by Sonam Wangdi. Pa Chhu (Paro River) viewed from Nemi Zampa, Paro with Rinpung Dzong in the backdrop

Foreword

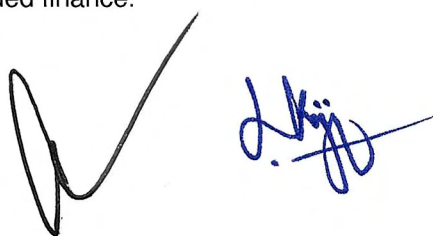
Bhutan's development journey has long been guided by the vision of balancing economic progress with environmental stewardship. Our water resources have played a central role in our national development, economic resilience, and the well-being of our people. Bhutan, though a carbon negative, with climate change, impacts are evident –rising temperatures, shifting rainfall patterns, an increasing frequency of floods and landslides, windstorms and forest fires, diminishing springs, extended dry spells, and rising risks from glacial lake outburst floods. These impacts on our water resources threaten the safety of communities, ecosystems, and the economic foundations on which our national prosperity depends. As a result, they have heightened our vigilance, calling for coordinated action and a long-term investment plan to ensure the resilience of this vital resource, which is paramount to safeguarding Bhutan's prosperity and our overall water security. Without sustained and strategic intervention, climate change could reduce Bhutan's Gross Domestic Product significantly by 2050.

In recognition of these growing risks, the Royal Government of Bhutan has taken proactive steps by prioritizing climate adaptation as an essential pillar to strengthen preparedness and long-term resilience. The updated Nationally Determined Contribution 2025 and the National Adaptation Plan 2023 articulate a clear direction and pathways towards long-term climate adaptation across priority sectors. However, like many countries, Bhutan faces a substantial gap in adaptation finance. While commitments exist, the level of investment mobilised thus far remains far below what is required to safeguard our people and economy.

To confront this challenge, Bhutan has adopted an investment-led approach to adaptation. We are pleased to present the **Bhutan Climate Adaptation Investment Plan (CAIP) for the Water Sector**, the first sectoral plan of its kind to be developed under this new approach. Water was selected as the initial priority due to its centrality to Bhutan's economy, its vital role in energy security and agricultural productivity, and its acute vulnerability to climate change.

The CAIP for the Water Sector represents a significant advancement in translating national priorities into actionable, coherent, investable, and forward-looking programmatic interventions. It brings together the latest climate science, including insights from the State of Climate 2024, and applies a strategic, system-wide diagnostic to understand how climate risks will affect water supply, water demand, and water-related disasters. By stress-testing Bhutan's water system under multiple climate futures, the CAIP provides a robust evidence base for prioritizing adaptation investments that are both urgent and transformative.

Developed through a whole-of-government effort and guided by an Inter-Agency Working Group led by the Department of Water of the Ministry of Energy and Natural Resources, with the Department of Macro-Fiscal Development Finance of the Ministry of Finance serving as the focal point for the Asian Development Bank. The CAIP adopts a strategic investment-led approach. It presents a coherent pipeline of **eleven strategic programmatic investment packages** totalling USD 847 million over the next 15 to 20 years, reflecting a holistic and integrated response to the challenges facing Bhutan's water systems. These investments demonstrate high economic returns, provide pathways for private-sector participation, and highlight opportunities for mobilising public, private, and blended finance.



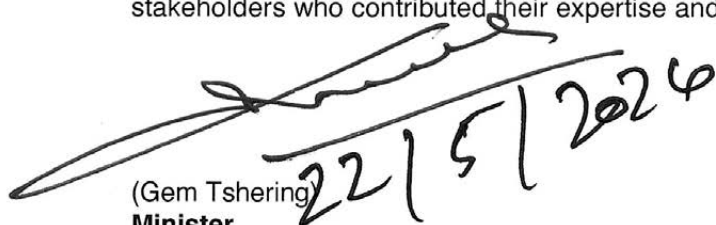
For the Ministry of Energy and Natural Resources, the Plan presents a coherent strategy for protecting Bhutan's water-dependent sectors –most notably hydropower– while enhancing the climate resilience of water supply, watersheds, ecosystems, and rural communities. It strengthens the institutional foundations for integrated water resource management, disaster risk reduction, and nature-based solutions.

For the Ministry of Finance, this Plan provides a critical tool for aligning adaptation with fiscal policy, medium-term expenditure frameworks, and public investment management processes. It offers a credible pathway to structure climate finance engagement with development partners, aligning with Bhutan's Resource Mobilisation Plan, Green Financing Taxonomy and Sustainable Financing Framework, and to ensure that adaptation investments strengthen long-term fiscal resilience.

The CAIP is both a roadmap and a call to action, and aligns closely with national development priorities under the 13th Five-Year Plan, which reflects Bhutan's commitment to forward-looking and evidence-based policymaking. It establishes a pipeline of investment-ready opportunities that will guide our engagement and foster partnerships with climate funds, development partners, and the private sector toward a climate-resilient future. It also outlines the enabling policy and regulatory reforms, governance improvements, and capacity-building needs required to deliver adaptation at scale. A key strength of the CAIP is its rigorous economic and financial assessment, which confirms a compelling economic rationale for adaptation.

As Ministers responsible for Bhutan's natural resource management and fiscal stewardship, we affirm our commitment to advancing the implementation of this Plan. The CAIP for the Water Sector represents an essential step toward securing Bhutan's climate-resilient future and ensuring that our development remains sustainable, inclusive, and aligned with the aspirations of our people and generations to come.

The Royal Government of Bhutan expresses its deep appreciation to the Asian Development Bank for its support through the Climate Adaptation Investment Planning program, and to all national stakeholders who contributed their expertise and insights and made this Plan possible.


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Ministry of Finance



Ministry of Energy and Natural Resources



Ministry of Finance

Executive Summary

The Bhutan Climate Adaptation Investment Plan (CAIP) for the Water Sector was developed by the Royal Government of Bhutan (RGoB) to advance prioritized climate adaptation investments. It aims to build the climate resilience of the water and related sectors of Bhutan in a holistic way.

The Climate Adaptation Investment Plan builds on the adaptation priorities identified in Bhutan's National Adaptation Plan (NAP) and aims to support the mobilization of finance to implement these investments. Based on consultation among government agencies, RGoB developed adaptation investment planning for one of the priority sectors of the NAP. The water sector was identified due to its economic importance and high sensitivity to climate change.

The CAIP process described in this report uses a strategic approach to develop a pipeline of programmatic investments and help unlock opportunities from various finance sources for implementation. It takes an 'investment-led' approach to identify bankable adaptation programs. This moves beyond small, individual projects to investable packages of adaptation interventions. The analysis takes a systems perspective and develops the plan using a policy-consistent framing that aligns the adaptation objectives with the development planning and public financial management landscape.

The CAIP was implemented through a five-step approach. Step 1 was a country policy context analysis, to identify planning and financing frameworks, relevant actors and entry points. Step 2 built on existing climate risk assessments to develop a strategic climate diagnostic, and Step 3 developed the NAP priorities into investment packages, based on their urgency. Step 4 assessed the costs and benefits of packages, including their potential economic and financial viability. Step 5 investigated the financing opportunities for each package, considering multiple sources and appropriate financial instruments. The process also identified the enabling conditions to help deliver adaptation.

The CAIP development was overseen by a cross-government Inter-Agency Working Group, led and coordinated by the RGoB's Department of Water, and consisting of representatives from relevant ministries and departments across the government. It was developed with the support of the Climate Adaptation Investment Planning (CAIP) program of the Asian Development Bank (ADB).

Context

Bhutan has an extensive climate change policy landscape, with an updated Nationally Determined Contribution (NDC) in 2021 and a published NAP (2023). The NAP identifies adaptation priorities across seven identified sectors over the period to 2040. Water is among the NAP priority thematic sectors. This sector is critical for the economy, through the linkages with hydropower and agriculture activities. Bhutan also experiences frequent water-related disasters such as floods and landslides. The NAP includes a set of priority activities for the water sector and for the risks of water-related disasters. These activities were subsequently developed into a NAP water sector roadmap in 2024, identifying priority objectives, activities and indicators, and centered around an integrated water resources management (IWRM) approach. The CAIP built on this roadmap, and in line with its IWRM framing, considered the overall water system, including water supply and demand, as well as the management of water-related disasters. This systems framing was used across the CAIP.

The CAIP also mapped the broader institutional and policy landscape, to identify relevant entry points and processes. At the national level, medium-term (5-year) priorities are identified through the national development planning process. The latest priorities are set out in Bhutan's *Thirteenth Five Year Plan* (2024–2029). This plan (referred to in this report as 'the 13th plan') identifies the priority water-related investment needs. It also sets out policy priorities to maximize the economic and social benefits of water resources, including payment mechanisms. Currently, water charges are levied in the 4 major cities and 16 *dzongkhag* headquarters of the country, but not in other areas. The 13th plan also identifies water-related disaster risk management priorities. The CAIP process also reviewed public financial management systems to help embed adaptation investments in subsequent economic planning and budgeting. RGoB has implemented several reforms over the past decade, including the *PFM Strategy and Action Plan 2023–2028*. This includes updated processes for public investment management, though specific criteria are not yet in place.

This step also set the outcome for the CAIP, which is aligned to the goal of the NAP water roadmap: this is to mobilize the finance to enhance the climate resilience of Bhutan's water sector while achieving equitable, sustainable water allocation among competing sectors by 2040. The CAIP also will help deliver the economic outcomes for sustainable water and security for managing water-related disasters in the 13th plan.

Strategic Climate Risk Assessment

The CAIP has undertaken a strategic climate diagnostic, building on existing studies and climate risk information, including Bhutan's most recent report the *State of Climate 2024*, but extending to provide a greater emphasis on informing adaptation investments. Therefore the analysis in this report focuses on the system level, including the use of climate-related multihazard risk analysis, and considers the climate risks on water supply, water demand, water-related disasters, and cross-sector risk linkages.

Bhutan has three main climate zones: hot, humid, and wet conditions in the southern foothills; cooler and more temperate conditions in a central belt; and cold and dry conditions in an alpine tundra zone of the north. Most rainfall occurs from June to September during the monsoon. The country experiences major impacts from monsoon rainfall, and fluvial floods and landslides are frequent, leading to major losses and damages.

The climate of Bhutan is changing. Analysis of observational data shows a marked shift over recent decades, with strong warming trends. Changes in rainfall show mixed results, but there has been a marked rise in flood occurrence since the 1970s, with increased flood-related damages. Higher air temperatures are contributing to the shrinkage of the area of glaciers and snow, and also raise the risk of glacial lake outburst floods. Increased snow and ice melt affect the baseflow of rivers and increase risks, including to hydroelectric power, which is Bhutan's main export earner. There are also reports of greater variability in rainfall and the drying of important water supply resources, notably springs. These supply around two-thirds of water for domestic and agricultural needs, and drying is directly impacting farmers and communities.

Climate change is expected to amplify these water-related risks and add new threats. However, future changes are uncertain. To address this, the study evaluated different futures using various Representative Concentration Pathways, Shared Socioeconomic Pathways, and climate models. These were used to

develop a central warming scenario, as well as an extreme high warming scenario for ‘stress-testing’ the overall water system (water supply and demand, as well as water-induced disasters), to inform future water adaptation planning. The analysis then assessed quantitative changes in the average and variability of the regional climate out to the 2050s using a set of key water risk indicators.

The results project that future average and extreme temperatures are expected to rise, though the amount of warming is uncertain. Higher temperatures will affect water demand and supply, including glacial melt (and timing of peak water availability), as well as increasing risks of flooding from glacial lake outbursts. Climate models generally project increased annual and monsoon rainfall, but this has to be seen in the context of existing high year-to-year variability. Greater rainfall totals, along with projected rises in the intensity of heavy precipitation indicate increased flood risks. Modest changes in future winter dry spells indicate potentially increased drought risk which, coupled with drying of springs, could directly impact rain-dependent agriculture, particularly for farmers.

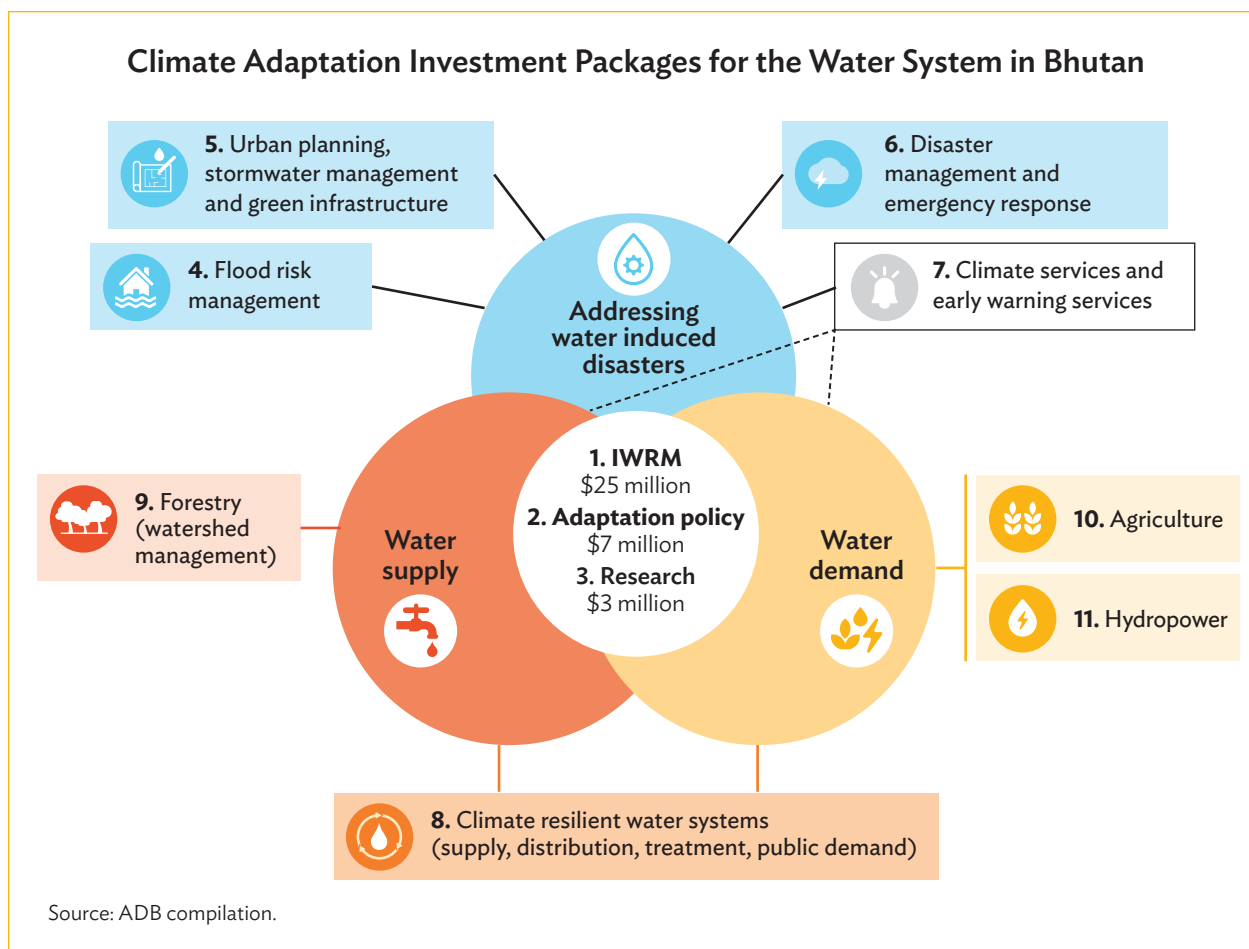
Adaptation Investment Packages

The Bhutan NAP and water sector roadmap priority activities were used to develop an initial set of adaptation priorities. The CAIP then mapped and aligned these to the priorities for water identified in the 13th plan, to ensure consistency with government development planning priorities. This formed a core set of IWRM and DRM actions.

The CAIP then took the analysis of climate risks to the entire water system from the diagnostic step and used these to develop a more holistic, integrated analysis. This recognized that more targeted and ambitious adaptation—especially in the water sector—requires a multisector approach. This was advanced by the Inter-agency Working Group in a cross-governmental RGoB workshop. This discussed the relevant climate risks and then developed a pipeline of adaptation investments. The workshop identified a long-list of adaptation activities that together could build the climate resilience of the water sector. These include targeted activities with explicit adaptation objectives, as well as activities to climate-proof planned development. Overall, a detailed pipeline of 187 activities was identified and then costed, with total investment needs estimated at \$847 million over the next 15 to 20 years.

The CAIP process then prioritized and sequenced these adaptation activities by focusing on three complementary building blocks to prioritize early adaptation, as part of an adaptive management framing. These are: (a) no-regret measures that address existing climate variability and extremes, (b) climate smart design and climate proofing of long-lived investments or decisions that will be made in the short-term, and (c) investments in information, monitoring, and learning to improve future decisions. This approach was used to identify which activities should be taken forward immediately in the current 5-year plan and which could be deferred to subsequent plans.

The next step in the CAIP process was to take these adaptation activities and assemble them into strategic adaptation investment packages across the water system, i.e., into programmatic areas. In total, 11 packages were developed (shown below).



Economic and Financial Analysis

The analysis of adaptation benefits is challenging, due to the site and context-specific nature of climate risks, and the uncertainties around future climate change. However, the analysis of benefits is critical to the CAIP analysis as this builds the justification for public investment and helps to identify potential private sector opportunities. The analysis of these benefits, in turn, informs the economic and financial analysis of adaptation.

The CAIP identified the potential benefits of each of the adaptation investment packages above. This involved looking at the benefits from three different perspectives: (a) the economic (societal) benefits of adaptation, (b) the associated fiscal benefits of adaptation, i.e., the effects on government spending and revenues for the public finances, and (c) the direct financial benefits of adaptation and the potential for generating cash flows.

This analysis found that all packages have high potential net positive economic (societal) benefits, such as from improved efficiency of water management, as well as reduced impacts of water-related disasters. The analysis also found that many of the packages could deliver fiscal benefits (for the public finances), for example, by reducing spending on disaster relief costs, and some could increase revenues from the water sector. Finally, it identified that some packages could have financial benefits, notably for investments in water technology, as well as from increased revenues following water charging reforms.

The analysis then assessed the potential economic return of the packages, based on a review of country projects and economic appraisals, as well as the wider literature. This indicates that all packages have potential to deliver net positive economic benefits, with economic internal rates of return that pass typical threshold levels for investment. This highlights the strong economic case for the individual packages and the CAIP overall. However, the financial internal rates of return of many packages were low and have limited revenue potential. This makes it more challenging to ensure all the investments are financially viable and sustainable. More positively, there are potential ways to improve the financial sustainability, discussed below.

Finance Matchmaking

A core aspect of the CAIP is identifying finance sources to implement investments. International public finance has been the main source of adaptation finance in Bhutan and will remain important. However, RGoB recognizes the need to diversify this base. The analysis assessed the potential for different sources of finance (domestic public, international public, private and blended) for each package. It also examined specific sources, as well as the instruments through which this finance may be channeled, and where relevant, the sources of funding to repay this finance.

The analysis finds that there is scope to expand private sector in financing CAIP packages aligned to RGoB's broader ambitions to expand the role of the private sector. Preliminary analysis finds that in a business-as-usual approach, about 10% of adaptation investments could attract private finance. This could rise to 25–33% through expanded public-private partnerships (PPPs), supportive blended finance structures, and regulatory reforms.

These opportunities are concentrated in certain packages. For instance, private investment could play a leading role in the deployment of water-saving technologies such as drip irrigation, water storage and harvesting systems, and other climate-smart innovations. In water supply and sanitation, PPP models can mobilize private capital, provided they demonstrate value for money, maintain equitable access, and include contractual mechanisms that support climate resilience. This potential also exists for large-scale flood protection and green infrastructure. Smaller-scale private investment in nature-based solutions can grow through expanded Payment for Ecosystem Service (PES) models and complementary financial or regulatory incentives. A small but growing market exists in the private provision of value-added weather and climate services.

Realizing these opportunities will require blended finance mechanisms as private sector engagement in the water sector is nascent, and financial institutions have limited awareness. Different blended finance options are relevant across the different CAIP packages. One promising model is a concessional credit line complemented by technical assistance for climate smart solutions aligned with the CAIP (e.g., drip irrigation and rainwater harvesting). This can be advanced through a detailed market study alongside a learning lab to help financial institutions understand the market potential. Other models include the use of returnable grants for early-stage enterprises to deliver CAIP-aligned goods and services. PPP models will likely require payment guarantees.

To catalyze these opportunities, RGoB must sustain its ambitious regulatory and policy reform process. This includes reforms in water pricing and the acceleration of efforts to mainstream green finance in the national financial system, including developing the adaptation focus of the sustainable finance taxonomy. There is scope to strengthen the business environment, including for entrepreneurs and their investors. Restructuring the water sector to establish independent municipal corporations will enhance sustainability.

For other packages, while some increase in domestic public finance may be possible, a large share will require development partner support. Capital-intensive investments are expected to be co-financed by international financial institutions, with concessional and grant resources leveraged through their climate finance windows and trust funds. Some packages could combine project-level support with policy-based financing to advance institutional reforms and other “soft” measures. Opportunities exist to access finance from multilateral climate funds, including the Green Climate Fund, Adaptation Fund, Global Environment Facility, and, potentially, the new Accelerating Resilience Investments and Innovations for Sustainable Economies Program of the Climate Investment Funds.

Finally, proceeds from carbon credits through the Bhutan Climate Fund (BCF) could support implementation of investment packages.

Enabling Factors and Next Steps

There are often barriers and constraints that can hinder adaptation. These can be overcome with enabling factors that can help strengthen the planning, implementation, and financing of adaptation.

The first enabler is capacity building and institutional strengthening. It is critical to ensure these activities (and the costs to deliver them) are included in the overall investment plan. These investments will, in turn, deliver benefits by improving the efficiency and effectiveness of adaptation implementation. Detailed capacity building and training activities are included in each package. However, broader capacity building is needed across the relevant ministries and departments in all aspects of adaptation investment planning. There is also a need to integrate the adaptation investment packages in the CAIP into the next 5-year plan, with the capacity and support to ensure this happens.

A second enabler is to improve cross-sector working and coordination, building on the integrated approach used to develop this investment plan. Implementation of the plan and delivery of finance at scale will require changes to the current approach—which is focused on individual projects—toward a more holistic and programmatic approach that seeks to take the packages forward.

A third enabler is policies and reforms that could make financing of the water adaptation investment plan more sustainable. Critically, this includes water pricing reform to support financial stability and stronger incentives to conserve water, while protecting the needs of the most vulnerable. It would also be useful to further develop regulatory incentives for climate-resilient infrastructure.

Other supporting activities would help ensure implementation of this adaptation investment plan (and associated opportunities). This includes the socialization of the plan with potential funders and financiers, including with the global climate funds and bilateral and multilateral development partners active in Bhutan. This would ensure the plan becomes the primary document and basis for mobilizing climate finance for the water sector. It would also include the socialization of the plan internally across RGoB, and establishment of the governance arrangements to take the plan forward. Such activities would benefit significantly from continued development partner support (by ADB or others).

Implementation of the plan would also benefit from more harmonized development partner support. An initial mapping of support to the water sector of Bhutan, including current and pipeline projects, has been undertaken for this investment plan. This reveals that some of the identified investments are already being supported or are under consideration, but also that opportunities exist for improved coordination and integration among the development partners to deliver adaptation at scale into the water sector.

Finally, the activities and packages in the CAIP could be linked to the development of the BCF. An opportunity exists to develop a more explicit adaptation component of the BCF, with a centralized unit or country platform to coordinate and harmonize adaptation finance activities, plus a project/investment preparation facility and a funding window. Such an extension of the BCF would improve ownership and coordination, and build capacity, while optimizing the mobilization of external resources for climate adaptation behind a unified set of country-led priorities.

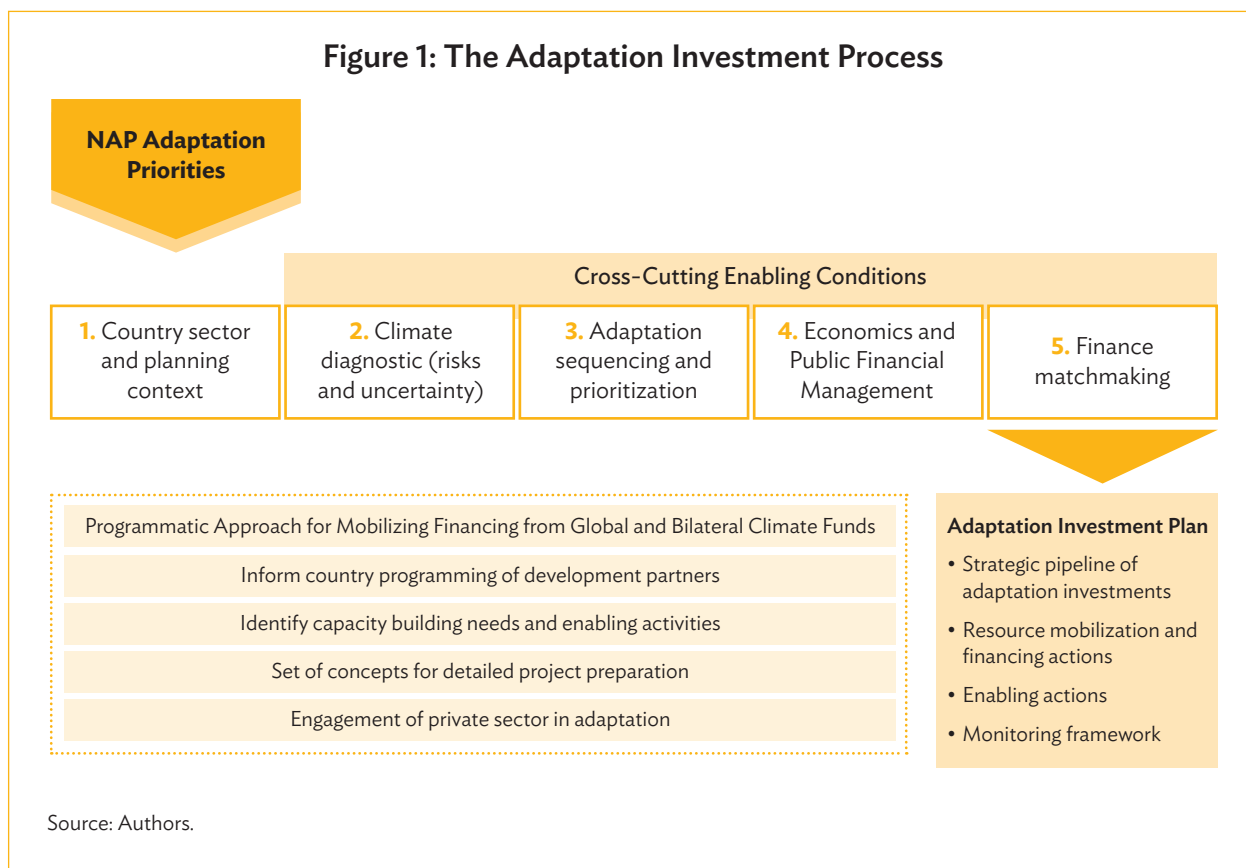


1 Introduction

1. The Royal Government of Bhutan (RGoB) has a highly developed climate change policy landscape. RGoB published an updated Nationally Determined Contribution (NDC) in 2021, which focused on mitigation priorities, and then published and submitted a National Adaptation Plan (NAP) to the United Nations Framework Convention on Climate Change in 2023 which set out adaptation priorities (RGoB 2021, 2023).
2. Bhutan has a large adaptation finance gap, as current international public adaptation finance flows—tracked at \$30 million a year on average (over the period 2018-2022) (UNEP 2024)—fall well below the anticipated financing needs of the NAP. This reflects the level of international public finance, which, although rising, falls short of the anticipated costs of adaptation in the NAP. This finance can be challenging to access, because of the time and resources needed. However, it also reflects the challenges in converting NAP or NDC adaptation priorities into investment-ready programs that can attract climate finance. This reflects that there are barriers and constraints to adaptation finance (UNEP, 2024). These arise from market failures (that include information failures, positive externalities, and imperfect financial markets, Pauw et al., 2021) and from practical issues over the bankability of adaptation. These include issues such as site specificity and low replicability, typically small investment size, project complexity, and the number of actors and intermediaries involved, which makes it difficult to mobilize finance at scale from multiple sources.
3. Such challenges can be addressed by adaptation investment planning. This process employs an ‘investment-led’ approach to identify bankable adaptation programs, and takes a strategic approach to move beyond small, individual projects, to develop a pipeline of programmatic investments that reflect the priorities outlined in formal adaptation plans.
4. The aim is to unlock opportunities from various finance sources to implement these priorities, including public, private, and blended sources (Box 1). This intention to deliver finance at scale requires alignment with medium-term national planning, economic, and fiscal frameworks. The emphasis is on adaptation investment planning as part of the broader NAP process rather than seeking to produce standalone investments.
5. Given the detail required, the adaptation investment process typically focuses on a priority sector or thematic area of the NAP. Based on consultation, RGoB prioritized the water sector because of its considerable economic importance and high climate sensitivity.

6. The ***Bhutan Climate Adaptation Investment Plan for the Water Sector*** (CAIP) was developed by RGoB to advance priorities identified by Bhutan's NAP. The CAIP aims to support the mobilization of finance to implement investments, and to build climate resilience in the water sector in a holistic manner by integrating water resources management and disaster risk management and supporting other water-related sectors.
7. The CAIP was developed by the cross-government Inter-Agency Working Group, led and coordinated by the Department of Water, which consisted of technical experts from relevant RGoB ministries and departments, with support from the Climate Adaptation Investment Planning Program of the Asian Development Bank (ADB) under TA 6933-REG. This is an initiative that helps ADB's developing member countries take an 'investment-led approach' for scaling up public and private investment in climate adaptation.
8. The CAIP was delivered through technical studies, assessments, and analysis, complemented by national stakeholder consultations and workshops. Work also included initial training of Inter-Agency Working Group members and the sharing of cross-country experiences with other CAIP country programs.
9. The approach also identifies cross-cutting and enabling conditions (policy, regulatory, capacity building) that can support adaptation finance and implementation. This includes identification of capacity building needs, institutional and governance actions, as well as possible policy reforms. This also considered how new resources could be channeled through the Bhutan Climate Fund (BCF), as well as other climate finance initiatives being pursued by Bhutan, including the Bhutan Climate Change Fund, and country programming processes of multilateral climate funds, multilateral development banks (MDBs), and development partners.
10. Co-creation of CAIP activities with stakeholders is embedded throughout the five steps, shown in Figure 1. A more detailed description of the method is presented in Annex 1. In Bhutan, the stakeholder process was driven by the Inter-Agency Working Group. It also included a dedicated national workshop to agree on the adaptation activities and packages. The ADB adaptation investment planning CAIP program supported these activities through technical assistance and country missions, and by embedding national consultants.

Figure 1: The Adaptation Investment Process



11. The five strategic steps taken to devise a climate adaptation investment plan for the water sector are laid out through the report chapters:

Chapter 2. Policy Context. The initial step is a country context analysis, which includes an assessment of planning and financing frameworks and identifies relevant actors and entry points for adaptation.

Chapter 3. Strategic Climate Risk Diagnostic. This step builds on existing climate risk assessments to develop a strategic climate diagnostic to identify potential current and future climate risks.

Chapter 4. Adaptation Prioritization and Investment Packages. The next step develops the NAP priorities into investment packages, based on their urgency and sequencing.

Chapter 5. Benefits and Economic Analysis. Following the identification of packages, this step assesses their benefits and the costs, including potential economic and financial viability.

Chapter 6. Finance Matchmaking. The final step investigates the financing opportunities for each package, considering multiple sources and appropriate financial instruments. The process also identifies the enabling conditions to help deliver adaptation.

Chapter 7. Enabling Factors and Next Steps. The report concludes by examining the enabling conditions that facilitate Bhutan's climate adaptation investments and detailing the recommended next steps for the CAIP process

Box 1: What is an Adaptation Investment Plan and How Does This Differ from NAPs, NDCs and Project Proposals?

Adaptation investment planning is a part of the overall NAP or NDC process and aims to take the identified adaptation priorities in these documents and unlock finance for implementation at scale. The process differs from the development of an individual adaptation proposal (for example development of a proposal for submission to a global climate fund) because it:

- Works at a strategic or programmatic level, rather than an individual project level, thereby developing integrated packages of adaptation investments.
- Integrates (mainstreams) adaptation investments within government planning and financing frameworks, as appropriate, rather than developing standalone projects with their own governance and financing arrangements.
- Investigates multiple sources of finance, and considers domestic and private sector finance, as well as international public adaptation finance at the programmatic scale.
- Involves multiple actors for implementing adaptation, including activities delivered by the government as well as by companies and households.

Adaptation investment planning builds on existing NAPs and NDCs, as these have been implemented to date, and associated financing frameworks, but extends these in important ways:

- For public sector activities, aligns with public financial management and investment criteria used by government in prioritizing public investments, and the fiscal and medium-term expenditure framework, and it recognizes the need to align to these frameworks when financing at scale.
- Considering the urgency of needs, applies an adaptive management framework to the sequencing of activities over time, and identify early priorities.
- Assesses the economic benefits of adaptation, not just the costs, and evaluates the economic case for investment.
- Examines multiple sources of funding and finance, as well as different financial instruments, to see how to crowd in finance for adaptation, matchmaking sources and instruments to investments.
- Identifies the enabling conditions to help implement and finance adaptation, including capacity building and institutional strengthening, addressing barriers and constraints (e.g., information, institutional arrangements, processes), creating the enabling environment for adaptation (e.g., policy, regulation, legislation), and ensuring these activities are also financed.

An adaptation investment plan is also more specific than a national adaptation plan because it focuses on a specific sector or geographical area. The choice of this focus will depend on government priorities, the institutional and governance context, as well as the relevant entry points and opportunities.

2 Policy Context

Key Messages

- The CAIP builds on the existing climate change landscape and seeks to mainstream adaptation in systems and processes. Thus, the process starts with a review of the policy context.
- Bhutan has published an updated NDC (2021) and NAP (2023) identifying water as a priority thematic sector. NAP water sector priority activities were subsequently developed in a NAP water sector roadmap in 2024, which identified priority objectives, activities, and indicators using an integrated water resources management (IWRM) approach. The CAIP built on this road map and expanded it to include a wider framing of the water system, including water supply and demand, alongside the management of water-related disasters. This systems framing was used across the CAIP. To understand the linkages, the CAIP mapped the overall institutional and policy landscape.
- Since a key focus of the CAIP process is mainstreaming in national development planning and public financial management, these processes were reviewed. The main national development priorities are set through medium-term (5-year) plans, Bhutan's most recent being published as the *Thirteenth Five Year Plan (2024–2029)*. The plan identifies priority water-related investment needs and sets out policy priorities to maximize the economic and social benefits of water resources, including payment mechanisms.
- The CAIP process also aims to embed adaptation into public financial management systems. A review of current systems identified that RGoB has implemented several public financial management reforms over the past decade, with updated processes for public investment management, though specific criteria are not yet in place.

12. Step 1 in the CAIP is to understand the context for adaptation. This includes not only climate change policies and NAP priorities, but also the frameworks for wider national and sector development planning, public financial management, and investment planning, and institutional and the governance arrangements and responsibilities. This step also develops the strategic approach to the analysis and identifies specific objectives of the adaptation investment plan.
13. The NAP (2023) identified priority adaptation programs in seven thematic sectors presented in the previous chapter: (a) water; (b) agriculture and livestock; (c) forest and biodiversity; (d) human settlements and climate-smart cities; (e) health; (f) energy, and (g) climate services and disaster risk reduction. Adaptation investments are needed in all these thematic sectors. RGoB decided to focus CAIP work on the water sector.

14. Bhutan has abundant water resources, which arise mostly from the southeast monsoon (more than 70%), with the remaining primarily from melting glaciers and snow, as well as from lakes and springs. Water resources are critical for the security of public supplies, hydropower, agriculture, and tourism—and thus for the economy. About 57% of households in dwellings have access to piped water, although access is much higher for urban (84%) than rural (39%) areas (and access to water in compounds outside dwellings is different). Most of the water supply and demand is managed by the public sector. Although there are charges for using water in major municipalities (but not outside these areas), water supply is not premised on full cost recovery. The country is also severely affected by water-related disasters, including heavy rainfall during the monsoon and cyclones; flash floods and fluvial flooding; landslides, soil erosion, and bedload transport; dry spells, droughts, and seasonal water shortages; the drying up of springs; glacial lake outburst floods; and forest fires (especially during dry winter months).
15. The NAP identified five strategic objectives for the water sector:
 - (1) Improve natural capacity for infiltration, water recharge, and water buffer for prevention of fast runoff and erosion.
 - (2) Optimize the use of available water discharge.
 - (3) Ensure a climate resilient supply of safe drinking water under climate change.
 - (4) Enhance water use efficiency and promote sustainable management of water resources for agriculture.
 - (5) Strengthen institutional capacity for water management.
16. It also outlined a costed list of strategic actions for each of these objectives (Annex 2). These include a mix of activities. The cost for delivering these priority NAP strategic water actions was estimated at \$205 million. These cover the short and medium-term planning periods.
17. For each strategic action, the NAP provided a more detailed list of the specific activities, split between the short term (up to 5 years) and medium term (5–15 years). These include 58 separate activities (across the five strategic areas) covering a range of investments, policies, capacity building, and assessment studies.
18. Following this, RGoB developed a Water Sector Roadmap for Implementing Bhutan’s NAP (ADB 2024) which had the overall goal of improving the climate resilience of Bhutan’s water sector while achieving equitable, sustainable water allocation among competing sectors by 2040.
19. The Roadmap produced an updated list of seven adaptation objectives:
 - (1) Strengthen water governance.
 - (2) Strengthen stakeholder engagement.
 - (3) Enhance water use efficiency and reduce water loss across all sectors.
 - (4) Invest in water allocation monitoring and enforcement mechanisms.
 - (5) Ensure the environmental sustainability of water sources.
 - (6) Develop and implement a disaster management plan for the water sector.
 - (7) Strengthen water quality management to protect public health.

20. The Roadmap also developed a logframe and a resource mobilization strategy, and it identified 28 activities across the seven objectives (Annex 3).
21. RGoB has also published and submitted a Long-Term Low Greenhouse Gas Emission and Climate Resilient Development Strategy (RGoB 2023b) that includes adaptation actions out to 2050. The Bhutan Climate Fund (BCF) is being established with the support of the World Bank (World Bank 2018). This is focused on aggregating and monetizing Bhutan's high-integrity net negative greenhouse gas emissions at a fair price, focusing on carbon offset revenues from hydropower and forestry (NEC 2023). Funds generated will support development goals and could include adaptation funding.
22. Within RGoB, climate change is the responsibility of the Department of Environment and Climate Change (DECC), which sits within the Ministry of Energy and Natural Resources (MoENR). This Department has a Climate Change Division that is responsible for coordinating adaptation (as well as national and international reporting obligations). There is also a National Environment Commission (NEC), a high-level multisector body that operates as an autonomous agency tasked with making decisions and coordinating all matters relating to the protection, conservation, and improvement of the natural environment. The NEC has a mandate to develop, review, and revise environmental policies, plans, and programs. It also serves as the high-level National Climate Change Committee (NCCC). The NEC Secretariat, in supporting the NEC/NCCC, leads the preparation of national policies, strategies, and plans on environment and climate change, such as environment conservation, biodiversity, pollution abatement, water resources, climate change policy, NDCs, NAPs, and low emission development strategies. There is also a Climate Change Coordination Committee, or 'C4', a forum for discussion and coordination of technical matters related to climate change which makes recommendations for the NCCC/NEC to consider. The Department of Macro-fiscal and Development Finance in the Ministry of Finance is the National Designated Authority for the Green Climate Fund (GCF) and the Designated Authority for the Adaptation Fund. The Bhutan Trust Fund for Environmental Conservation is an accredited direct access entity with both the GCF and the Adaptation Fund.
23. A government reorganization in 2022 led to a restructuring of ministries and other government agencies under the Civil Service Reform Act (RGoB 2022). The NEC Secretariat was reorganized into two departments: the Department of Environment and Climate Change and the Department of Water, which were placed under a newly formed Ministry of Energy and Natural Resources. The ministry includes several other water relevant departments, including the Department of Forest and Park Services, the Department of Energy, and the National Center for Hydrology and Meteorology. The Department of Water is the national focal point for all water sector climate adaptation work in Bhutan, and takes the lead on formulating policies, regulations, and strategies related to water management. It prepared the water section of the nation's current 5-year medium-term plan, for 2024–2029. All three main divisions are relevant to adaptation investment planning: the Water Resource Planning and Monitoring Division, the Water Services Division, and the Water Resources Management Division.
24. Additional water-related infrastructure development activities are the responsibility of other ministries. Flood risk management sits in the Department of Human Settlements (DHS) under the Ministry of Infrastructure and Transport. Within the same ministry is the Department of Infrastructure Development (DoID), which includes the Regional Offices for Infrastructure Development and delivers water infrastructure projects (including water and sanitation). There is also the National Centre for Hydrology and Meteorology (NCHM), which provides weather and

climate services (including hydrological services, severe weather and early warning services). Some early warning systems (EWS) for floods in Bhutan have been in place for some time (Shrestha et al. 2016). A new road map *Institutional Strengthening and Modernization of Hydromet and Multi-Hazard Early Warning Services in Bhutan* has been developed with World Bank support (World Bank 2024a).

25. Bhutan has several adaptation projects in the water and disaster risk management sectors (either projects with dedicated adaptation objectives or that integrate adaptation as part of projects with wider development objectives). These include Green Climate Fund (GCF) projects on agriculture and community resilience, an Adaptation Fund and Global Environment Facility (GEF) project on climate resilient water infrastructure. MDBs and bilateral development partner also support projects that include climate resilience. Among them are the ADB-financed Water Flagship Program Support Project and the Phuentsholing Township Development Project; and the World Bank, Global Facility for Disaster Reduction and Recovery (GFDRR) and Japan International Cooperation Agency (JICA) funded Climate and Disaster Resilience Development Policy Financing with a Catastrophe Deferred Drawdown Option, as well as the World Bank Strengthening Risk Information for Disaster Resilience in Bhutan.
26. Bhutan's national development priorities, as set out in long-term and medium-term development plans, are critical to understanding the upstream and strategic context for the CAIP. The medium-term national development framework in Bhutan uses a 5-year planning framework. Following a government reorganization in 2022, the *Thirteenth Five Year Plan (2024–2029)* was developed. This was led by the Office of the Cabinet Affairs and Strategic Coordination. The 13th plan was published in June 2024 (RGoB 2024) and, as the main RGoB planning document, sets out national goals and key performance indicators (KPIs). It also represents a strategic shift toward rebalancing the “four pillars of Gross National Happiness” (GNH)¹—and a focus on transforming the economy to fulfill Bhutan's needs in the 21st century. The long-term goal is for Bhutan to be a High Income GNH Economy by 2034.
27. Sector and adaptation priorities will need to be incorporated into the outcome framework of the 13th plan. They will also have greater relevance and support if they enable the plan's KPIs to be achieved. In turn, RGoB is likely to prioritize financing for national and sector-based adaptations that can make a stronger contribution to national objectives, outcomes, and KPIs. The plan's objectives and outcomes could also help create opportunities for adaptation financing because of the focus on economic transformation through privatization, PPPs, and private sector development and participation.
28. Within the 13th plan's economic development objective/outcome (section 3.1), and strategies and programs (section 3.1.2), is an Ecological Diversity and Resilience Programme (3.1.2.3). This recognizes that Bhutan's economy is largely based on climate-sensitive sectors and that their disruption by climate change could have an irreversible and devastating impact on national socioeconomic well-being. Therefore, mitigation and adaptation are identified as urgent priorities, requiring climate change to be mainstreamed across sectors. The 13th plan has specific objectives for water (Box 2). This includes the need to look at opportunities for increasing water supply and for managing water demand, including through water charging. The potential for new revenues

¹ Gross National Happiness is a holistic and responsible approach to development that is geared towards societal wellbeing, and moves beyond economic growth alone as represented by the Gross Domestic Product (GDP). It balances economic growth with environmental sustainability, social progress, and cultural vibrancy – underpinned by a framework of good governance.

from water resources is also identified. As the 13th plan is not fully funded, a focus of the adaptation investment plan is to look at financing opportunities for water sector adaptation priorities, though there is also interest in identifying external finance sources for the NAP and for NAP water road-map activities.

Box 2: Water Priorities in Bhutan's Thirteenth Five Year Plan

Sustainable water resource management will be taken forward with the development and implementation of a national water master plan and river basin management plans, guidelines on climate-resilient water infrastructures based on assessments of climate vulnerability and risk for priority water sectors, and the institution of a knowledge bank on water resources management. Avenues for potential natural and built water storage will be explored and developed, and suitable nature-based solutions for watershed conservation and restoration will be implemented....To maximize economic and social benefits from water resources, payment mechanisms will be established for water services and investment opportunities will be explored. Potential groundwater and recharge areas, and possible avenues for abstraction will be explored and assessed. Avenues for water-based ventures will be created, along with the promotion and adoption of emerging water-efficient and innovative technologies.

Source: RGoB, 2024, page 58.

29. Relevant disaster risk management priorities are also presented in the Strengthening Security Objective of the 13th five- year plan (section 3.3). Outcome 1 is *Safety and security threats and disaster risks to the country, its economy, infrastructure, institutions, and people are mitigated and managed*. The outcome is relevant for adaptation, while two of its five outputs are highly relevant for water-related disasters. These are: (1) critical infrastructure will be secured through robust planning, risk management, and investment in infrastructure that is resilient to hazards and disasters, and (2) communities are prepared and resilient to disaster. This encompasses the adoption and implementation of local disaster risk reduction strategies.
30. Priorities for the plan were identified for each ministry (and for departments within each) with allocated indicative budgets for delivery. As mentioned, the capital investment needed to deliver the plan will be partly financed from the RGoB budget and partly by loans and grants from development partners. RGoB is allowed to borrow only for capital expenditures, but not for recurrent costs.
31. In line with the 13th plan, the Department of Water has identified its own priorities:
 - Develop and implement national integrated water master plan and river basin management plans.
 - Explore and develop avenues for potential natural and built water storage.
 - Implement suitable nature-based solutions for watershed conservation and restoration for the sustainable supply of water.
 - Establish payment mechanisms for water services and explore investment opportunities.
 - Assess climate vulnerability and risks for priority water sectors and develop a guideline on climate resilient water infrastructures.

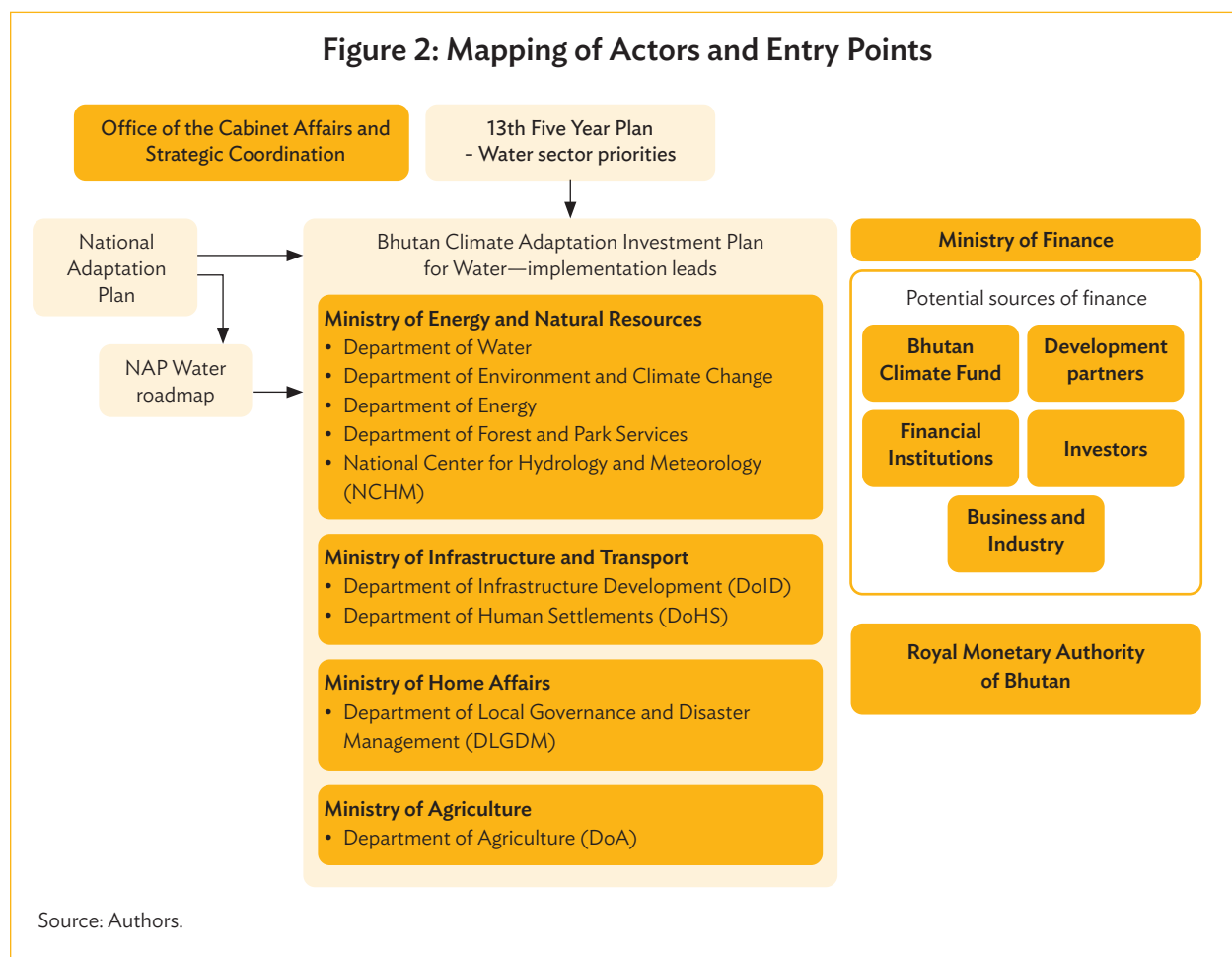
- Explore and assess potential groundwater and recharge areas, and possible avenues for abstraction for conjunctive use in the surface water scarce areas.
 - Promote and adopt emerging water efficient and innovative technologies.
 - Create avenues for water-based ventures.
 - Institute knowledge bank on water resources management.
 - Revise water policy and vision 2008, and the Water Act 2011.
 - Conduct monitoring on implementation of water guidelines and regulations.
32. These Department of Water activities are based around information, policy, and enabling actions/ activities when seen through the lens of IWRM, though there are some more specific delivery aspects for nature-based solutions and water storage. Importantly, many of these activities overlap with NAP water sector priorities. This list therefore provides focus areas for the CAIP. Note that NAP activities that are outside the plan's priorities can still be taken forward if there is (concessional) external finance available. The department is also involved in two adaptation projects—one funded by GEF and another funded by the Adaptation Fund that takes a nature-based solution approach working with the International Centre for Integrated Mountain Development (ICIMOD). Some of these CAIP priorities were covered in the NAP water roadmap (i.e., IWRM, water efficiency, nature-based solutions), but the others were not.
33. The 13th plan priorities also includes capital investments for water supply and water system infrastructure under the DoID, and for flood protection infrastructure under the DHS.
34. The CAIP process has also reviewed public financial management and public investment criteria for project appraisal by RGoB. This allows adaptation investments to be analyzed in a manner consistent with Bhutan's current investment planning. RGoB has implemented several public financial management reforms over the past decade. The latest is the *PFM Strategy and Action Plan 2023–2028* (RGoB's third such strategy). This aims to continue and deepen public financial management reforms.
35. The public investment management function is decentralized (World Bank 2023a). Implementing agencies prepare detailed project reports or initial project documents, as well as detailed feasibility studies. Although some socioeconomic impacts are discussed in those reports and documents, economic analysis (i.e., cost–benefit analysis) is not systematically undertaken for publicly-funded projects—whereas it is for donor-funded projects (World Bank 2023a). Proposals submitted by implementing agencies are reviewed by the Department of Planning, Budget and Performance and the Department of Macro-Fiscal and Development Finance under the Ministry of Finance. Selection of investment projects is based on criteria set out in the *Flagship Program Guidelines*. Projects that meet the criteria should be selected prior to inclusion in the budget.² Proposals that meet the criteria are submitted to Cabinet for approval and, if approved, implemented. Details of approved projects, including total budget allocations, are published on the website. The ongoing *PFM Reform Strategy and Action Plan 2023–2028* (RGoB 2023c) for managing public finances is developing guidelines for economic (cost–benefit) analysis and project prioritization criteria.

² RGoB's Flagship Program Guidelines include selection criteria; and some new major investment projects must comply with guidelines issued to relevant sectors. Prior to inclusion in the budget, some major investment projects are prioritized by a central entity on the basis of published standard criteria (plan targets, annual targets, budget write-up format, and other aspects specified in the Budget Call Notification). Following dissolution of the Gross National Happiness Commission in September 2023, its functions for project identification and formulation were transferred to the Department of Planning, Budget and Performance and the Department of Macro-Fiscal and Development Finance (World Bank 2023a, 2023b).

36. In January 2024, Bhutan officially graduated from the United Nations list of Least Developed Countries (LDCs) after meeting predefined criteria on income, human assets, and economic and environmental vulnerability. Although this is a major achievement, over time it could affect access to highly concessional lending from climate funds—although transitional arrangements are currently in place. Economic development and graduation are also important for the Classification and Graduation Policy used by MDBs for lending policies and rates, which are typically based on per capita income and creditworthiness. However, Bhutan is still eligible for MDB concessional financing support. For example, the country has been granted a Small States Exception to ensure eligibility with concessional financing support from the International Development Association. Likewise, as of 2025, ADB defines Bhutan as a ‘Group A’ country, recognized as being in greatest need of concessional financing from the Asian Development Fund (ADF), which in Bhutan’s case is grants blended with ADB’s conventional lending.³ In addition, Bhutan is eligible to receive full grant financing for qualifying projects through the ADF’s climate change adaptation and disaster risk reduction thematic window.⁴
37. The CAIP analysis has also considered PPP arrangements and current private sector involvement in the water sector. Private capital is limited in Bhutan, and lending costs for the private sector are high. However, the government has enacted several reforms to promote foreign direct investment and PPPs and improve access to finance. Credit flows are largely directed to tourism and housing, though the Bhutan Development Bank has an extensive agricultural portfolio and is at stage 1 of GCF accreditation. Bhutan National Bank and Bank of Bhutan are also seeking GCF accreditation.
38. RGoB’s climate change action approach is based on the extensive Climate Change Policy described earlier. Steps have been taken to improve performance. In the fiscal year ended 30 June 2022, government officials from four pilot agencies were trained in climate budget tagging; and annual budget report for the next fiscal year included a section on climate co-benefits (World Bank 2022). The Budget Call Circular that year provided guidance on incorporating climate change aspects into capital budget proposals. However, it did not include a methodology to track climate change-related expenditure, or expenditures that are counter to climate policy, or refer to the Climate Change Policy 2020 (RGoB 2023c). The 2023 Public Expenditure and Financial Accountability (PEFA) Climate Responsive Public Financial Management (CRPFM) Assessment (World Bank 2023b) found scope for further improvements through better alignment between RGoB’s annual and medium-term budget and national climate change strategies. A green taxonomy has been developed, although this is initially focusing on mitigation and cross-cutting (rather than adaptation).
39. A summary of the context review is presented in Figure 2, including the key actors, their relevant mandates, and key entry points for the CAIP.

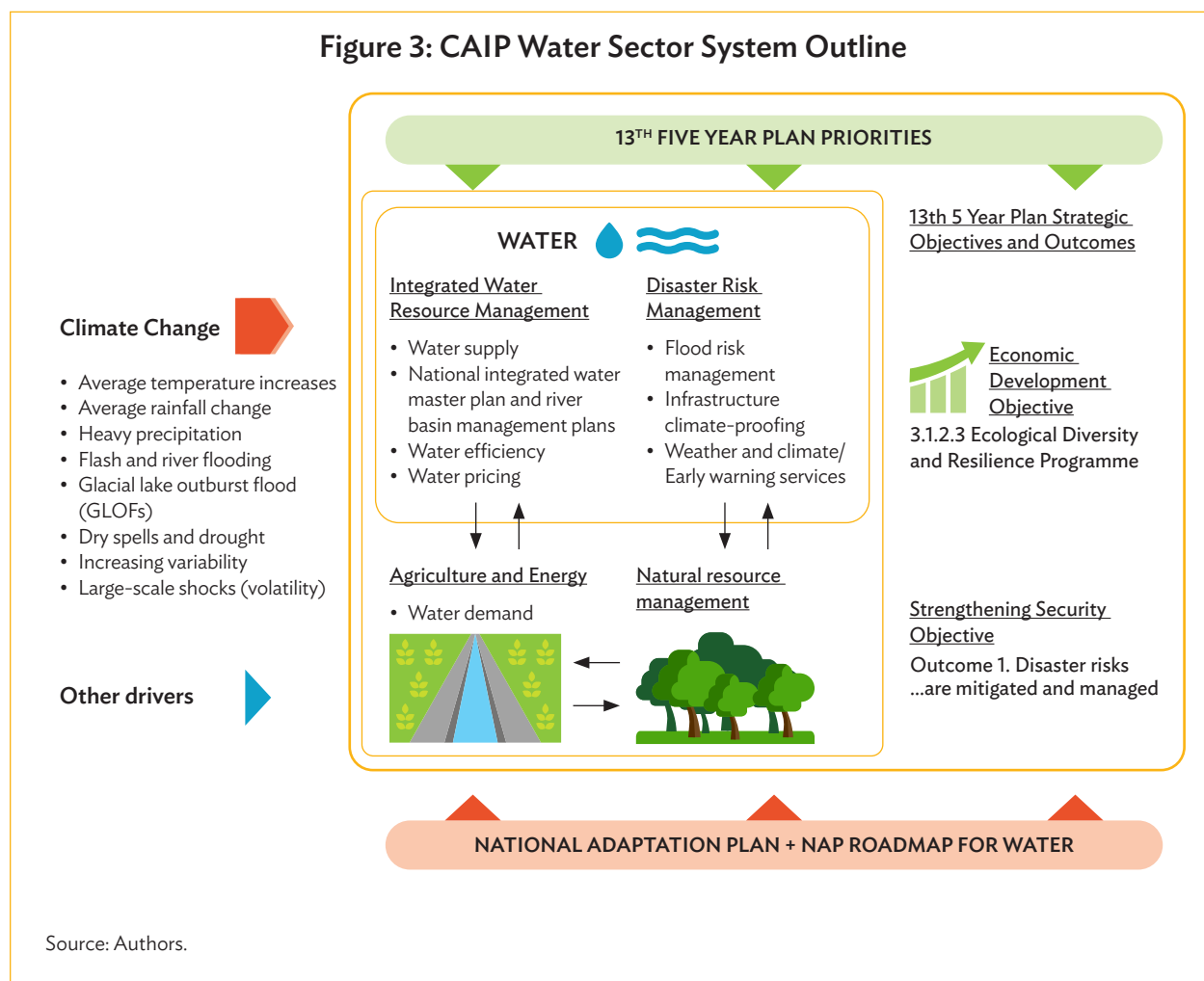
³ ADB. *Public Sector Financing*.

⁴ ADB. 2024. *Concessional Assistance Policy for the ADF-14* Period, August.

Figure 2: Mapping of Actors and Entry Points

40. Figure 3 shows a water system map for the CAIP, with various links to water management (including supply and demand, as well as water-induced disasters) and key cross-sector linkages. This context also clarifies that the objectives of the adaptation investment plan are to progress financing for the prioritized water NAP actions and activities in the 13th plan, with a supplementary analysis of the potential for external financing for the wider set of water-related activities. This recognizes that more targeted and ambitious adaptation usually requires a multisector approach.

Figure 3: CAIP Water Sector System Outline



41. The context review also set out the outcome for the CAIP, which, building on the goal of the NAP water road map, is to mobilize the finance needed to enhance the climate resilience of Bhutan's water sector while achieving equitable, sustainable water allocation among competing sectors by 2040. The CAIP will also help deliver the economic outcomes for sustainable water and the security outcomes for managing water-related disasters in the 13th plan.

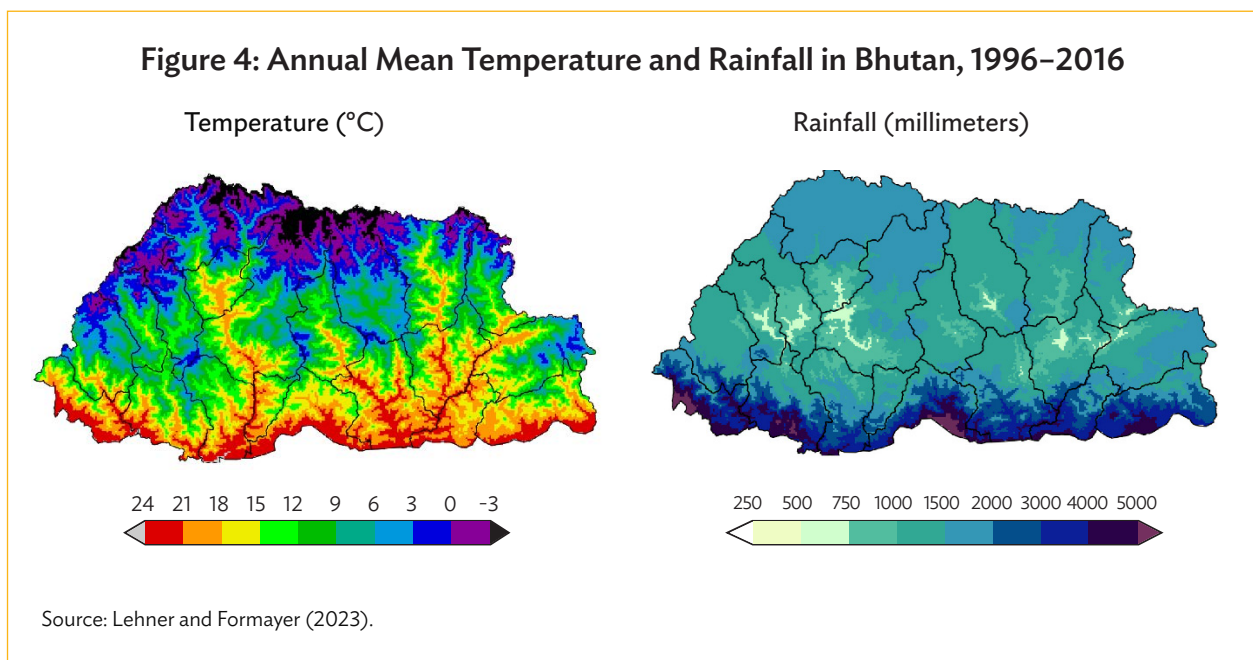
3 Strategic Climate Risk Analysis

Key Messages

- The CAIP undertook a strategic climate diagnostic. This built on existing studies, but extended the analysis to the system level, considering climate-related multihazard risks, and risks to water supply, water demand, and water-related disasters.
- The analysis found that the climate of Bhutan is changing. Analysis of observational data shows a marked shift over recent decades, with strong warming trends. This is reducing the areas of glaciers and snow, and affecting the baseflow of rivers. It is also increasing the risk of glacial lake outburst floods. While changes in rainfall are mixed, there has been a marked rise in flood occurrence. There are also reports of greater variability in rainfall and the drying of important water supply resources, notably springs, which supply about two-thirds of water for domestic and agricultural needs.
- Climate change is expected to amplify these water-related risks and add new threats. However, these future changes are uncertain. The climate diagnostic developed a central warming scenario, as well as an extreme high warming scenario for 'stress-testing' the overall water system. It produced quantitative projections for key water system risk indicators out to the 2050s.
- The results project that future average and extreme temperatures are expected to rise, though the amount of warming is uncertain. This will affect water demand and supply, including glacial melt (and timing of peak water availability), as well as increasing flooding risks from glacial lake outbursts. It also projects increased annual and monsoon rainfall, but continued high year-to-year variability. Greater rainfall totals, along with projected rises in the intensity of heavy precipitation indicate increased flood risks. Modest changes in future winter dry spells indicate potentially increased drought risk.

42. Step 2 in the adaptation investment process is to undertake a strategic climate diagnostic. This has a greater emphasis on informing adaptation decisions, and is undertaken at a strategic and programmatic level, rather than through projects, and includes the consideration of multihazard climate risk analysis. It therefore considers the full water system (Figure 3), including the potential effects on water supply and demand, as well as water-induced disasters. The diagnostic builds notably on the water sector NAP preparatory study (Department of Water 2023) and the *State of Climate Report 2024* (NCHM 2025), plus other research outputs and new investigations, to develop risk profiles over time that reflect climate uncertainties.

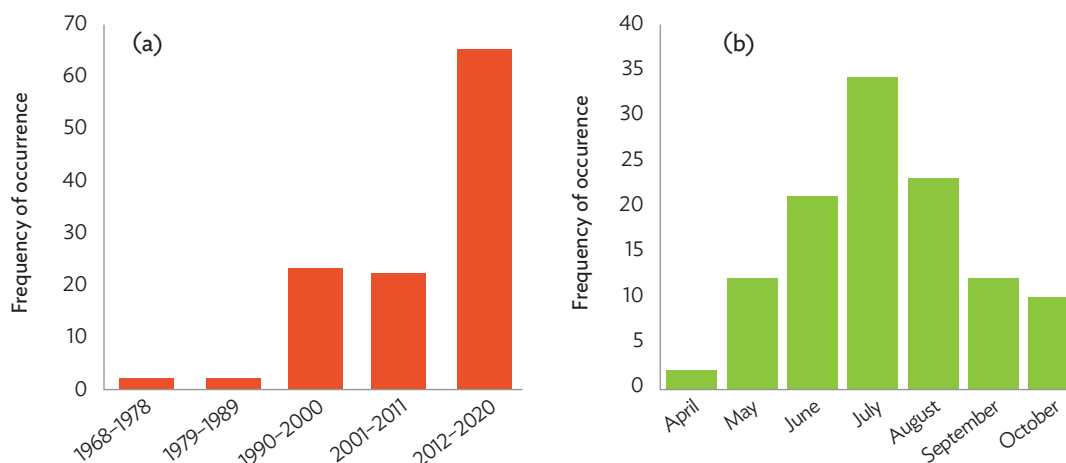
43. Bhutan is a land-locked country with a highly varied topography that has produced three main climate zones (Figure 4). Hot and humid conditions occur in the Duar Plains (southern foothills belt), where elevations are 150 meters to 2,000 meters above mean sea level, with heavy rainfall and seasonal temperatures in the range 15°C to 30°C. Cooler, more temperate conditions are found in the Lesser Himalaya region (central belt), where elevations are 2,000 meters to 4,000 meters, with moderate rainfall, cool winters, and warm summers. The alpine tundra climate zone of the Greater Himalayas (northern belt) has elevations above 4,000 meters, with cold winters and cool summers. Annual mean precipitation totals range between less than 600 millimeters in the northwest (Gasa) and more than 5,000 millimeters at some sites in the southwest (Chhukha). There are four main rainfall seasons: (a) pre-monsoon (March–May), (b) southwest monsoon (June–September), (c) autumn/post-monsoon (October–November), and (d) winter (December–February) (NCHM 2025).



44. More than 70% of annual rainfall typically occurs during the monsoon season, though there is considerable interannual variability of air temperature and precipitation. Heavy monsoon rainfall increases the risks of flash floods, fluvial flooding, and landslides. Bhutan experiences frequent floods (Figure 5) and is increasingly experiencing localized droughts (Tariq, Wangchuk, and Muttill 2021). These floods may be generated by cloud bursts (pluvial events), heavy monsoon rainfall (fluvial), and glacial lake outbursts (meltwater events). For instance, the *State of Climate Report 2024* refers to four extreme hydrological events that year. Overall, the frequency of recorded floods increased threefold between the 1970s and 2010s. July has the largest number, corresponding to the month with maximum average rainfall. These events have major impacts on people (including fatalities) as well as leading to infrastructure damage. Periodic droughts also occur, though fewer quantitative data points on these events are available.

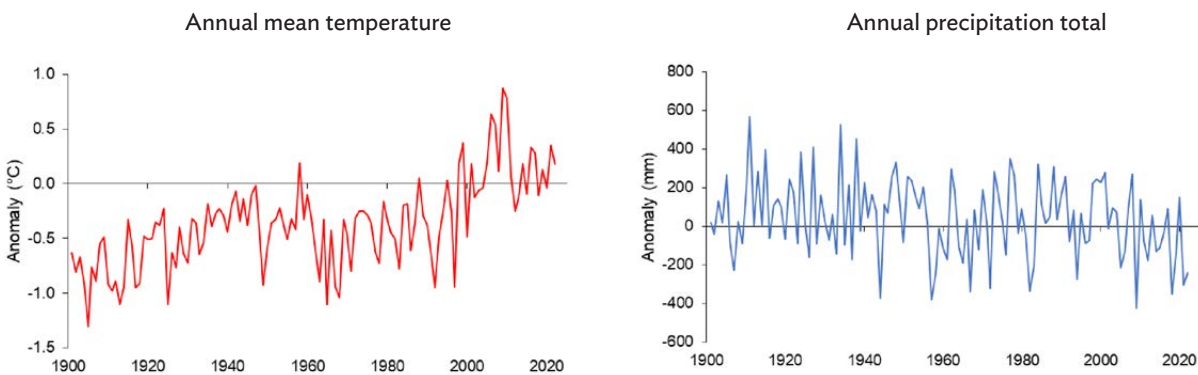
45. The climate of Bhutan is changing. An analysis of observational data for the country shows a marked shift over recent decades, with strong warming trends, fewer frost days, and longer growing seasons. Since the 1900s, annual mean air temperatures have increased by about 0.9°C. Most rapid recent warming has occurred during the summer monsoon and rates of warming are also reported to be more rapid in the highlands than in the lowlands (Hoy et al. 2016).

Figure 5: Frequency of Flood Occurrence by Decade, 1968–2020



Source: Tempa (2022).

46. Trends in annual precipitation are harder to detect, because of the sparse meteorological network, high inter-annual variability, and highly local influence of topography. Some evidence exists that annual precipitation has increased since the 1970s, primarily in the western half of Bhutan. However, a study of seasonal rainfall amounts and frequency of rain days during 1986–2018 found mixed results (Sharma and Adhikari 2022), with reductions in winter and post-monsoon rainfall found at the majority of sites, especially at lower elevations. Long-term changes in both air temperature and precipitation (Figure 6) have implications for glacier-fed rivers and downstream water supplies. Between the 1980s and 2010, the loss of glacial area was approximately 23%, mainly from clean-ice glaciers at elevations below 5,600 meters. Trends in extreme rainfall show mixed results but there has been a marked rise in flood occurrence since the 1970s. Rising air temperatures are also contributing to marked shrinkage of the area covered by glaciers and snow in Bhutan. Associated meltwater and heavy rainfall on the margins of ice can cause glacial lake outburst floods in downstream valleys. Between 1980 and 2010, glacial lakes in Bhutan increased by 8.7%, as the glaciers shrank (ICIMOD 2016). The increasing risk of outburst floods and shrinking of glaciers has major implications for flood levels and baseflows of rivers as well as for hydroelectric power, Bhutan's main export earner.

Figure 6: Bhutan Temperature and Precipitation Change, 1901–2023 versus 1991–2020

Source: Gridded Climatic Research Unit (CRU) Time-series (TS) data version 4.09.

47. A recent study on the hydrological impacts of climate change in Bhutan also indicates it is likely that climate change is impacting water availability and specifically spring discharges in southern regions (Deltares 2023). This directly impacts Bhutan's farmers and communities as they depend on these resources for livelihoods and provide around two-thirds of water for domestic and agricultural needs. Survey results also report that farmers see recent trends toward more unpredictable weather, less or no rain, the drying of irrigation sources, the emergence of diseases and pests, less or no snow, shorter winters, and sudden high-intensity rains (Chhogyel et al. 2020).
48. Climate change is expected to increase these existing risks while adding new and unprecedented threats. However, it is not possible to predict the regional climate of Bhutan with confidence. Average and extreme temperatures are projected to rise, and this finding is consistent across all models, but the exact level of warming is uncertain. For example, by the 2050s, the CMIP6 ensemble⁵ (10th to 90th percentile range) indicates that mean air temperature could change by +1.2°C to 1.8°C relative to 1991–2020. Changes in annual mean rainfall generally indicate modest increases of 0% to +9% by the 2050s for Bhutan, depending on emissions scenario. However, considerable uncertainty is produced by inter-annual variability, the choice of emissions scenario (Shared Socioeconomic Pathways, SSPs) and climate model, and by topographic variations. The CAIP process conducted a literature review to understand the potential impacts of climate change in Bhutan for the water sector and associated value chains. A summary of the key impacts is given in Table 1. This includes issues with water supply (top) and water-induced disasters, as well as the main water use sectors (agriculture and hydropower).

⁵ For an overview of the Coupled Model Intercomparison Project Phase 6 (CMIP6) experimental design and organization, see: <https://wcrp-cmip.org/cmip-phases/cmip6/>

Box 3: Representative Concentration Pathways and Shared Socio-economic Pathways

To assess future climate change, a set of common scenarios are used in climate models: the Representative Concentration Pathways (RCPs). These provide climate (forcing) pathways that cover futures consistent with the 2°C goal through to high-end (4°C) scenarios. To capture the natural inter-annual variability of the climate, results from these models are typically presented for a period of 20 years, with a historic reference period compared to future time-slices.

The RCP4.5 scenario is broadly similar to current policies and leads to 2.7°C of warming (average) globally by 2100 relative to pre-industrial, whereas the RCP2.6 scenario is broadly in line with achieving the Paris target to limit warming to below 2°C. The RCP7.0 scenario leads to much higher warming after 2050 and RCP8.5 is an extreme scenario with high levels of warming and can be used as an extreme stress test.

For analysis, the RCPs are often combined with Shared Socio-economic Pathways (SSPs). These provide a set of socio-economic data for alternative future pathways, reflecting variations in future population, economic development, technology, policies, etc. There are five SSPs, each with a unique set of socio-economic data and assumptions. The SSPs are presented along the dimensions of challenges to mitigation and adaptation. These include SSP1 (Green Growth), SSP2 (Middle of the road), SSP3 (Regional rivalry), SSP4 (Inequality), and SSP5 (Fossil fuel development).

Combining SSPs and RCPs gives a matrix of possible futures. However, this means there are a very large number of possible RCP—SSP combinations, and it is usual to sample across this matrix.

49. RGoB published a new set of climate projections in 2024 based on 10 climate models from CMIP6, and three emissions scenarios: Shared Socioeconomic Pathways, SSPs 126, 245, and 370 (NCHM 2024). The UNEP Vanishing Treasures project (Formayer, Lehner, and Nadeem 2021; Lehner and Formayer 2023) also created scenarios for two target areas in Bhutan. The analysis for the CAIP built on these projections, but developed a wider set of indicators relevant to the water sector, using CMIP6 results (Table 2). To address uncertainty, the analysis used climate projections for Bhutan for the next 20 and 40 years, in districts that are representative of changing conditions in the northern highlands, the central belt, and southern lowlands. This has sampled different SSPs and climate models out to the 2050s to look at changes in variability as well as the average. These storylines have been used to assess the degree of change expected with a central warming scenario, using SSP 245, and also to assess the potential change with extreme warming, using SSP 585.⁶
50. These projections were used to develop a set of key impact indicators of high relevance for the different components of the water system (supply, demand, and disasters) and therefore for adaptation (Table 3). They supplement those used to assess climate risks on water resources for the NAP. This stress test is different to conventional impact modeling studies because it considers the wider value chain plus analysis of multihazard risks for the water sector.

⁶ The SSP 245 scenario is broadly similar to current policies (UNEP 2024) and leads to about 3°C of warming (average) globally by 2100 relative to preindustrial times. SSP 585 is an extreme scenario, with low probability and higher levels of warming, and is used as an extreme stress test.

Table 1: Mapping of Potential Water-Related Risks

Hazards	Risks
Water resources (supply)	
Higher temperatures	Increased melting of snow, glaciers and permafrost increase river flows in the short-term, reducing flows in the longer term, affecting water availability (in multiple sectors)
	Increased water demand (all sectors)
	Increased open water evaporation from reservoirs and rice fields
	Decreased reliability of water quantity and quality (monsoon season)
Changing precipitation patterns	Increased local dry spells and demand for irrigation water
	Increased drying out and loss of springs and streams in the winter
	Increased competition over water resources
	Increased groundwater recharge and runoff during wetter summer monsoon
Drier winters/lower flows	Mixed outlook on the frequency and duration of low flows and droughts for rivers
Disaster Risk Reduction Events (water-induced disasters)	
Higher temperatures	Increased melting (with heavy rainfall) increases the risk of glacial lake outburst floods
Increased frequency of heavy rainfall events	Increased risk of pluvial and fluvial flooding
	Increased damage to infrastructure such as roads, bridges, irrigation, energy, water
	Disruption to water and energy supplies by floods and landslides
Increased risk of multiday heavy rainfall	Increased risk of soil erosion, land instability, triggering of landslides, damage and siltation of irrigation systems
Hydropower (water users/demand)	
Higher temperatures	Earlier onset of spring melt and inflows to reservoirs and run of river schemes
	Temporary boost to river flows by melting glaciers up to 'peak water'
	Permafrost melting and damage to energy distribution networks
	Increased transmission losses due to higher temperatures
Changing precipitation	Lower winter precipitation and river flows affecting power generation
Increased frequency of heavy rainfall events	Increased risk to hydropower plant safety
	Increased soil erosion in headwaters and sedimentation of reservoirs
	Increased flood wear of hydropower equipment and maintenance costs
Agriculture (water users/demand)	
Climatic shifts	Shifts in suitability and tolerance of crops and varieties
	Shifts in range and prevalence of pests and diseases
Higher temperatures	Longer growing season particularly at higher altitudes
	Increased evapotranspiration and water demand by irrigators
More variable rainfall	Decreased crop yields; shortened development stages
	Increased soil erosion and land degradation
	Impacts at key crop stages, e.g., flowering, drying
Increased frequency of extreme events	Increased loss and damage of crops
	Increased incidence of malnutrition and food insecurity
Higher CO ₂	Potential CO ₂ fertilization effects with benefits for crops, weeds

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Table 1 *continued*

Hazards	Risks
Ecosystems	
Higher temperatures	Increased degradation of forests, wetlands, and marshes
	Increased likelihood of wildfires
Changing precipitation patterns	Increased challenge of maintaining environmental flows in rivers
	Shifting range of pests, diseases and invasive species
	Extreme variations in groundwater levels and natural spring flows
	Increased degradation of pasture and grasslands by overgrazing

Table 2: Climate Change Impact Indicators for Water Resource and Flood Management in Bhutan

Indicator	Explanation	Interpretation for Bhutan water-system
Water supply/water-induced disasters		
Annual frequency of Tmin < 0°C (days)	Frost days	Likelihood of permafrost thaw, snow and ice melt, glacial lake outburst, and damage to infrastructure
Average spring air temperatures (°C)	Proxy for pre-monsoon (March-May) snow and ice melt	Likelihood of reduced area of snow and ice, increased river flows
Maximum 1-day rainfall total (mm)	Proxy for flash flood, landslides and soil erosion	Risk of flash floods, landslides and damage to infrastructure, especially in summer
Average summer rain total (mm)	Proxy for strength of summer monsoon	Risk of fluvial floods, amount of water for hydropower production
Maximum dry spell length (days)	A proxy for meteorological drought	Increased demand for irrigation water, and risk of reduced spring flows
Water demand		
Reference crop evapotranspiration	A proxy for crop water demand	Modest increase in evapotranspiration by crops is expected due to higher air temperatures
Growing season length (days)	Span in number of days with daily mean temperature > 5°C	Increased productivity and yields of crops

Table 3: Climate Change Impact Indicators for Highlands (Gasa), Central Belt (Trongsa) and Lowland (Pemagatshel) Zones of Bhutan

Indicator	Range	SSP 245			SSP 585		
		Highland	Central	Lowland	Highland	Central	Lowland
Tmin < 0°C (days)	Lower	-15	-17	0	-18	-20	0
	Upper	-31	-32	-1	-40	-41	-1
Average spring temperature (°C)	Lower	+1.0	+0.8	+0.6	+1.2	+1.1	+1.0
	Upper	+2.2	+1.8	+1.6	+3.1	+2.2	+2.1
Maximum 1-day rainfall total (%)	Lower	-33	-36	-44	-32	-35	-43
	Upper	+42	+35	+42	+46	+42	+48
Mean summer rainfall (mm)	Lower	-36	-110	-101	-54	-144	-127
	Upper	+75	+198	+273	+161	+332	+345

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Table 3 *continued*

Indicator	Range	SSP 245			SSP 585		
		Highland	Central	Lowland	Highland	Central	Lowland
Max. dry spell length (days)	Lower	-1	-1	-4	-2	-2	-3
	Upper	+4	+4	+7	+4	+4	+8
Evapotranspiration (%)	Lower	+5	+3	+2	+8	+5	+3
	Upper	+14	+9	+5	+19	+12	+7
Growing season (days)	Lower	+16	+14	0	+23	+20	0
	Upper	+34	+32	0	+45	+41	0

Note: Changes are in percentages (or days) for 2040–2059 projections relative to a 1995–2014 baseline based on CMIP6 medians. Upper and lower bounds are based on 10%–90% ranges of the CMIP6 ensemble. mm = millimeters.
Source: Authors.

51. Key identified climate stressors are expected to affect all aspects of the water system (supply, demand, and water-induced disasters) and include:

- Seasonal average and minimum air temperatures are rising, and the annual number of frost days ($T_{min} < 0^{\circ}\text{C}$) is falling, especially in the highlands and central belt. Fewer frost days could mean earlier and longer melt seasons for snow and ice, permafrost thaw, and increased glacial melt and runoff. This can affect surface water supply—both the total volume and the timing. However, rising temperatures could also create more favorable conditions for groundwater recharge and longer growing seasons for agriculture, particularly at higher elevations.
- Rising temperatures also have potential to increase the risks of water-induced disasters. This includes an increased risk of land instability and glacial lake outburst floods.
- Maximum 1-day rainfall totals are expected to become heavier, leading to increased flash flood risk. The analysis finds that a 1-in-20-year event is expected to increase by a factor of 1.44 by the 2050s. Moreover, the increase is greater for rarer events: the 1-in-50-year and 1-in-100-year extreme rainfalls could change by factors of 1.54 and 1.62 by the 2050s. This has implications for the choice of sites and design standards used for water-energy infrastructure as well as for hazard and flood risk management.
- Changes in rainfall variability are likely to be more important than trends in the average, which are modest even for the summer monsoon (which is expected to become wetter). Historic seasonal rainfall totals show marked inter-annual variability, and this could affect the length of dry spells in the post-monsoon and winter seasons.
- In terms of water demand, rising air temperatures are expected to increase crop water demand (evapotranspiration) by nearly 20% in the highlands and by almost 10% in the lowlands by the 2050s. This implies that demand for irrigation water could increase, even before longer growing seasons and the possibility of larger cropped areas are considered.
- Annual maximum dry-spell lengths are generally expected to increase. Along with projected increases in extreme rainfall and evapotranspiration, effective recharge of soil and groundwater could decrease over large parts of the country. As a result, spring discharges may decrease with climate change in southern regions, though projections are more mixed for northern regions, and the spatial variability and uncertainty in these projections is large (Deltares 2023). Rain-fed spring flows from shallow soils at higher elevations are particularly sensitive to changes in rainfall amounts and state—i.e., liquid or frozen (Dendup et al. 2024).

- These changes in water supply and water demand could have complex effects on the overall water balance which involve the issue of peak water. In the short to medium-term, river flows may be augmented by melting snow and ice stores in high altitude basins. However, moving to the long term, river flows may decline as seasonal rainfall (without snow and ice-melt) becomes the dominant source of river discharge. The timing of peak water is uncertain because it depends on the initial condition of glaciers, the pace of warming and changes in seasonal precipitation patterns, and on imperfect representations of ice-flow processes by glacial-melt models. However, the timing of peak water has potentially high future impacts for the water and energy sectors of Bhutan.
52. There is also an increasing likelihood that these risks could be experienced as compounding hazards, when two events happen at once (leading to higher overall impacts than if such risks were experienced individually) or in succession risks (such as droughts followed by floods) which can lead to interaction effects. There are also potential interdependencies, direct and indirect cascading impacts between risks.
53. Climate risks will not be distributed equally. They are likely to have disproportionately greater impacts on the poorest (in relative terms such as percentage of income). Also, recurrent climate shocks could keep people in poverty (or drag them back into poverty), as these groups have fewer resources, higher vulnerability, and lower adaptive capacity. There are also important gender differences in exposure and vulnerability to climate risks. Consideration of the distributional effects of climate risks—and adaptation benefits—is therefore critical.



4 Adaptation Prioritization and Investment Packages

Key Messages

- The CAIP built on the NAP and NAP water road map, and the water priorities of the *Thirteenth Five Year Plan* (2024–2029), which focused on integrated water resources management and disaster risk management activities. This information was used to develop an initial set of adaptation activities to address the risks identified in the climate diagnostic.
- The CAIP then extended this analysis to the entire water system—comprising integrated water resources management, disaster risk management, and water supply and demand— recognizing that more ambitious adaptation in the water sector requires a multisector approach.
- A workshop was held to discuss the relevant climate risks and a pipeline of adaptation across the water system, producing a long-list of adaptation activities that together build the climate resilience of the water sector. This pipeline included 187 activities, with total investment needs estimated at \$847 million over the next 15–20 years.
- The workshop also prioritized and sequenced these adaptation activities. This approach was used to identify which activities should be taken forward immediately in the current plan, and which could be deferred to subsequent 5-year plans.
- The CAIP process then took the adaptation activities and assembled them into strategic adaptation investment packages (programmatic areas). In total, 11 packages were developed, covering the various elements of the water system.

54. Step 3 in the CAIP process involved the development of adaptation activities into investment packages to tackle the strategic climate risks identified across the water system.
55. The starting point for this step was to build on the priorities of the NAP water sector and the NAP water road map, and the strategic actions and individual adaptation activities in these (Box 4). These are focused on the core water activities associated with IWRM and disaster risk management (DRM).

Box 4: Options, Components, Projects, Programs, Actions, Activities, and Packages

Many different terms are used to describe adaptation actions. This can include individual options or components, which can be grouped into projects or programs. The use of these terms, and the level of aggregation they refer to, vary with organization. For example, an adaptation project can be a small project of less than \$25,000, or a multilateral development bank investment exceeding \$100 million. In this report, we focus on 'strategic actions' and the individual 'activities' within these. These can involve small or larger scale actions.

These activities have then been grouped into Adaptation Investment Packages. This refers to a set of adaptation activities related to a sector, region, theme or financing sources. Adaptation investment packages aim to cluster or bundle adaptation activities to build resilience at scale.

56. The IWRM and DRM activities in the NAP/NAP road map were then considered in the context of the priorities for the water sector set out in the 13th plan. This alignment is critical as the plan sets the overall development context and investment priorities for the water sector. This helps to demonstrate how adaptation reinforces key national development objectives.
57. To do this, strategic priorities in the NAP and the NAP water road map were aligned with the 13th plan (Table 4). Some activities in these package focus on capital investment, others on institutional strengthening and policy reforms, and others on technology.

Table 4: Strategic Actions from the NAP Water Sector Roadmap, Their Climate Benefits and Their Linkages to Water Priorities of the Thirteenth Five Year Plan

	Strategic actions in NAP water roadmap	Climate rationale and benefits	13th plan priorities
Policy and institutional	NAP water road map objective 1 and 2—	—Integrate climate change and adaptation into the integrated water resources management (IWRM) framework. —Maximize societal benefits of water	Development and implementation of a national water master plan and river basin management plans
	Integrated water resources management; Strengthen stakeholder engagement		Institution of a knowledge bank on water resources management.
	NAP water road map objective 4—Water payment policy (note linkages to IWRM/ policy revision) link to	—Enabling factors. —Incentivize efficient water use and potential sources of financing for adaptation	Payment mechanisms will be established for water services and investment opportunities will be explored
	Climate design standards and implementation	—Targeted action to promote climate proofing —Reduced loss, damage, repair	Guidelines on climate-resilient water infrastructures based on assessments of climate vulnerability and risk for priority water sectors
	NAP water road map objective 7—Abstraction	—Improved sustainable supply to meet changing water balance under climate change	Potential groundwater and recharge areas, and possible avenues for abstraction will be explored and assessed

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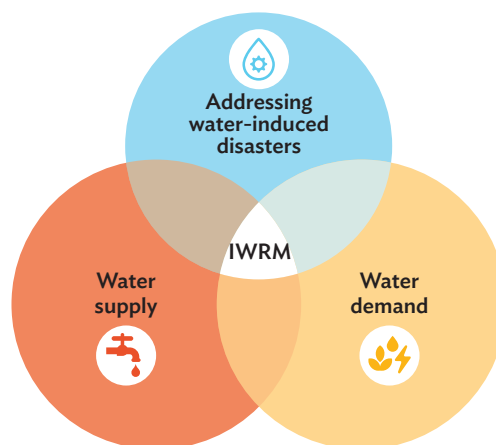
Table 4 continued

	Strategic actions in NAP water roadmap	Climate rationale and benefits	13th plan priorities
Infrastructure and technology	Water storage investment (built/engineered and natural)	—Improved supply to meet changing water balance under climate change/flow regulation	Avenues for potential natural and built water storage will be explored and developed
	NAP water road map objective 5—Nature-based watershed conservation and restoration	—Improved supply to meet changing water balance under climate change Reduced runoff Mitigation co-benefit	Suitable nature-based solutions for watershed conservation and restoration will be implemented.
	NAP water road map objective 3— Water-efficient technology	—Reduced water demand reducing supply increase under climate change, higher resilience	Avenues for water-based ventures will be created, along with the promotion and adoption of emerging water-efficient and innovative technologies.
	NAP water road map objective 6— Develop and implement a disaster management plan for water sector	—Water-induced disasters including targeted adaptation strategic actions —Reduced loss and damage (infrastructure) —Reduced health impacts (fatalities and injuries)	Critical infrastructure will be secured through robust planning, risk management, and investment in infrastructure that is resilient to hazards and disasters.
			Communities are prepared and resilient to disaster. This encompasses the adoption and implementation of local disaster risk reduction strategies.

Sources: ADB (2024) and RGoB (2024).

58. In line with the CAIP's systematic and holistic approach, adaptation activities were broadened to include the overall water system, based around IWRM principles (Figure 7). This recognized that more targeted and ambitious adaptation—especially for water—requires a multisector approach that spans water supply, water demand, and water-induced disasters.

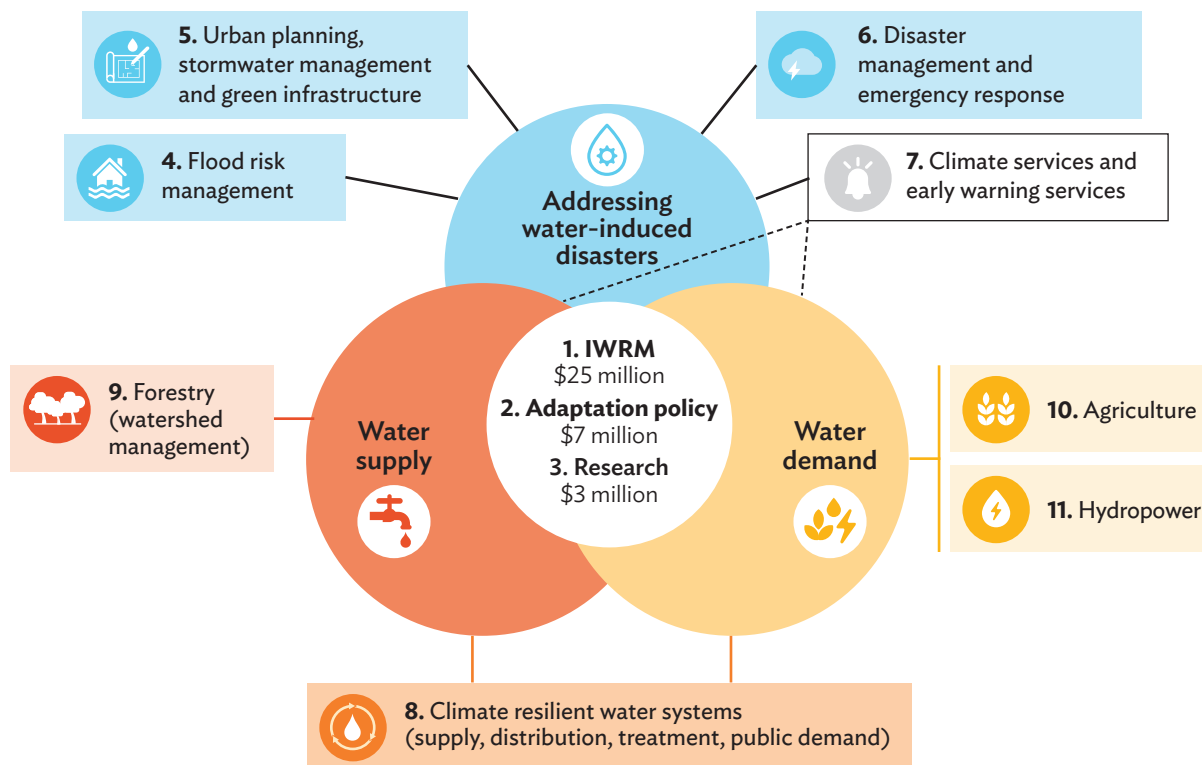
Figure 7: Overview of the Water System



IWRM = integrated water resources management.
Source: Authors.

59. To do this, the CAIP Inter-agency Working Group held a 3-day workshop (ADB 2024b) in Bhutan in October 2024. This workshop involved all government ministries and departments associated with the water system. The workshop used the climate diagnostic results from Step 2 to discuss all activities needed to build a more resilient water system, broadening out from the previous NAP actions (IWRM and DRM) to include relevant upstream and downstream activities. This included activities related to water extraction, treatment and supply, water-use and demand (agriculture, energy), as well as cross-cutting activities.
60. The workshop assembled a pipeline of adaptation activities spanning the entire water system, totaling 187 activities (with Annex 4, containing the full list). The workshop also collated information on the potential costs of these individual activities. Participants concluded that the estimated total cost of implementing all these packages over the next 15–20 years was \$847 million.
61. The next step was to combine this long list of adaptation activities into a set of strategic adaptation investment packages. This consolidates similar activities from the long list, in line with the key components of the water system in line with components of water supply, DRM activities, and water demand (Figure 7), and ensures a more programmatic approach. The grouping also sought to align with institutional and governance responsibilities for consistency with line ministry mandates, though in some cases packages included several different ministries working together. Figure 8 presents an overview of the 11 packages and their positions within the water system.

Figure 8: Overview of the Adaptation Investment Packages



Source: Authors.

62. These packages target a wide variety of different beneficiaries and include broad ranging activities that will provide benefits across sectors and for households and businesses (e.g., in addressing water-related disasters and through climate services). They also include specific targeted packages to certain economic activities and sectors, notably agriculture (farmers) and hydropower.
63. Importantly, they include different types of adaptation, which in turn affects the potential for climate financing and concessionality. This links to the later climate finance step, and to support this, the activities were classified using typology proposed in the MDB Common Principles for Climate Change Adaptation Finance Tracking (EIB, 2022). This defines these three types of adaptation activity (Box 5). This includes development activities which require climate proofing, where adaptation is a secondary benefit. It also includes development activities with multiple objectives, one of which is adaptation. Finally, it includes targeted adaptation activities where adaptation is the primary objective and the climate rationale is very strong. The latter have the highest potential for concessionary adaptation finance.
64. The type of activity will influence the potential for concessional adaptation finance and links to subsequent financing opportunities. For example, climate-proofing development (Type 1 activities) add climate resilience to planned developmental projects, and in such cases, climate finance is more likely to support the additional adaptation cost and not the entire development investment. Since the core project is a standard development activity, it may not always have a strong case for concessional (especially grant) financing. On the other hand, targeted adaptations (Type 3 activities) are likely to mobilize adaptation financing for the entire investments and so may have a stronger case for concessional financing.

Box 5: Summary and Examples of the Three Types of Adaptation Activities

Type 1. Climate proofing of projects that support development outcome(s). This involves the integration of adaptation into planned projects to manage climate risks (now and in future) and ensure that a project's objectives are achieved. An example is the climate proofing of new roads or new sewerage systems to take account of projected higher rainfall intensity. In this case, adaptation is a secondary objective of the investment.

Type 2 (also sometimes called Type 2a). Activities with the shared objectives of adaptation and development. These directly reduce physical climate risk (now and for projected future climate) and build the adaptive capacity of the system within which the activity takes place. It intentionally aims to steer development outcomes in a resilient direction. Adaptation is one of a number of objectives of the activity or investment. For example, a social protection project might be based on a system wide assessment of climate risks which includes adaptive features that would allow the social protection system to scale up after climate-related shocks.

Type 3 (also sometimes called Type 2b). Activities that enable adaptation. These reduce the underlying causes of systemic vulnerability to climate change (current and future climate change) and remove knowledge, capacity, technological, and other barriers to adaptation (i.e., they are pure adaptation). Adaptation is their primary objective. Examples include flood barriers to protect a region or town (taking account of future climate change and current risks), or funds to small and medium-sized enterprises to accelerate the development, application and transfer of adaptation solutions.

65. The resulting mapping found a wide range of types of activities across the packages:

IWRM, policy, and planning

- (1) **Integrated water resources management.** These activities include a set of activities related to the management of water supply and demand. It includes a mix of Type 1, 2, and 3 adaptation activities (see Box 5), with a strong focus on integrating climate risk management into IWRM analysis and implementation.
- (2) **Adaptation policy and planning.** These are Type 3 activities as adaptation is the primary objective.
- (3) **Research and education.** These include a mix of water priorities and Type 1, 2, and 3 activities.

Addressing water-induced disasters

- (4) **Flood risk management investments.** This is focused on flood protection schemes and therefore involves Type 3 adaptation activities.
- (5) **Urban planning, stormwater management and green infrastructure.** This involves integrated urban planning and investments, including stormwater and green infrastructure. These include a mix of Type 1, 2, and 3 adaptation activities.
- (6) **Disaster management and emergency response.** These cover disaster preparedness and contingency planning, including community-based disaster risk management in vulnerable communities and strategies for protecting critical infrastructure, and are primarily Type 3 adaptation activities.
- (7) **National climate services and early warning systems (EWS).** These are primarily Type 2 and 3 activities. They involve strengthening and modernizing weather and climate services, as well as improving early warning of glacial lake outbursts and flooding.

Water supply and demand

- (8) **Climate resilient water systems.** This set of water investments includes supply, transmission, distribution and treatment, as well as sewerage. It includes some Type 1 activities (climate proofing of planned water supply investments), where climate is not the primary objective, but also activities that are Type 2 and Type 3 (such as addressing climate-related impacts on water supply).
- (9) **Agriculture (irrigation).** These are potentially relevant as climate adaptation investments when addressing climate-related water impacts but will also require climate proofing. These investments need to be part of a broader adaptation investment plan for agriculture.
- (10) **Energy.** These include water-related projects with integrated multipurpose hydro schemes and pumped hydro storage. Although these are primarily mitigation projects they do have the potential for adaptation co-benefits from water regulation and mixed schemes (e.g., irrigation and power generation).
- (11) **Forestry.** This includes nurseries and new forest plantations. Although these are primarily mitigation projects they do have the potential for adaptation co-benefits from upstream catchment management (reduced runoff, flow regulation).

66. The adaptation investment packages are described in turn, and a longer list of individual activities is in Table 5.

67. **Package 1: Improving water management.** Focuses on integrated water resources management (IWRM) and takes account of climate change. IWRM helps manage and develop water resources and maximizes economic and social welfare without compromising ecosystem sustainability. It promotes a cross-sector approach that balances competing uses of water, with a strong focus on water governance and coordination, through institutional and regulatory arrangements. This helps maintain a balance between water demand and sustainable supply under climate change.
68. The package includes subactivities on river basin management that ensure upstream-downstream linkages); governance arrangements including water user associations; and studies and monitoring to establish sustainable resources to inform IWRM (e.g., studies of groundwater resources and potential for supply). On the demand side, it includes investigation of payment (pricing) mechanisms to ensure users pay for water (and that the appropriate value is paid), as well as promotion of water-efficient technology, including potential no-regret measures that could lead to cost savings.
69. IWRM plays a key role in ensuring current and future water planning takes account of climate change, and so involves elements beyond a business-as-usual approach. Accounting for climate change can be achieved through the integration of climate change projections in the analysis of water supply availability and by assessing the effects of climate change on levels of water demand and factoring these subsequently into management as well as allocation decisions. The key benefits of the approach are through the information and improved decisions it allows, including opportunities to improve the efficiency and effectiveness of water use under climate change. It also provides benefits through improved watershed management, which also helps mitigate floods and droughts, including the projected increase in these extremes under climate change. IWRM—through a process of monitoring and feedback over time—can be used as part of an adaptive management framework.
70. **Package 2: Adaptation policy and planning.** Provides important benefits by improving the effectiveness and efficiency of policy.
71. **Package 3: Research and education.** Covers research and curriculum activities that help to improve future decisions and provide the capacity and skills needed to enable adaptation.
72. **Package 4: Water-induced disasters and flood risk management.** Emphasizes flood protection investment projects to reduce the negative impacts of flood events and is related to Package 5.
73. **Package 5: Urban flood risk management.** Features urban planning and integration as well as stormwater management projects, and includes the use of green infrastructure and capacity building. Again, these are focused on reducing water-induced disasters but can also help in managing risk by reducing exposure.
74. **Package 6: Disaster management and emergency response.** Contingency planning and disaster preparedness and many non-structural activities to help reduce the impacts of climate extremes, in both preparation and the response to extreme events.
75. Close linkages exist between packages 4, 5, and 6 but their separate listing enables a more systematic approach to disaster risk management for climate extremes. The three packages produce benefits

by avoiding losses associated with current climate variability and extremes, as well as future climate change. They also address the priority climate hazards identified in the NAP, reducing risks to people (injuries, fatalities, post-event health impacts) and to public and private infrastructure (losses, repairs, maintenance). Impacts associated with infrastructure service disruption (such as increased transport and travel times) and economic losses and disruption to business activity are also reduced. The green infrastructure investments have potential co-benefits such as carbon sequestration.

76. **Package 7: Weather and climate services.** Improved or new weather and climate services, including short-term weather forecasts, early warning systems, and seasonal forecasts, tailored for the water sector. These aim to reduce the impacts of climate variability and extremes that already cause significant losses in Bhutan and are expected to increase with climate change. These improvements bring economic benefits to users through avoided negative losses and enhanced productivity. However, to maximize these benefits, investment is needed across the whole information value chain—for enhanced monitoring, modeling, and forecasting, improved communication and reach, then increased uptake and effective use of the information in decisions (Soares et al. 2018).
77. The package is focused on the overall modernization and strengthening of the national meteorological and hydromet services and is in line with the road map on *Strengthening and Modernization of Hydromet and Multi-Hazard Early Warning Services in Bhutan* (World Bank 2024). The package includes investments in equipment, monitoring and modeling (observation network, hydromet, weather and climate services, the cryosphere) and operating costs. However, to be effective, complementary investment along the weather and climate service value chain would be needed to ensure the improved services reach the intended decision-makers, and that the information is then used effectively. A complementary investment in forest wildfire management is also included in this package.
78. **Package 8: Climate-resilient water systems.** Promotes a focus on the water network to address climate-related pressure from changing rainfall regimes and peak water. This includes a set of planned improvements to water supply, transmission, distribution, and treatment, and to manage water demand. This includes urban systems with potential for revenue generation (water tariffs are already imposed in the 4 *thromdes* and 16 *dzongkhag* municipalities). Rural areas do not currently have tariffs for water usage. For development project investments, the focus would be on climate proofing to ensure that water infrastructure is designed with the future climate in mind (noting that recent floods have damaged water supply connections). However, some targeted investments will have potential to help meet growing demand for water under climate change, as well as support areas experiencing reductions in supply. These investments can also improve the efficiency of water supply, and so decrease climate-related pressures. The package also includes activities to reduce non-revenue water—i.e., water pumped and then lost or unaccounted for due to leakage, which can also help increase water availability. Additional technological improvements will help to improve water distribution and allocation, as well as storage capacity.

79. Investments in sewerage systems included in Package 8 will have considerable benefits by improving health and offer additional benefits by reducing impacts of climate change associated with floods (infrastructure damage, health risks) and droughts (reduced surface water and groundwater supplies). Core investments in sewerage will come from development finance. As these will need to be climate resilient (climate proofed) they will need to seek incremental finance for adaptation. Climate change will make investment in sewerage systems more urgent, because of the potential increase in floods.
80. Among the other packages, three are key for the **integrated and holistic approach** adopted in the CAIP. These include forestry and the linkages to watersheds in managing supply, but also the key end-user sectors associated with water, including demand. Inclusion of activities here links to the IWRM focus of Package 1. While they are part of the adaptation investment plan, opportunities exist to seek financing from other (non-adaptation) sources.
81. **Package 9: Forests.** A focus on mitigation (carbon sequestration) investment through forest plantations, for which sources of finance include the BCF and Bhutan for Life. Forests have high adaptation co-benefits by reducing runoff and enhancing water flow management. Hence, forests have high downstream benefits in reducing flood risk and improving water flows.
82. **Package 10: Energy projects.** Again, the focus is primarily on mitigation investments such as a small multipurpose hydropower plant, a pumped hydro storage plant, or a hydrogen plant. All have important adaptation co-benefits associated with the potential storage of water.
83. **Package 11: Agriculture irrigation investments.** High adaptation potential for the agriculture sector comes from refurbishing or building new irrigation channels, solar pumps for lift irrigation and water-efficient irrigation (drip and sprinkler), as well as supporting planning, information systems, and capacity building. These investments also have potential to increase water demand—and so are key to IWRM planning—and may help improve the efficiency of water use. They also help manage climate related risks to production, though these package 11 investments need to be considered within a broader agriculture sector adaptation investment plan.

Table 5: Water Adaptation Investment Packages, Subpackages, Estimated Finance Needs, and Indicative Activities in Bhutan

Lead	Subpackage	\$ millions	Pipeline activities
Package 1: Integrated Water Resources Management (\$25.5 million)			
Department of Water (DoW)	IWRM Planning and Water User Associations	1.65	Develop and implement national integrated water master plan (IWMP) and river basin management plans (RBMP) (4 basins). Institutionalize training for water managers, water user association (WUA) officers, and policymakers. Community based water resources management . Set up a monitoring and evaluation framework for the water sector along the lines of the Bhutan Water Security Index (BWSI).
	Research, studies, information, capacity, and monitoring	10.75	Institute knowledge bank on water resources management. Conduct national water resources inventory, explore the volume of rainwater generated in water-stressed areas. Strengthen data base/inventory on drinking water supply schemes. Wetland assessment and inventory. River basin management and planning for basin optimization. Strengthen drinking water quality monitoring and surveillance. Robust water resources planning and monitoring system. Strengthening research on water resource management (groundwater, hydrological and groundwater modeling, studies on household options, including RWH and assessing climate risks in water-intensive industries. Enhancing capacity of key stakeholders in managing the impacts of climate change on water. Watershed assessment and implementation of intervention measures—suitable nature-based solutions. Conduct monitoring on the implementation of water guidelines and regulations. Explore and develop potential natural and built water storage.
	Abstraction analysis	0.25	Explore and assess potential groundwater and recharge areas, and possible avenues for abstraction for conjunctive use in the surface water-scarce areas.
	Payment analysis	0.1	Establish payment mechanisms for water services and explore investment opportunities.
	Water ventures	0.2	Create avenues for water-based ventures.
	Nature-based solutions and Payments for Ecosystem Services	11.7	Improve natural capacity for infiltration, water recharge, and water buffer for prevention of dust runoff and erosion. Strengthening and upscaling payments for ecosystem services (review of framework and field guide). Implement suitable nature based solutions for watershed conservation, source revival and restoration for sustainable supply. Springshed and watershed interventions.

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Table 5 continued

Lead	Subpackage	\$ millions	Pipeline activities
Package 1: Integrated Water Resources Management (\$25.5 million)			
	Water-efficient technology	0.47	Promote and adopt emerging water-efficient and innovative technologies. Promotion of water-efficient technologies Conduct advocacy on water-efficient technologies. Introduce incentives for industries and agriculture to adopt cleaner processes and environmentally friendly practices that reduce water contamination.
	Planning and policy	0.4	Assess climate vulnerability and risk for priority water sectors. Develop an assessment guide for integration of holistic use of water resources. Revise water policy and vision 2008, and Water Act 2011.
	Climate Resilience Standards		Develop climate-resilient water infrastructure guidelines.
2. Adaptation policy and planning (\$6.8 million)			
Department of Environment and Climate Change (DECC)	Adaptation policy and planning	6.7	Establish climate change/Gender, Environment, Climate, Disaster, Poverty (GECDP) units. Review and revise adaptation policies and legislation. Strengthen the National Environment Commission Secretariat. Annual review and progress reporting on NAP process (start of the 2nd NAP). Climate change vulnerability analyses and mapping. Tool for assessing adaptive capacity and vulnerability for planning. Policy relevant research. Climate change learning module and curriculum (vocational). Strengthen linkages with government, academia and nongovernment/civil service organizations. Indigenous knowledge systems—repository, public sensitization program, mainstream.
3. Research and education (\$3.5 million)			
College of Science and Technology (CST) and DoW	Water-related research and education	3.5	Rain water harvesting and treatment facility. Establishment of Water Research and Services Center. Development of water resources engineering laboratory. Construction of physical facilities, equipment, WRE and faculty capacity building. Research on enhancing water distribution network systems. IoT based smart agriculture in different climatic zones. Research ground water—recharge zonation. Curriculum review—program accreditation. Teaching learning materials. Knowledge dissemination and training. Knowledge hub or center on Water resource and its management.

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Table 5 continued

Lead	Subpackage	\$ millions	Pipeline activities
4. Flood risk management (\$68 million)			
Department of Human Settlements (DHS)	Flood protection and adaptation projects (and implementation of flood protection plans)	68	Implementation of DRIVE Gelephu Flood Protection Project, Implementation of flood protection works (Lhamoizingkha). Implementation of flood management plan (Mau, Paro, Samtse, Punakha, Thimphu, Gasa, Haa, Kerongchu, Rongchuthang, Gelephu Mindfulness City [GMC]). Preparation and implementation of FMPs (Tashiyangtse, Trashigang, Pemagatshel, Chhukha, Lhuentse, Trongsa, Bumthang, Punakha, Dagana, Gasa).
			Preparation of guidelines/standards—infrastructure planning and design of flood disaster adaptation measures.
5. Urban planning stormwater management and green infrastructure (\$225 million)			
DHS	National capital region—linked urban centers	19.5	Preparation and Implementation of Linked Urban Centers (planning, transport, water supply, sewer, stormwater, green open space)—(Samtse-Phuntsholing, Samdrup Jongkhar-Nganglam) and (Bumthang-Trongsa, Trashigang-Mongar).
	Water services master plan	71.4	Implementation of Water Services Master Plan by improving the stormwater management system and introduction of nature-based solutions and ecosystem-based adaptations to reduce urban flooding—proposed in ECRUL.
	Green infrastructure	72	Green Infrastructure and open spaces including Wangchhu River Corridor—proposed under a PTA with India and under the ECRUL project (GEF)—Flood plain (Disaster Mgt.)—Water sensitive urban design—nature-based solutions.
		12	Water services, green infrastructures and waste for all <i>dzongkhags</i> other than <i>thromdes</i> .
	Stormwater	40.3	Implementation of stormwater management plans for <i>thromdes</i> (Phuntsholing, Samdrup Jongkhar, Gelephu).
	Capacity building and research	10.2	Capacity development of engineers, urban planners, architects and GIS officers in climate resilience/adaptive (nature-based) planning, designing, digitization, and implementation. Conduct research on climate smart city planning, digitization, nature-based solutions and climate adaptive measures in stormwater, sewer, water supply, and floods.
6. Disaster Management and Emergency Response (\$20.1 million)			
DHS	Disaster Management and Contingency Plan	12	Implementation of Disaster Management and Contingency Plan (stockpiling of emergency shelter items, water and sanitation items, and bridge parts). Revision of current DMCP approved in the <i>Thirteenth Five Year Plan (2024–2029)</i> .
DLGDM	Disaster (emergency) response	8.1	Multisector disaster response team/community-based. Operationalize Multi-Hazard Risk Decision Support System Training, including SAR training, and equipment Capacity development of disaster management committees and local governments. Strategy for the protection of critical infrastructure. Community-based disaster risk management in vulnerable communities. Public education and awareness on disaster risk management.

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Table 5 *continued*

Lead	Subpackage	\$ millions	Pipeline activities
7. National Climate Services and Early Warning Services (\$61.7 million)			
National Centre for Hydrology and Meteorology (NCHM)	Hydromet Infrastructure and Data Center	22.8	Establishment of National Weather and Flood Warning Center and Scientific Facilities. ICT infrastructure upgradation, Develop a cloud-based data storage system, Enhancing central data base management.
NCHM	Modernization of National Hydromet Observation Network	24.0	Upgrading and standardization of hydromet network including new stations. Ambient water quality monitoring and automatic sediment monitoring. Weather radars, upper air station, new synoptic stations.
NCHM	Enhancing Cryosphere Monitoring and Research in Bhutan Himalaya	5.6	Studies of glacier melt, snow, rain and groundwater and surface runoff. Research and monitoring on the status of glaciers. Modeling of glacial lake outburst flood scenarios from potentially dangerous glacial lakes. Monitoring of bench-mark glaciers. Conduct glacial lake outburst flood risk assessment (Drangmechhu, Nyera Ama Ri, and Jomori basins). Reduce glacial lake outburst flood hazard (Thorthormi)—Siphon technology. Establish regular avalanche risk and warning services. Establish a network of permafrost stations. Expand cryosphere monitoring stations in high altitude regions. Establishment of a glacial lake outburst flood monitoring and cryosphere research facility in Lunana. Conduct feasibility studies to build emergency storage, bypasses, and controlled releases from glacial lakes.
NCHM	Hydrological and Early Warning Services	5.3	Expand early warning systems for eastern basins. Upgrade the glacial lake outburst early warning monitoring network and communication system. Hydrological, hydrodynamic and dynamic riverbed modeling. Development of the River Information System. Flash flood forecasting system.
NCHM	Weather and Climate Services	4.0	Developing probabilistic forecasting, impact-based forecasting, nowcasting, and sector-based forecasting. Enhance climate services (Medium range, agromet and climate projections).
Department of Forests and Park Services (DoFPS)	Forest wildfire risk management	0.3	Fire hotspot mapping, forest fire prevention awareness campaigns and coordination meetings. Capacity building for forest officials. For high risk areas: formation and training of community-based forest fire management groups, measures to reduce fuel load, exploration of water storage.

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Table 5 continued

Lead	Subpackage	\$ millions	Pipeline activities
8. Climate resilient water systems (\$159 million)			
Department of Infrastructure Development (DoID)	Water supply, transmission, distribution and treatment	37.3	Construction of intake, transmission main, distribution network, pumping and water treatment plants including urban areas (investments vary with location, but includes Wangdiphodrang, Bumthang, Amochu, Gedu, Bajo, Nobding, Trongsa Damphu, Tsirang, Phaling, Autsho Yenlag, Nagamphu, Trashigang, Yangtse). Construction of water supply at Punakha, Chuzergang Gewog, Sarpang, Gelephu Changtagang, Maedwang, Helela, Rama. Training and skilling of water operators, technicians, Training of water engineers, 20 <i>dzongkhags</i> and 4 <i>thromdes</i> Planning, designing and implementation of the climate resilient water infrastructure including innovative technologies— rain water harvesting, pumping, SCADA. Digitization of the water supply systems. Develop or update Guidelines/Standard Operating Procedures/ Standards/Specifications for water infrastructures.
		10.0	Implementation of a climate resilient water safety plan for 20 <i>dzongkhags</i> and 4 <i>thromdes</i> .
	Non-revenue water measures	9.0	Reduction of “non-revenue water” through assessment and implementation of remedial measures for critical areas under Thimphu, Samdrupjongkhar and Phuntsholing thromdes.
	Rural Water Supply Schemes	18.9	Construction of Rural Water Supply Scheme (RWSS) (Gaseypey/Kemji, Dhalgolia, Tsirang Upper Lapsaybotay+. Construction/rehabilitation/extension of RWSS in 20 <i>dzongkhags</i> .
Thimphu Thromde	Improved water distribution, water treatment, capacity building and water safety plan	8.8	Thimphu Thromde water distribution Network (Smart device and SCADA). Smart water meter and improvement of Water Billing System and Software. Construction of Water Distribution network (Serbithang, Nubding). Construction / renovation of WTPs (Nubding Motithang and Jungshina, Improvement of water distribution Changzamtog, Realignment of water line Chamgang to Semtokha, Restoration of Water Supply Infrastructure damaged by flood Dechencholing. Borewell restoration Debsi. Research and implement a riverbank filtration system. Capacity building for engineers and technicians. Digitize the water distribution network for Thimphu City in GIS format. Enhance and implement a Water Safety Plan for Thimphu City.
DoID	Sewerage systems national	69.8	Construction of sewerage systems (multiple investments). Strengthen human resource capacity for sanitation management.

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Table 5 *continued*

Lead	Subpackage	\$ millions	Pipeline activities
Thimphu Thromde	Sewerage systems, Thimphu	4.8	Research, design and construct optimized sewage treatment plant for Thimphu Thromde.
9. Forest (\$9.4 million)			
DoFPS and DoW	Forest plantations	9.4	Establishment of nurseries and creation and maintenance of valuable timber species plantations—about 2,000 hectares of plantations Catchment management and wetland conservation.
10. Energy (water-related) (\$87.2 million)			
Department of Energy (DoE)	Water-related energy investment projects	87.2	Small integrated multipurpose hydropower plant Parochhu, Pumped hydro storage plant (2). Hydrogen plant.
11. Agriculture (Irrigation) (\$181 million)			
Department of Agriculture (DoA)	Irrigation development	181	Construction of 173 new irrigation channels (782 km length). Renovation of 300 existing irrigation channels (852 km length). Annual operations and maintenance costs of developed irrigation channels. Solar pumps for lift irrigation in 12 sites. Support water-efficient irrigation (drip and sprinkler) for commercial vegetables (solar powered) (20 sites). Project studies and preparation. Irrigation Information Management System. Land development and agricultural mechanization. Institutional strengthening and capacity building.
TOTAL		\$847 million	

Source: Authors.

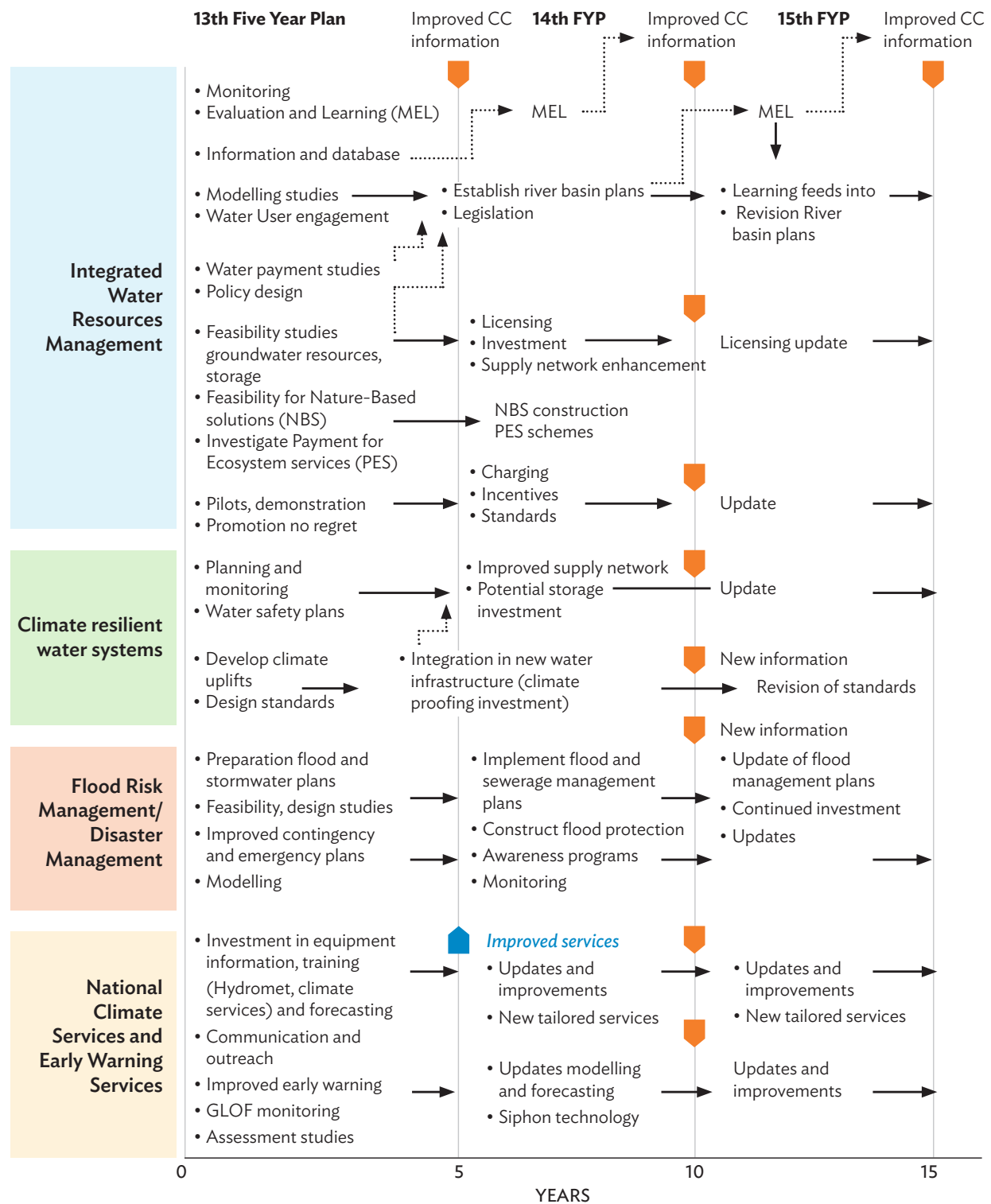
84. The next part of this step considers prioritization. To fit with the adaptive management framework, the CAIP looked ahead to the timing and sequencing of adaptation activities over the next 15–20 years, linking these to the 5-year planning periods.
85. Informing this, the CAIP approach assesses which activities are most urgent to do first and which can be done later. This uses a set of building blocks of priority actions that are likely to deliver net economic benefits, based on a portfolio and adaptive management approach. The three building blocks are:
- (1) No-regret, low-regret, and win-win adaptation options These address the existing economic costs of climate extremes or observed climate trends, as well as building resilience and provide immediate economic benefits (or co-benefits). An example would be climate services for agriculture or climate smart agriculture.
 - (2) Climate smart design and climate proofing of long-lived investments or decisions that will be made in the near-term: There is an urgent need (and an opportunity) to include adaptation in near-term investment decisions that have long life-times (such as infrastructure, land-use plans) to reduce lock-in.⁷ This involves an incremental cost but delivers high net benefits by avoiding future climate impacts (Hallegatte et al. 2019a). An example would be the climate

⁷ Lock-in is defined as early actions or decisions that involve long lifetimes or path dependency, which could increase future risk or vulnerability, and are difficult or costly to reverse later (quasi-irreversibility). This can be from an action or decision that is business-as-usual, from a lack of an action or decision, or from a maladaptive action or decision (Watkins and Betts 2021).

proofing of new transport infrastructure by building to higher design standards that take account of climate change.

- (3) Low-cost preparatory activities to improve future decisions, as part of adaptive management plans (adaptation pathways): This can involve information gathering, research and monitoring, as well as governance and coordination (and relevant enablers). These are all especially valuable for future decisions that have long lead times or involve large but uncertain impacts.
86. These building blocks can also be used for mapping out adaptation pathways, to take account of high uncertainty around future climate change risks. They embrace adaptation as an iterative, holistic, and participatory process, with an ongoing and evolving response to growing risks over time, rather than as a one-off decision. Adaptation pathways are based on portfolios of activities, which may include a mix of capacity building (soft options) and technical (engineered or structural) options.
 87. The initial adaptation pathways of RGoB's NAP in 2023 helped to inform this step. The NAP assessed short-term (first phase) actions and activities over the next 5 years, as well as (second phase) actions and activities needed over the following 5–15 years. This included research and planning in the first phase, to allow implementation later (e.g., formulate stormwater plans in the first phase and implement in the second phase).
 88. The CAIP analysis built on this and developed some initial pathway thinking for four of the packages (Figure 9). This identifies how activities in a package can be sequenced to provide a logical set of early and later actions, and how in turn these can link to the focus on adaptive management, which uses information and lessons from initial actions to improve future adaptation decisions and overall resilience over time (in this case linked to successive 5-year planning periods). This identifies early quick wins which focus on maximizing no-regret (and low-regret) decisions. These activities deliver immediate economic benefits and help improve future resilience. This would include water-efficiency activities, reducing non-revenue water, and targeted weather and climate services, along with the climate proofing of infrastructure with long life-times. It also includes many softer options—such as governance and coordination, information and monitoring—that build the foundations for making the water system more resilient. For example, initial development of river basin management plans, could be followed by the development and implementation of investment projects. It might also include early assessment studies for flood protection schemes. Importantly, these early steps include enabling factors. An example would be investigation of water charging regimes and their linkages to demand management and water-efficient technology.

Figure 9: Examples of Timing, Sequencing, and Urgency of Activities That Form Adaptation Pathways



Source: Authors.

89. A key part of this adaptive management approach is to establish a process for monitoring, evaluation, and learning. This is relevant for all packages—and particularly important for the IWRM actions and activities—for assessing changing supply and demand and peak water under climate change. Feedback from enhanced monitoring and investigations can be used to shape water management decisions. For example, more baseline information on sustainable water resources might inform allocations for abstraction, or shift the focus to demand management and improved water efficiency. The same feedback could be used for infrastructure investments; noting that earlier, larger-scale, and even transformative adaptation may be needed under more extreme climate futures.
90. These frameworks can also include output and outcome indicators. A number of key performance indicators (KPIs) for the IWRM and DRM packages set in the *Water Sector Roadmap for Implementing Bhutan's NAP* (ADB 2024) can be integrated into the CAIP going forward. Complementing these, is a set of nationally relevant indicators in the 13th plan, including outputs and outcomes for managing disaster risks (to the country, its economy, infrastructure, and institutions). Outputs highly relevant for the CAIP include that: (a) critical infrastructure will be secured through robust planning, risk management, and investment in infrastructure that is resilient to hazards and disasters, and (b) communities are prepared and resilient to disaster.
91. It would be possible to develop more specific adaptation pathways and indicator frameworks as the packages move toward preparatory studies and implementation. This could include specific adaptation pathways and incorporate decision making under uncertainty (Marchau et al. 2019; Bednar-Friedl et al. 2022), noting that water sector planners often employ decision-scaling and robust decision-making techniques (Groves et al. 2019; Ray and Brown 2015). Metrics from the climate risk analysis (in the NAP water document and above), supported by key thresholds and performance indicators, could inform these actions. For instance, thresholds could be specified for sustainable water abstraction levels, or for minimum environment flows. Climate risk metrics can also capture the envelope of future changes to bracket central and extreme outcomes (such as earlier reductions in water availability) as and the risk of lock-in. Portfolios of activities could then be triggered in response to evolving conditions. This would require more in-depth analysis, building on the enhanced monitoring phase outlined in this report. Stronger focus on addressing risks of lock-in and on the design of infrastructure could complement this, as could decision making under uncertainty concepts of robustness, flexibility, minimizing regrets and portfolios, and climate resilient spatial planning for flood risk management.
92. To develop the prioritization of activities, a CAIP workshop session applied sequencing analysis to identify which of the 187 pipeline activities would take place during the 13th plan, and which would be in the 14th and 15th plans (linked to the approaches in Figure 9). Such phased priorities are also set out in the road map for *Institutional Strengthening and Modernization of Hydromet and Multi-Hazard Early Warning Services in Bhutan*. This identifies urgent activities for the next 5 years, such as strengthening the capacity of Bhutan's National Centre for Hydrology and Meteorology through equipment, technology, and training. These approaches led to a ranking of priority early activities within each package.
93. A priority scoring for each of the 187 pipeline activities was undertaken at the Inter Ministerial Water Sector workshop. About 130 of the strategic activities (70% of all activities) were identified as being high priority. A further prioritization meeting was held in March 2025 with the Inter-agency Working Group. This included a further round of prioritization including the inclusion of a 'very high' urgency score (Annex 4).



5 Benefits and Economic Analysis

Key Messages

- Analysis of adaptation benefits is critical to the CAIP process as this builds justification for investment and helps to identify public and private sector opportunities. The analysis of these benefits also drives the economic and financial analysis of adaptation.
- The CAIP identified potential benefits of each of the adaptation investment packages, assessing these from three perspectives: (a) the economic (societal) benefits, (b) the associated fiscal benefits—i.e., the effects on government spending and revenues, and (c) the direct financial benefits and the potential for generating cash flows.
- This analysis found that all investment packages have high potential positive economic (societal) benefits. The analysis also found that many of the packages could deliver fiscal benefits (for the public finances); for example, by reducing spending on disaster relief costs, and some could increase revenues from the water sector. Finally, it identified that some packages could have high financial viability, notably for investments in water technology, and from increased revenues following water charging reforms.
- The analysis then assessed the potential economic return of the investment packages, based on a review of country projects and economic appraisals, as well as the wider literature. This indicates that investment packages all have potential to deliver net positive economic benefits, with Economic Internal Rates of Return that pass typical threshold levels. This highlights the strong economic case for the individual investment packages and the CAIP overall. However for all packages, the financial returns and Financial Internal Rates of Return are much lower, and in many cases under current policies, there is limited revenue potential for most packages under business-as-usual approaches.

94. Step 4 in the CAIP is to assess the benefits of adaptation and undertake an economic analysis. This builds on the NAP, yet as with nearly all submitted NAPs, it included an assessment of costs but did not assess the benefits of adaptation. The CAIP addresses this gap in the wider NDC process. This analysis then helps (a) allocate investment responsibility to the public and private sector and (b) related sources of finance.
95. The economic analysis has focused on each of the 11 adaptation investment packages. This provides the information to justify public investment (for packages likely to be publicly financed) as well as information for packages that are seeking potential private investment to see if they provide sufficient returns.
96. Ideally, this economic analysis should be used to help prioritize alternative adaptation activities and subpackages, as part of standard economic appraisal. The economic analysis should also be used to check that the preferred packages pass the necessary investment thresholds (in effect,

that the economic benefits outweigh the costs). For public investments, this will include the consideration of any relevant criteria (economic thresholds) in the national public investment management systems (noting that these are still under development in Bhutan) and economic thresholds for MDB finance, where this is sought. For private investments, it will include assessing the financial returns.

97. However, the economic appraisal of adaptation is challenging (UNEP 2023). This is because adaptation is a response to site and context-specific climate risks (requiring local analysis of hazard, vulnerability, and exposure), and to risks that can change dynamically over time and involve high uncertainty. This makes traditional economic analysis (and optimization) difficult. Furthermore, while adaptation often involves upfront investment to address future (uncertain) risks, this generates benefits that are primarily in the future and may be difficult to justify when compared to upfront costs (in present-value terms). There is also a stronger focus on process and non-technical activities, which are more difficult to assess in economic appraisal, though they lead to increased efficiency and effectiveness (LSE 2016).
98. To address these challenges new frameworks have been developed for adaptation, with adaptive management and adaptation pathway frameworks, as well as new project appraisal methods that include decision making under uncertainty (Watkiss et al. 2014) and robust decision making, real options or dynamic adaptation pathway. These require an extended cost-benefit analysis framework (i.e., which use the core concepts of that framework, but include other steps to allow consideration of uncertainty). There is also a need to ensure that methods allow the economic appraisal of soft adaptation options and enabling factors. However, these new methods are time and resource-intensive and require considerable capacity and expertise.
99. Despite these challenges, many early adaptation activities (no regret actions) make economic sense because they lead to net positive economic returns. For the CAIP analysis, the benefits of each of the subpackages is mapped in terms of their economic (societal) benefits—i.e., including social or environmental costs and benefits. This is a standard part of economic appraisal. However, in line with the investment-led approach, separate analysis considered the fiscal and financial benefits. It therefore assessed the potential fiscal benefits that these economic benefits may generate, and the positive implications for spending (cost savings) or revenues for the public finances. It has also assessed whether any of these economic benefits generate direct financial benefits and revenues (cash flow, either directly or from the co-benefits of adaptation) that provide opportunities for private sector investment. Examples are revenues generated from delivering water services (and potential for PPPs) or private sector benefits from adopting climate smart technologies. The analysis of fiscal and financial benefits aims to help unlock both public and private investment in adaptation (Table 6).
100. This indicates all packages have potentially high economic (societal) benefits. The observation is in line with the focus on water policy and governance, public water systems, disaster risk management, and national climate services—all of which are primarily dominated by public finance. The benefits of IWRM include maximizing economic and social welfare (on the use of water) without compromising sustainability, and associated allocative efficiency improvements, as well as the potential for enhanced ecosystem services. In addition, they include benefits from climate-resilient water supply, such as improved access to water, more reliability, and better quality. This can also provide public health benefits and increased business productivity. Furthermore, disaster risk management actions and national climate services generate economic benefits. These arise from early warning systems, and are primarily in the form of reduced economic costs of disasters,

including reduced direct loss and damage, health impacts, and reduced indirect effects across the economy.

101. The packages can also provide fiscal benefits, notably from the reduction in disasters and associated public expenditure on relief and recovery costs. Potential fiscal benefits also can come from increased efficiency and effectiveness of water sector investment and recurring costs (from improved supply and demand management), and potential revenues from water investments and associated taxes, charges, or fees.
102. Finally, there are some direct financial benefits and potential sources of revenues (cash flows), particularly for water investments and technology, which could be increased through reform of water charges. Scope also exists for direct investment through a state-owned enterprise, a PPP, or even a private utility model. However, the potential for revenue generation from water charging will be strongly influenced by Bhutan having a small population, which is only about 790,000 people (and with a lower number in urban areas where tariffs only apply currently), as well as the relatively limited size of its private sector.

Table 6: Potential Economic, Fiscal, and Financial Benefits of the Proposed Adaptation Investment Packages

Subpackage	Economic benefits	Fiscal benefits	Financial benefits or revenues
1. Integrated Water Resources Management			
1.1. IWRM planning and Water User Associations	Management of water resources to maximize economic and social welfare without compromising sustainability—benefits of allocative efficiency (allocation of water to maximize the highest value use)—benefits to water users from availability/consistency of supply Maintenance/improvement of ecosystem service benefits Improved governance (Water User Associations) and reduced economic loss and disruption Improved investment landscape (investor confidence) Social cohesion and collaboration, including increased ownership and stewardship over resources, leading to improved efficiency Reduced water-induced disasters (see activities in Packages 4 and 5 below).	Potential to promote allocative efficiency (taxes, charges, subsidies, etc.) and increased revenues (e.g., hydropower exports / royalties) Improved management and improved planning of fiscal expenditure Reduced costs from environmental degradation and restoration Lower cost of dispute management Fiscal cost savings disaster response	Revenues from hydropower and agriculture (water users); though note there may be some financial downsides for some actors compared to current status quo (allocations and pricing)
1.2. Research, capacity, monitoring	Benefits of allocative efficiency Value of information—improved future decisions (efficiency and effectiveness)	Potential to promote allocative efficiency increase revenues	Improvement of current or proposed revenue models

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Table 6 continued

Subpackage	Economic benefits	Fiscal benefits	Financial benefits or revenues
1. Integrated Water Resources Management			
1.3. Abstraction analysis	Value of information—potential increase in sustainable water supply and associated economic benefits Potential supply benefits (see activities on water supply in Package 8)	Possible revenue from enhanced supply Improved management and improved planning of fiscal expenditure	Household and rural benefits (meeting unmet demand). Access to lower cost supply
1.4. Payment analysis	Benefits of allocative efficiency to incentivize responsible and sustainable water use and pricing that reflects full economic cost Potential to use tiered or subsidized payment models to ensure affordability for low-income households	Revision/expansion of water tariffs allows cost recovery for building and maintaining water systems (easing fiscal pressure on government budgets)	Revenues from water taxes or charges—potential for state or private investment (public-private partnerships (PPP) or the utility model)
1.5. Water ventures	Increased economic output and potential economic diversification Increased employment opportunities	Increased government revenue from water-based businesses contribution	New revenue streams from new ventures
1.6. Nature-based solutions and Payment for Ecosystem Services (PES)	Improved ecosystem services (provisioning, regulating, cultural and supporting—including market and non-market), e.g., water regulation, reduced runoff, soil erosion, reduced siltation, and carbon sequestration. Potentially increased economic output/resilience of water-dependent industries	Potentially better management and improved planning of fiscal expenditure Possible increased tax revenues from water-dependent sectors (if more profitable)	Possible carbon sequestration (carbon credits). Potential revenues from PES schemes (from water dependent sectors)
1.7. Water-efficient technology	Benefits of allocative efficiency Reduced costs for water-dependent industries Job creation (new technologies) Improved ecosystem services (reduced water abstraction)	Reduced public expenditure on water supply Potential increased tax revenues (more profitable water sector, new technology markets (tax revenue))	Lower water costs (cost savings from adoption) Potential for private sector (goods and services)
1.8 Planning and policy	Improved water resource management/allocative efficiency from improved allocations, decisions, etc.	Fiscal cost savings from improved efficiency	Possible increased revenues from system efficiency
1.9 Climate resilience design standards	Improved infrastructure resilience, reduced loss and damage Reduced loss of services (reduced economic losses) Reduced health impacts (from water connection losses)	Reduced public investment in replacement or repair. Reduced loss of revenues from supply interruptions and economic impacts Fiscal cost savings of disaster response	Reduced loss of revenues

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Table 6 *continued*

Subpackage	Economic benefits	Fiscal benefits	Financial benefits or revenues
2. Adaptation policy and planning			
2.1. Adaptation policy and planning	Improved efficiency and effectiveness of policy and planning decisions Value of information and improved future decisions	Increased potential for raising external finance (climate finance) Reduced costs	Potential for increased climate finance including for the private sector
3. Research and education			
3.1. Water-related research and education	Value of information and improved future decisions Possible potential for direct, indirect, and induced economic effects, including productivity spillovers from research investments and knowledge exchange	Potential increased tax revenues from economic effects and productivity spillovers	Possible potential to generate information or solutions that have market and revenue potential
4. Flood risk management			
4.1. Flood protection projects (and implementation of flood protection plans)	Reduced loss and damage of assets (public and private) and associated services Reduced losses to economic activities Reduced mortality, injuries, morbidity, displacement and mental health impacts (reduced medical costs and loss time, improved welfare) Improved economic activity and investment (confidence in investment and economic activities for protected areas) Reduced environmental loss and damage (including to ecosystem services)	Reduced reconstruction and repair costs Reduced disaster relief and recovery efforts. Increased budget predictability (reduced volatility, reduced emergency spend) Reliability of tax revenues (uninterrupted business activities, smoothing revenue collection)	Reduced financial loss and damage (public and private sector) Potentially lower insurance costs/premiums Increased investment attractiveness and inflows of capital
5. Urban planning, stormwater management and green infrastructure			
5.1. Linked urban centers including planning, transport, water supply, sewer, stormwater, green space	Enhanced economic development (improved connectivity and trade) Improved investment attractiveness for business and industry Travel time savings (improved transport) Includes water supply benefits (see Package 8 below), stormwater (5.2), and green infrastructure (5.3)	Increased tax revenue (from development around linked urban centers) Potential fiscal savings from more efficient uses of resources from integration Includes water supply benefits (see 8) and stormwater (5.2) and green infrastructure (5.3)	Potential revenues from new state-owned enterprise/PPP/utility models Potential cost savings for households and businesses Includes water supply benefits (see Package 8 activities) and stormwater (5.2) and green infrastructure (5.3)

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Table 6 *continued*

Subpackage	Economic benefits	Fiscal benefits	Financial benefits or revenues
5. Urban planning, stormwater management and green infrastructure			
5.2. Water services master plan incl. stormwater management and nature-based solutions	Includes water supply benefits (see 8) and stormwater (5.2) and green infrastructure (5.3).	Includes water supply benefits (see 8) and stormwater (5.2) and green infrastructure (5.3)	Includes water supply benefits (8) and stormwater (5.2) and green infrastructure (5.3)
5.3. Green infrastructure and open spaces	Includes benefits of flood protection (see activities for Package 4 above), plus green spaces, wetlands, and natural stormwater retention areas provide additional ecosystem services including carbon sequestration, urban biodiversity, recreational benefits (health and well-being benefits) Construction tends to be labor intensive and so potential job creation	Includes benefits of flood protection (4)	Includes benefits of flood protection (Package 4 activities above), plus Potential carbon credits
5.4. Stormwater management	Includes benefits of flood protection (see activities for Package 4)	Includes benefits of flood protection (4)	Includes benefits of flood protection (4 above)
5.5. Capacity building and research	Skill development and economic empowerment, including spillovers Enhanced benefits for the actions above (e.g., flood protection investments, water services, stormwater management) from higher capacity, improved decisions, reduced losses, and higher efficiency and effectiveness	Cost savings for Government from improved efficiency and effectiveness, and reduced costs, losses, failures and repairs, as well as improved service reliability and functionality (potentially enhancing revenues)	More effective and efficient delivery of revenues/financial benefits
6. Disaster Management and Emergency Response			
6.1. Disaster Management and Contingency Plan	Reduced loss and damage to assets (public and private) and associated services Reduced disruption and losses associated with economic activities (preparedness, quicker response, quicker recovery) Reduced mortality, injuries, morbidity, displacement and mental health impacts (reduced medical costs and loss time, improved welfare—including post disaster Improved economic activity and investment (confidence in investment and economic activities for protected areas) Improved resilience of livelihoods, ability to resume economic activities post-disaster, reducing long-term economic losses	Reduced disaster recovery costs and financial burden Reduced impact on businesses activity and tax revenues Reduced need for social protection spending	Reduced financial and revenue loss and damage
6.2. Disaster (emergency) Response	As above	As above	As above

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Table 6 continued

Subpackage	Economic benefits	Fiscal benefits	Financial benefits or revenues
7. National Climate Services and Early Warning Services			
7.1. Hydromet Infrastructure + data center/ Modernization of Observation Hydromet Network	Value of information from improved hydromet and weather and climate services, including early warning systems, leads to improved decisions for flood risk management, and leads to ... Reduced economic impacts from disasters (direct and indirect), and Reduced health and well-being impacts	Fiscal cost savings from reduced disaster relief, restoration costs, etc. Weather and flood warning center could possibly generate revenue through the sale of data and services to businesses	Reduced financial and revenue loss and damage Possible revenue from information but note public good nature of information
7.2. Cryosphere Monitoring and Research	As above, but for glacial lake outburst flood risks Potentially also benefits from understanding of peak water	Fiscal cost savings from reduced disaster relief, restoration costs, for glacial lake outburst flood risks	Reduced financial and revenue loss and damage
7.3. Hydrological and Early Warning Services	Value of information: information from improved hydromet and weather and climate services including EWS leads to improved decisions for flood risk management, leading to ... Reduced economic impacts from disasters (direct and indirect), and Reduced health and well-being impacts, reduced environmental impacts	Reduced disaster recovery costs and financial burden (fiscal spending) Reduced impact on businesses activity and tax revenues Reduced need for social protection spending	Reduced financial and revenue loss and damage (public and private)
7.4. Weather and Climate Services	Value of information: information from improved weather and climate services leads to better decisions and can reduce losses (see above) and also potentially enhance productivity (e.g., tailored services for agriculture, hydropower management, etc.)	Fiscal cost savings from reduced disasters, restoration costs, etc. Possibly fiscal revenues from sales of weather and climate data	Reduced financial and revenue loss and damage (public and private) Possible some revenue potential from paid for services by end-users Potential for value added by private sector
7.5. Forest wildfire risk management	Reduced economic losses to timber, assets, infrastructure agriculture, etc. from reduced wildfire Reduced social costs—including reduced fatalities and injuries Reduced carbon emissions and air pollution (health benefits) from fire Reduced loss of forest ecosystem services	Reduced costs of emergency response and suppression/ reduced costs of restoration Reduced damage to government assets Reduced loss of revenues	Avoided losses to businesses and tourism

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Table 6 *continued*

Subpackage	Economic benefits	Fiscal benefits	Financial benefits or revenues
8. Climate resilient water systems			
8.1. Water supply, transmission, distribution and treatment	For those already connected, improved reliability or quality. For those not yet served (new connections) benefits from displacement of other sources of supply (cost savings) Enhanced public health (reduced waterborne diseases, and reduced lost time and medical costs, as well as wider welfare benefits) For some projects, increased supply from reducing losses Increased business productivity from water supply reliability/quality Investment attractiveness for water dependent sectors Property value growth (from connected areas) Equitable access to water for underserved or marginalized communities	Government revenue from water services, including residential and industrial users Reduced need for emergency water supplies Reduced health impacts and lost time (labor supply/productivity)	Revenue generation from water taxes, charges or fees (potential for state-owned enterprises/public-private partnerships/utility model) Operational cost savings
8.2. Non-revenue water measures	Improved water system efficiency Enhanced water availability (for household, business, agriculture)—and improved water for economic use Reduced operational costs (from minimizing water losses, and costs of treating and distributing water) Reduced pressure on ecosystems (reduced abstraction) and improved ecosystem services	Enhanced revenue generation (water billed) Reduced supply investment Cost savings	Increased profitability of water supply (increased attractiveness for state-owned enterprises/public-private partnerships/utility model)
8.3. Rural Water Supply Schemes	Benefits from displacement of other sources of supply (cost savings) Enhanced public health (reduced waterborne diseases, and reduced lost time and medical costs, as well as wider welfare benefits) Equitable access to water, particularly benefitting underserved or marginalized communities, which can enhance social stability Potentially wider economic benefits as above, including for rural businesses	Potential for revenue generation from water taxes, charges, fees, though currently rural areas not charged for water Reduced social protection costs from improved health and incomes	Possible (limited) revenues from water taxes, charges, or fees
8.4. Improved water system and water safety plan Thimphu	As above for supply, transmission, distribution and treatment For water safety plan, improved resilience of water infrastructure (similar to climate resilient standards above)	As above for supply, transmission, distribution and treatment	As above for supply, transmission, distribution, and treatment

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Table 6 continued

Subpackage	Economic benefits	Fiscal benefits	Financial benefits or revenues
8.5. Sewerage systems	Improved public health and productivity (reduced risk of waterborne disease)—lower medical costs and reduced labor supply/productivity impacts Increased property value and economic development Reduced environmental pollution Enhanced Gender Equality and Empowerment	Reduced public health expenditures Reduced emergency and disaster relief spending	Revenue generation from services (for state-owned enterprises/public-private partnerships, or private utility models) from sewerage charges—household and business
9. Forests			
9.1 Forest plantations	Economic revenues from timber and other forest products Job creation, including rural employment opportunities Soil stabilization—reducing soil erosion, landslide risk, runoff, water flow regulation, carbon sequestration	Tax revenues (from timber-based revenues)	Revenues (sale of harvested timber and other forest products) Carbon credits
10. Energy projects			
10.1. Mitigation investment projects	Energy generation, storage, supply stability and economic growth Job creation Spillover economic benefits Greenhouse gas emission reductions Reduced air pollution	Government/tax revenues from energy sales and exports For pumped storage, potential for cost Efficiency and Energy Security/Revenue maximization. Hydrogen potential for reduced imports of fossil fuels (foreign exchange)	Revenue generation from power sales: Carbon credits
11. Agriculture (Irrigation)			
11.1. Irrigation development	Increased agricultural output resulting from improved productivity or enhanced yields and reduced unit production costs or reduced losses (including reduced vulnerability to rainfall variability and drought). Can also allow more diverse and higher value crops Food security/improved calorific intake In Bhutan, potential for gender empowerment given number of women farmers	Increased tax revenues Reduced costs of emergency spending and disaster relief for droughts	Increased output/higher value output Increased farmer income Enhanced land value Financial cost savings (potentially)

Economic and Financial Returns

103. The next step of the CAIP looked at the potential economic and financial return of each of the adaptation investment packages. This involves two separate assessments, which use different approaches and metrics (Box 6).

Box 6: The Difference Between Economic and Financial Returns

While they are closely related, the economic and financial appraisal are different.

- **Economic appraisal**, as used by governments and multilateral development banks, is based on the principles of welfare economics, and aims to assess the ability of a policy, program, investment, or project to improve social welfare or well-being. It is carried out from the perspective of society and includes the economic valuation of non-market effects, such as environmental benefits and costs. This enables assessment of the socioeconomic costs, benefits, and other dimensions of alternative choices.
- **Financial appraisal** is different and considers the incremental revenues and costs generated by an investment, and the ability to generate cash flows that might be used to repay any financing. It is therefore carried out from the perspective of an investor (not society as above). A financial analysis excludes environmental or social benefits except where these are reflected in financial cash flows. It will also consider the cost-recovery objectives and mechanisms, and it will often also undertake a financial and fiduciary analysis of the implementing and executing entity.

Economic and financial analysis both involve the identification of benefits and costs and convert these cost and benefit streams/cash flows to present values using discount schemes. Both generate net present value (NPV) and can be used to estimate internal rate of return indicators.

- Results of an economic appraisal or cost-benefit analysis can be expressed as the Net Present Value (NPV)¹ the benefit-to-cost ratio² or the economic internal rate of return.³
- In the financial appraisal, the analysis assessed the financial NPV or financial internal rate of return (or other similar metrics, such as the payback).

¹ The net present value is the sum of future values (in real prices) that have been discounted to bring them to today's value (HMT 2019). It is estimated as the total present value (discounted) benefits divided by total present value of costs.

² The total present value of benefits divided by total present value of costs.

³ The rate at which the NPV is zero, which can be compared with the discount rate to assess if a project generates a sufficient return on investment to be viable.

104. Appraisal of economic and financial returns requires a quantitative analysis of the identified benefits. This can be undertaken amid more detailed technical analysis as the adaptation investment packages are progressed. Nonetheless, it is possible to assess the indicative benefits of the packages by using previous studies with similar actions.
105. An initial review of the adaptation investment packages was made to assess the potential returns, based on a literature review and previous projects in the region. Detailed economic and financial appraisal will need to be conducted as policy packages are developed into full concepts and proposals. It should be emphasized that the following analysis has not focused on the economic internal rate of return (EIRR) for sewerage systems, mitigation projects, agriculture (irrigation) development, and forest plantations. That is because these are more likely to access other climate and development finance than to access adaptation finance.

106. **Package 1** is on **integrated water resource management (IWRM)**. This is primarily about investing in information, capacity building, policy, and governance rather than capital investment. Nonetheless, previous studies (CCC 2021; BCG 2023) have found that water pricing, loss reduction, and water efficiency (demand-side) measures have some of the highest benefit-to-cost ratios of all adaptation measures and are priorities for early adaptation as they involve many no-regret actions, such as immediate benefits from cost savings and reducing the need for capital-intensive water supply measures (now and over time).
107. Economic appraisals of IWRM projects are often based on analysis of downstream benefits such as irrigation project components or flood protection benefits, rather than the institutional investments. For example, an ADB climate-adaptive IWRM project in Cambodia included the following activities: strengthening planning, coordination, and climate change adaptation capacities of water resources management (Output 1); increasing water supply capacity by improving irrigation systems (Output 2); and reducing flood risks by improving flood protection (Output 3).⁸ However, the economic appraisal (ADB 2024c) focused on the economic benefits of the two irrigation components (which gave EIRRs of 16% and 22%) and the two flood risk management schemes (EIRRs of 11% and 51%), and did not provide an EIRR for the institutional IWRM activities (Output 1). The project did not have a cost recovery component, and thus has a low financial internal rate of return (FIRR): the sustainability of the project was based on the capacity of project-operating entities to sustain the incremental operations and maintenance costs. As a further example, an ADB IWRM project in India, which strengthened state and basin level institutions for IWRM and improved irrigation service delivery through system modernization and water users cooperative societies, assessed the EIRR of the project at 22%, but this was based on the irrigation benefits from upgrades to headworks (and increased yields) and reduced water losses in the irrigation systems (ADB 2014). However, for such projects, revenues typically only cover operations and maintenance costs.
108. This makes it difficult to provide an EIRR for the specific IWRM package, and the main economic benefits will be realized through the role of IWRM in delivering and enhancing benefits such as flood protection or irrigation. It is also difficult to identify specific adaptation benefits of IWRM, especially as the packages involve a mix of Type 1, 2 and 3 adaptations (See Box 5 for explanations of these). Similarly, the financial benefits and revenues are generated through the activities below, and most of the IWRM components of projects are taken forward through technical assistance support, noting that in time, these have the potential for revenue generation from water users.
109. **Package 2** on **adaptation policy and planning** mainly involves supporting activities to help overcome adaptation barriers but can deliver economic benefits by increasing the efficiency and effectiveness of adaptation implementation (LSE 2016). There are no financial returns.
110. **Package 3** on **research and education** for water-related activities will have economic benefits, the main being information (addressing market failures of information failures). However, besides increasing the stock of useful knowledge, it can increase the number and skills of scientists, create new or improved scientific instrumentation, and establish networks and even new business (Salter and Martin, 2000). This can lead to high economic benefits, for example, studies of university research identify direct, indirect, and induced economic benefits, productivity spillovers from investment and the value of knowledge exchange having high benefit-to-cost ratios (e.g., London Economics 2004).

⁸ Asian Development Bank (ADB). Cambodia: Integrated Water Resources Management Project.

- 111. Packages 4 to 6 address water-induced disasters.** These include flood protection investment projects and plans, disaster management, contingency planning and emergency response and urban water/stormwater management projects, including green infrastructure. There are numerous studies of the economic benefits of flood protection and flood risk management, and these report high net economic returns. For example, the median economic benefit-to-cost ratio for flood prevention and preparedness is typically reported at 3:1 to 5:1 (Mechler 2016; Econadapt 2016; World Bank 2021) but can rise to more than 5:1 (sometimes substantially so) for early warning systems (GCA 2019). These high returns are however conditional on these projects taking account of future climate change risks and including higher protection levels in design. Although hard engineered protection will be needed, the economic benefits of flood risk management can be more effective if implemented as portfolios that include soft options and nature-based methods.
- 112.** There is already one ADB project—the Bhutan Phuentsholing Township Development Project⁹—that is providing protection from floods and erosion, plus constructing smart urban infrastructure to allow phased urban expansion. Economic appraisal (ex-ante) estimated the EIRR at 11.3% based on the economic benefits from increased land values, the benefits from avoided damage to infrastructure, and the incremental benefits from water and power supply (ADB 2018a). The project was found to be financially viable,¹⁰ although with lower financial returns and a FIRR of 4.3% (ADB 2018b), from the revenues from the lease of newly developed land and charges for the infrastructure.
- 113.** A review of water supply projects across the wider ADB portfolio finds similar returns. For example, the Nepal Priority River Basins Flood Risk Management Project¹¹—which focuses on water-induced disasters and quantified benefits of avoided losses—estimated (ex-ante) at 10% EIRR (with individual components of 9.0% for Mohana Khutiya, 15.2 % for Bakraha, and 18.0% for West Rapti). However, this was a non-revenue-generating project, so there was no equivalent FIRR, and the financial viability focused on assessing government capacity to absorb the incremental maintenance cost of assets created under the project.
- 114. Package 7** activities are associated with **national climate services** to deliver economic benefits through improved information and better decisions. Weather and climate services provide a range of information to users, including weather forecasts, early warning, seasonal forecasts, and even climate change projections. This information can be used to reduce or avoid negative losses from weather extremes and climate variability (e.g., from floods or from lower-than-average seasonal rainfall) or improve positive outcomes such as agricultural yields. They are often cited as a ‘no-regret’ because they provide benefits today, but these benefits are also likely to improve under climate change. There are many economic appraisals of national modernization and strengthening projects, and these indicate high benefit-to-cost ratios. For example, a review of multiple GFDRR country studies and GCF proposals for similar national investments (Watkiss 2025) reports ex ante benefit-to-cost ratios of 2:1 to 6:1. However, to maximize the benefits of new or enhanced services, there is a need to invest along the services value chain (WMO 2022). This recognizes that economic benefits arise from the use of information in decisions, rather than just improved forecasts alone. The economic case is, therefore, strongest when investing strategically. This includes investments in enhanced equipment; monitoring and forecasting capability (including co-designed and tailored services); in the communication of this information to end-users; and for strengthening the uptake and effective use of forecasts by these users in decisions.

⁹ ADB. [Bhutan: Phuentsholing Township Development Project](#).

¹⁰ ADB. [Financial Analysis](#). Bhutan: Phuentsholing Township Development Project.

¹¹ ADB. [Nepal: Priority River Basins Flood Risk Management Project](#).

115. There was an economic analysis of the road map for *Institutional Strengthening and Modernization of Hydromet and Multi-Hazard Early Warning Services in Bhutan*. This reports estimates from an earlier analysis (in 2014), which estimated that the economic benefits of enhancing the capacity of NCHM across various sectors, including energy, agriculture, tourism, and disaster management would deliver an overall benefit-to-cost ratio of 3:1. However, the report also highlights that the benefit-to-cost ratio increases substantially over time, as benefits accrue in the medium and longer-term term, and could reach 8:1. Financing of national climate services (in developing countries) tends to be dominated by public finance, though there can be some revenues from targeted weather forecasts (e.g., for aviation), though there is currently no cost recovery for such services in Bhutan; as such there are currently no financial returns. The modernization road map anticipates new business strategies in the medium-term, including potential fee-based service provision. This could augment public income from RGoB, but most services would still be publicly funded.
116. **Package 8** is focused on **climate resilient water supply, transmission, distribution, and treatment**. The appraisal of such projects is more routine in economic assessments (e.g., ADB 2017). Water supply projects are usually assessed in terms of either improved services to households that are already connected to the system, or new connections (to households which are not connected—who rely on other sources of supply, such as wells, standpipes, or water vendors, or newly constructed houses, buildings or infrastructures). The economic analysis considers whether these produce incremental or nonincremental benefits.¹² Projects that improve water quality are likely to generate health benefits. Water supply projects may also increase supply by reducing leakage. The fiscal analysis considers how measures could help strengthen the financial sustainability of the water sector, and the implications for public finances (including improved revenues or reduced public spending and cost savings from a more efficient and resilient water sector).
117. ADB has already made water investments in Bhutan, notably the Water Flagship Program Support Project.¹³ This is primarily a water development project and does not concern specific adaptation components (though it was subject to a climate risk assessment and included adaptation). The economic appraisal (ex-ante) for this project (ADB 2022a) estimated the EIRR at 12.3% (with water supply in Thimphu at 21.4% in Wangdue Phodrang at 9.3%; and in Zhemgang at 15.5%). This indicates that economic returns are higher in more densely populated and wealthy urban areas. The financial appraisal of the project (ADB 2022b) highlights that government is responsible for capital investment into all the projects, but that there are some revenue-generating urban water supply subprojects (where some cost recovery is possible for operations and maintenance), whereas rural water supply and irrigation subprojects generate no revenue. This means the project has a low FIRR, though it was financially sustainable because it had budgetary allocations from the government, project city, and district administrations.

¹² For households not previously connected, output that substitutes for existing supplies is nonincremental and output that meets additional consumption is incremental. A project can deliver a qualitatively different supply. Benefits from nonincremental output can be estimated from the savings of resource costs associated with the existing supplies such as charges for water from vendors (where applicable) plus time spent on collecting water and fuel spent in boiling water. Benefits from incremental output can be measured by willingness to pay (based on the average of per unit user costs with and without project, or through a valuation study. For households already connected, a project may improve reliability or quality or expand supply. However, the economic appraisal only considers the incremental benefits. When a project leads to significantly improved services—in reliability, quality, and supply—these can be considered incremental for both previously connected and unconnected households, so all water demand is treated as incremental and measured by willingness to pay.

¹³ [ADB. Water Flagship Program Support Project.](#)

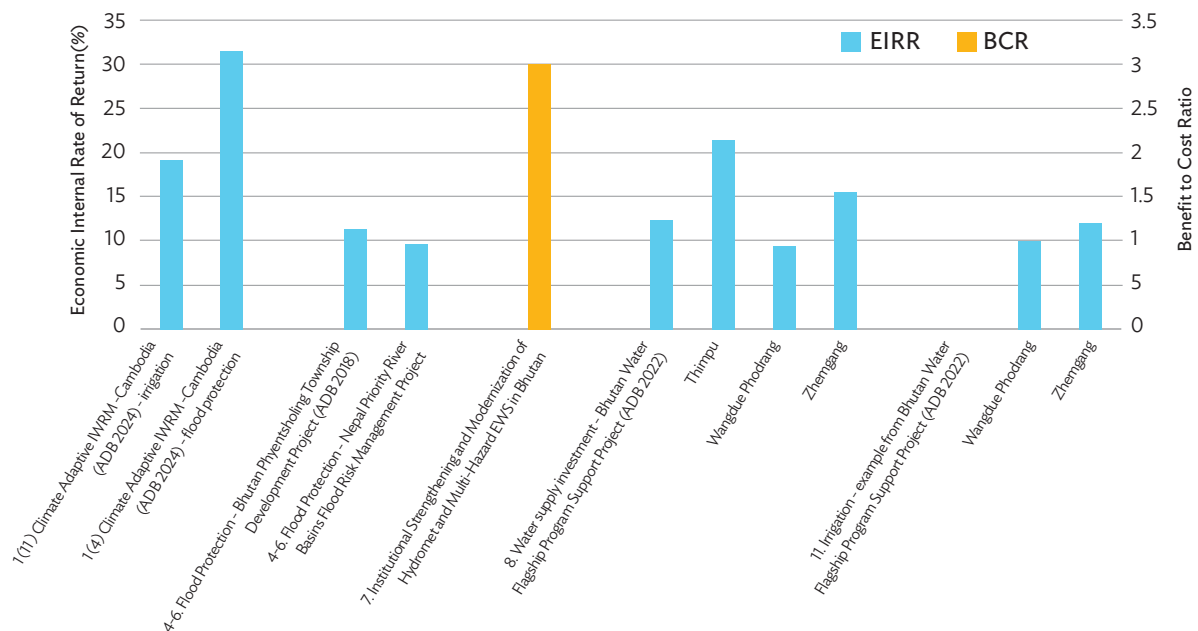
118. Similarly, the ADB-financed Bhutan Secondary Towns Urban Development Project¹⁴ focuses on urban services and identified the EIRR (ex-ante) of the project overall at 15%, with components on water supply (15%), sewerage (9%), and urban roads and drainage (21%) (noting again, this is the EIRR for the overall project, not just the adaptation components). A review of water supply projects across the wider ADB portfolio identifies these have similar EIRRs. For example, the Urban Water Supply and Sanitation Project¹⁵ in Nepal estimates (ex-ante) EIRRs of 12% to 16% (for three areas), while the Nepal Third Small Towns Water Supply and Sanitation Sector Project¹⁶ reports an aggregate EIRR of 19%. In line with ADB practice, these were subject to a climate risk assessment and would be climate proofed (but information on the adaptation EIRR is not separated).
119. However, there are also studies that look at the specific benefits of climate proofing water and sanitation sector investments. Previous World Bank analysis estimated that climate proofing new infrastructure, including water and sanitation, has a benefit-to-cost ratio of 4:1 and thus is highly cost-effective (Hallegatte, Rentschler, and Rozenberg 2019; Hallegatte et al. 2019). In terms of the financial viability of these investments—as water supply is not premised on full cost recovery in Bhutan—this makes financing more challenging.
120. **Package 9 on forestry** is primarily associated with mitigation, and while important, adaptation is a co-benefit, so it is not assessed here, though it has the potential for high economic and financial returns. Similarly, **Package 10 on hydropower** is primarily a mitigation action.
121. **Package 11 is on agricultural irrigation.** This delivers benefits through increased output resulting from improved productivity or enhanced yields. There are economic appraisals (ex-ante) of irrigation projects in Bhutan, as part of the Water Flagship Program Support Project. The economic appraisal (ex-ante) for this project (ADB 2022a) estimated the EIRR for irrigation at Wangdue Phodrang at 9.9%; and irrigation in Zhemgang at 11.9%. Irrigation across ADB's portfolio often have higher EIRRs than this, but these reflect areas with higher agricultural potential (e.g., compared to the Bhutanese landscape and climate)
122. These examples are brought together in Figure 10. This shows positive EIRRs for packages 1, 4, 5, 6, 8, and 11. Note that complementing these are net positive benefit-to-cost ratios (BCRs) for Package 7. This shows that the CAIP—for individual packages and overall—is likely to generate high economic (societal) benefits. Further, the levels are high enough to pass economic thresholds for financing.

¹⁴ ADB. Bhutan Secondary Towns Urban Development Project.

¹⁵ ADB. Urban Water Supply and Sanitation Project.

¹⁶ ADB. Nepal Third Small Towns Water Supply and Sanitation Sector Project.

Figure 10: Example CAIP Investment Package Economic Internal Rates of Return (EIRRs) and Economic Benefit-to-Cost Ratios (BCRs)



Note: Rates and ratios are based on ADB economic analysis (ex-ante). See the text for descriptions and notes.

Source: Authors based on project documents.

123. For public projects, RGoB criteria for management of public investment do not require systemic cost-benefit analysis (and thus there are no EIRR thresholds for investment). However, the *PFM Reform Strategy and Action Plan 2023–2028* (RGoB 2023c) recognizes the need for urgent reform (timeline of 1–2 years), and will include developing guidelines for economic (cost-benefit) analysis and project prioritization criteria. RGoB is also developing and finalizing new Public Investment Management Criteria. This is likely to include the EIRRs and FIRRs of investments.
124. In the absence of specific rates—and taking the example of ADB as an MDB that could provide concessionary finance—ADB has a minimum required economic internal rate of return (EIRR) of 9% (ADB 2017), though, for social sector projects, selected poverty-targeting projects, and projects that primarily generate environmental benefits, the minimum required EIRR can be lowered to 6%. Figure 10 shows that all the packages pass this threshold—though this involves circular reasoning because they need to pass the threshold to get approved. Nonetheless, it does demonstrate that meeting these thresholds is possible.
125. However, in every case the financial returns and FIRRs (Box 6) are much lower. Indeed of the projects above, the only one with an overall FIRR is the Bhutan Phuentsholing Township Development Project—and even here the FIRR was only 4.3% (compared to the EIRR of 11.3%).

126. Because the financial returns of the packages is lower than the economic returns, it will be more challenging to ensure these investments are financially viable and sustainable. In many cases, this will require the identification of highly concessional finance or require the identification of co-benefit streams. More positively, there are examples on how to do this for many of the packages—which are presented in the finance section.
127. Finally, this highlights the need to make the broader economic and fiscal case for adaptation—both macroeconomic and for project investments. In general, this is more difficult for adaptation than for standard capital investments because adaptation often involves defensive spending (non-productive capital) to avoid losses (rather than to produce economic gains). Furthermore, adaptation often involves increased government or social expenditure and recurring costs (rather than capital investment). Therefore, it is useful to make the wider case for adaptation, based on the public finances and macroeconomic and fiscal indicators. This includes the case for reinforcing linkages between development and resilience (World Bank 2024b) as well as the fiscal case for adaptation in maintaining government revenues and reducing expenditure on the increasing impacts of climate change—e.g., Climate Resilient Fiscal Management (ADB 2024d).

6 Finance Matchmaking

Key Messages

- Step 5 in the CAIP analysis makes the crucial identification of potential sources of financing for each of the adaptation investment packages as well as the funding models that could support these financial flows
- The step applies a decision tree to help identify, for each package, the potential role for public and private finance, the financial instruments employed, and the terms attached to these instruments
- Preliminary analysis suggests that, under a business-as-usual approach, about 10% of adaptation investment packages (by value) would have potential to attract private sector finance. This could increase up to 25%–33%, through the expanded use of public–private partnerships and with supportive blended finance structures and regulatory reforms.
- To realize this potential, some of the enabling environment reforms that will need to be prioritized include moving toward more rational water pricing, accelerated green finance reform, and regulatory reform to support innovative funding models (e.g., land value capture, payment for ecosystem services). A range of blended finance models will also likely be required including concessional credit lines, returnable grants/patient equity and guarantee structures.
- For those packages that will rely on public finance, while there is some scope for increased domestic public finance, a substantial share will need to be met with development partner support. Capital-intensive investments are expected to be cofinanced by multilateral development banks and other international financial institutions, with concessional and grant resources leveraged through their climate finance windows and complementary trust funds. Some investment packages could benefit from an integrated approach that combines project-support with policy-based financing. These would support progress in institutional reforms and implementation of complementary “soft” packages. There are also opportunities to access funding from many of the ‘standard’ multilateral climate funds, including the Green Climate Fund (GCF), the Adaptation Fund, the Global Environment Facility (GEF) and, potentially, the new Accelerating Resilience Investments and Innovations for Sustainable Economies Program of the Climate Investment Funds.

128. Successful implementation of the identified adaptation investment packages will hinge on mobilizing sufficient financial resources to cover both their upfront costs and, in many cases, their ongoing operating and maintenance expenses. Step 5 of the CAIP explores the identification of potential sources of financing for each of the packages and the funding models that could support these financial flows.¹⁷

¹⁷ Financing concerns how the upfront costs of an activity (i.e., package) are met. Funding concerns how the activity is paid for over its lifetime. Where financing is provided from sources and through instruments expecting a financial return (i.e., loans, equity), then funding involves identifying how to repay the finance used to meet the upfront costs.

129. To date, the focus in Bhutan—as in other countries—has been on accessing international public finance for adaptation. This especially includes grant and concessionary public finance from international climate funds, multilateral development banks, and bilateral development partners. This recognizes the principles of United Nations Framework Convention on Climate Change agreements and the low contribution to greenhouse gas emissions of developing countries. However, even with the increased finance agreed under the New Collective Quantified Goal at COP29, international public finance will be insufficient to meet developing countries adaptation finance needs.¹⁸ The challenges associated with relying exclusively on international public climate finance for climate adaptation have been reinforced by recent geopolitical developments. Hence, a broader set of finance is needed to deliver adaptation priorities.
130. Financing of adaptation (in general) comes from different sources. These can include international public or domestic public sector sources, the private sector, or the third sector (e.g., foundations or nongovernment organizations). It can involve a mix of these, through cofinancing arrangements or when public sector finance is used to de-risk and unlock private investment (blended finance). The financial instruments that can be used to finance adaptation include grants, concessionary loans, non-concessionary loans, equity, guarantees, and other instruments.
131. For public finance, there are several specific sources:
- *Public budgets underpinned by taxes and other non-tax revenues (e.g., royalties).* This is particularly relevant where the adaptation action is associated with an increase in day-to-day operating costs of the government such as the operating and maintenance costs of early warning systems, rather than the creation of assets that will increase future economic activity and the welfare of citizens. In the 2024/25 fiscal year, Bhutan's total budget was Nu 89,154.218 million, of which the allocation to recurrent spending was Nu 50,809.905 million (about \$591 million, using the average exchange rate for 2024/25).¹⁹ Bhutan implements climate budget tagging and the result of this analysis suggests that Nu 4,869.021 million (about \$57 million) was allocated to adaptation activities, covering both recurrent and capital expenditures. However, both the overall budget and the budget allocated to adaptation include resources provided by development partners channeled through the budget (and so is covered in the bullets below) (RGOB, 2024c).
 - In cases where the activities being financed are expected to result in identifiable cash flows or increase economic growth and hence tax revenues (such as investment in water supply), public bodies can use non-earmarked borrowing to meet budgetary shortfalls. This non-earmarked borrowing might either come from international lenders, such as an MDB, or from the capital market through bond issuance. RGoB sold its first government bond in 2020 (UNESCAP 2020) and it is generally looking to increase the depth and liquidity of the country's currently underdeveloped bond market (Manzoor 2021).
 - Public finance can also come from international partners who typically provide finance for a specific use of proceeds. Many different bilateral and multilateral partners provide this finance, on varying terms, and sometimes with specific focus areas. This is both the most common source of public finance for capital spending in Bhutan and also the main source of finance for adaptation. Over 2018–2022, adaptation finance flows from MDBs, climate funds, and bilateral partners averaged \$25 million a year.

¹⁸ Adaptation finance needs for all developing countries have been estimated at between \$215 billion to \$387 billion annually up to 2030 (UNEP 2023). The New Collective Quantified Goal on Climate Finance set a goal for all climate finance (combined mitigation and adaptation) of at least \$300 billion per year by 2035 for developing countries, which is likely to represent the level of international public finance available. The text also calls on all actors to work together to scale up financing to developing country Parties for climate action from all public and private sources to at least \$1.3 trillion per year by 2035.

¹⁹ 1 Nu = \$0.011625.

- There is growing interest in bonds to support activities with a specific use of proceeds. Of most significance to this adaptation investment plan are sovereign green bonds, where bond issuance raises financial resources that are allocated to climate or environmental purposes, including climate adaptation. However, RGoB has not made use of these instruments to date.²⁰
132. A further potential source of public finance for adaptation priorities are state-owned enterprises. There are 34 state-owned enterprises in Bhutan (defined as corporations with some government ownership). Druk Holding and Investment (DHI), fully owned by the government, is of particular importance as the government's commercial arm. Its mandate is "*to hold and manage the existing and future investments of the government for long-term benefit of the people of Bhutan.*" DHI has stakes in 21 companies (fully owning 10 and owning more than 50% of 4). In 2023, DHI generated revenues of Nu 10,477.18 million (about \$122.6 million), and it is estimated that through a combination of taxes and dividends, it contributed Nu 6,425.18 million of revenue to the domestic budget (about \$75.2 million)²¹ or about 12% of the total. This is provided to the general budget and not hypothecated to specific activities. However, the DHI-invested firms Druk Air and Bhutan Power Corporation Limited (BPCL) also receive state subsidies.²²
 133. The potential for using public finance to finance adaptation should be considered within the fiscal context of the country. In recent years, RGoB has undertaken a series of public financial management reforms to improve the efficiency of publicly financed activities and investments. Indebtedness, although high (110%–130% of GDP), is judged to be sustainable on account of the specific arrangements that underpin this debt. Most of the debt is linked to hydropower project loans from the Indian government, which are implemented under an agreement by which India provides the full financing and commits to purchase all surplus electricity at a price reflecting cost plus a margin (World Bank 2024c).
 134. In line with RGoB's strategic priorities, a key CAIP focus is to expand finance for adaptation beyond public sources, and to consider how to use available public finance more innovatively to crowd-in other sources, especially from the private sector. In some cases, small amounts of public finance (often provided on particularly attractive terms) may mobilize significantly greater amounts of private finance. This could be achieved if public finance can overcome barriers to private sector finance provision, including market failures such as information failures and positive externalities (Pauw et al. 2021), or other challenges that hold back private sector investment in adaptation such as a lack of information on effectiveness and benefits (CCC 2023).
 135. Private finance in Bhutan is dominated by banks and informal lenders. Bhutan has five commercial banks, some of which have significant public ownership but are profit-centered.²³ There are five microfinance institutions, three insurance companies, and one pension fund. These organizations are regulated by the Royal Monetary Authority (RMA) of Bhutan, which, for example, sets

²⁰ A further type of green bond is a sustainability-linked bond. Like a normal bond, its proceeds can be used for any purpose. However, with this instrument, one or more key performance indicators (KPIs) are tracked and a sustainability performance target (SPT) is set for those KPIs. The performance of the KPIs against the SPTs are assessed during the bond's duration, and that performance will alter the interest rate the bond issuer has to pay for the remainder of the tenor. Under a step-up structure, the interest rate increases if the target is missed, whereas under a step-down structure it decreases if the target is met. The Royal Government of Bhutan has had some exploratory discussions with development partners regarding the possible role for SLBs.

²¹ Using an exchange rate for 2023 of 1 BTN = \$0.011699.

²² The subsidy for the latter is the distribution of the 15% royalty on the use of water by hydropower plants which is used to provide electricity to rural and other customers at below market prices.

²³ Bank of Bhutan Limited (BoBL), Bhutan National Bank Limited (BNBL), Druk PNB Limited Bank (DPNBL), Bhutan Development Bank Limited (BDBL), and T-Bank. Of these, Bank of Bhutan and Bhutan Development Bank are majority-owned by either the government or state-owned enterprises, while DPNBL is majority owned by Indian state-owned Punjab National Bank.

macroprudential regulations to promote financial stability.²⁴ Also, about 20 companies are listed on the Royal Securities Exchange and raise capital by selling shares to the public (Royal Monetary Authority of Bhutan 2024b).

136. To explore potential financing, the CAIP has built on a previous World Bank decision tree for financing of climate smart agriculture (World Bank 2023c). This investigates the potential role for public and private finance, the financial instruments employed, and the terms attached to these instruments (Figure 11). It starts by asking whether the package is financially viable, in which case the opportunity for private finance is high, and progresses down the left-hand side of Figure 11, with the role for the public sector and public financing becoming progressively higher. It also sets out, for each source, the potential factors that are likely to shape the appropriate form of financial instrument.
137. Using this framework as a guide, the financing options for each package are now explored in more detail. For each core package, the discussion follows the same steps:
 - First, it provides a brief recap of the focus of the package, as well as estimate costs.
 - Then it discusses the likely balance between public and private finance for each package, and the specific components within the package, drawing on the finance decision tree framework in Figure 11.
 - For those elements of the package that are more likely to be financed using public sources, it identifies specific financing sources and the associated financial instruments, as well as precedents that Bhutan might draw from.
 - The fourth section provides similar information in relation to private finance opportunities.
 - The final section highlights the enabling environment reforms i.e. changes to policies, institutions, legal frameworks that will need to be pursued to facilitate these financial flows, focusing particularly on the reforms that will support additional financial flows from the private sector.

²⁴ These include that banks must maintain a capital adequacy ratio of 12.5% and maximum loan to value ratios that vary by loan size.

Package 1: Integrated Water Resource Management

What is the package?

138. Package 1 on integrated water resources management focuses on ensuring that water resources are managed and developed in a coordinated way, maximizing economic and social welfare without compromising ecosystem sustainability. The package includes activities on river basin management (working at the basin level to ensure upstream-downstream linkages); governance arrangements including water user associations; as well as studies and monitoring to establish sustainable resources. On the demand side, it also includes investigation of payment (pricing) mechanisms to ensure users pay for water, and that the appropriate value is paid, as well as the promotion of water-efficient technology. The key benefits of the approach are through the information and improved decisions it allows, including opportunities to improve the efficiency and effectiveness of water use under climate change.²⁵
139. The total estimated costs for Package 1 are about \$25 million, making it of moderate size compared with the other packages in the CAIP.

Balance between public and private sector

140. Some activities within this package can be expected to have no or very low financial returns—i.e., they are in category D of the Figure 11 framework. This includes, for example, activities related to IWRM planning (such as the development of a national integrated water master plan and river basin management plans and a wetland assessment) as well putting together a knowledge bank on water resource management, developing payment analysis and payment mechanisms, and carrying out abstraction analysis and research studies.
141. However, this package also offers the opportunity to engage private finance through business models that harness the value of water resources. This includes, for example, opportunities in engineered water storage, water-efficient technologies, and water-based ventures such as water kiosks along with ICT and IoT applications that can facilitate the collection of water tariffs. Some pioneering Bhutanese businesses such as Mawongpa sell products such as filtration systems, water pumps, water storage solutions, and pond liners, and illustrate the potential for private sector-led growth in these areas.
142. These activities could attract private capital on both the supply and demand-side of the market. On the supply-side, for example, finance needs to be mobilized for private companies to innovate and design, manufacture or supply water-efficient technologies (e.g., drip irrigation systems), water storage solutions (such as rainwater harvesting) or to develop water-related businesses. On the demand side, private sector businesses wanting to buy these products may need finance to cover the costs of purchase and installation at scale. However, in both cases, policy changes will be needed to realize private finance opportunities and they very likely will need to be supported by blended finance solutions (activities that are in category B or category C in Figure 11).
143. In aggregate, about 50% of this package could be financed using private capital, depending on the extent of enabling reforms.

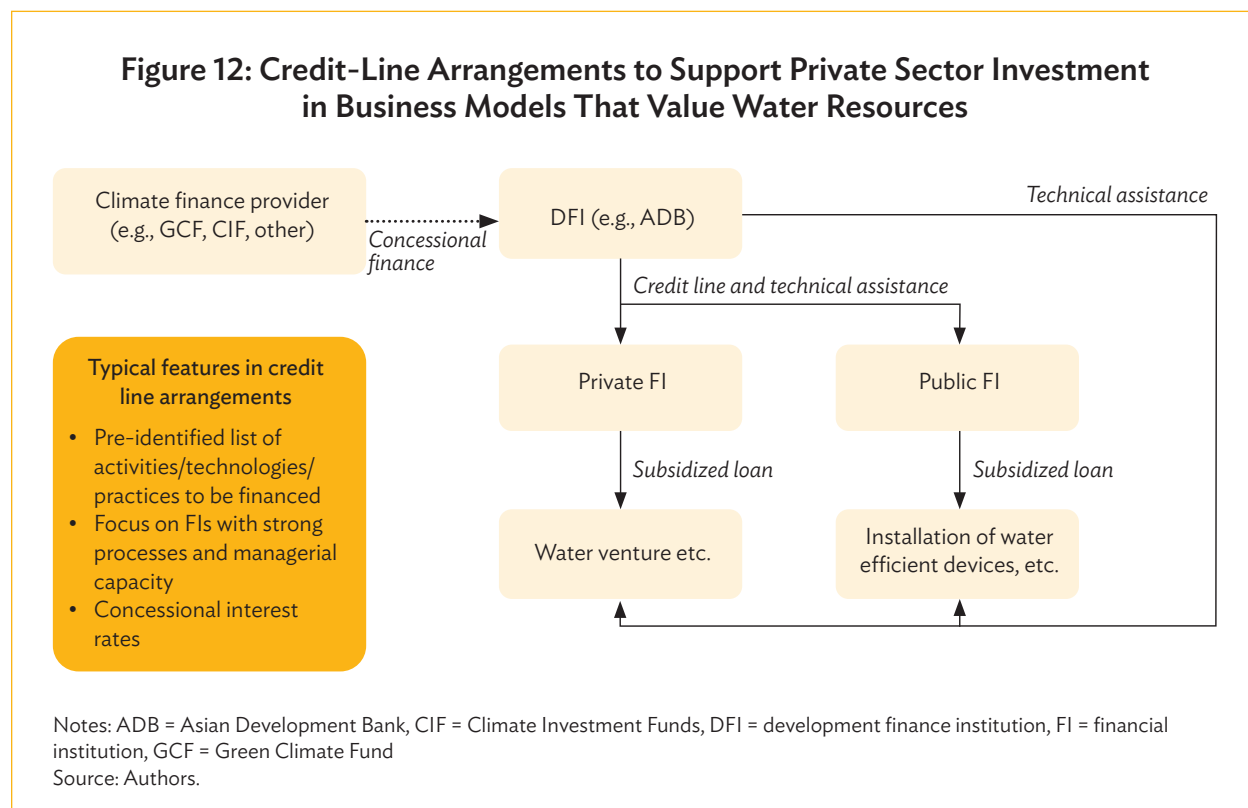
²⁵ The package also contains activities relating to nature-based solutions and payment for ecosystem services. However, as these are also part of Package 6, financing arrangements in relation to this activity is discussed there.

Public finance opportunities—instruments and specific opportunities

144. As some integrated water resources management activities are embedded in the 13th plan, a small amount of the required public finance will come from budgetary allocations. It is particularly important that ongoing costs of activities—where these are significant—are at least partly covered from budgetary allocations, due to the medium-term unpredictability of development partner support (for any specific activity). This might relate to, for example, promoting the adoption of water-efficient technologies.
145. However, additional resources can come from international public partners. Most activities in this package are in the middle of the adaptation-development continuum shown in Figure 11. They are valuable as development activities, but the importance and urgency of undertaking them increases because of climate change. As such, both general development assistance and climate specific finance sources may both be relevant.
146. Support might be provided in two ways:
 - As a standalone technical assistance (TA) grant. This modality would have the advantage of being able to proceed relatively quickly.
 - As a component of a larger investment or policy-based operation. In the case of integration within a lending operation, the associated investments would be expected to align with the outcomes of adopting IWRM. Links between some of the activities in this package and in Package 8 are particularly strong.
147. Specific opportunities for sourcing public financial resources include:
 - Direct TA support from bilateral donors: For example, the Danish International Development Agency and the Japan International Cooperation Agency have supported similar thematic interventions in the past. This would typically align with the TA grant modality.
 - International financial institutions (IFIs), providing grant-based technical assistance support: For example, ADB's Water Financing Partnership Facility, plus has previously supported water sector activities in Bhutan, has financing pillars related to both 'Strengthening policies, institutions and regulations' and 'Developing Capacity and Manage Knowledge'. In other countries (Thailand), ADB-led support for similar activities has also been funded by the Japan Fund for Prosperous and Resilient Asia and the Pacific. This approach would typically be provided as part of a large policy-based operation.
 - International climate finance providers: Historically, Bhutan has benefited from the GEF-managed Least Developed Country Fund for funding similar activities (UNDP 2025). However, graduation from least developed country (LDC) status makes this no longer possible. Other climate finance providers that may be relevant include the Adaptation Fund and the GCF. To access their resources, it will be necessary to identify clear adaptation benefits that investments will deliver, linked to the changing profile of Bhutan's climate risks and vulnerabilities. These sources of finance could be used within either of the two modalities (for standalone TA or larger investment or policy-based operations).

Private sector financing models, opportunities, and precedents

148. Two potential—and complementary—private sector financial models can be explored in more detail.
149. The first model is applicable in cases where revenues/cash flow are expected to be relatively predictable, such as for the installation of water efficient devices or in supporting the expansion of established water ventures. In this case, loan-based models are likely to be appropriate. However, commercial banks' lack of familiarity with these potential opportunities will have to be overcome. Key commercial banks currently have very little to no exposure to the water sector²⁶ and questions concerning the commercial viability of investment opportunities will need to be addressed.
150. One way to help tackle these challenges would be through a credit line to one or more commercial banks. This would provide concessional capital that the banks could lend on through an agreed set of activities aligned with CAIP objectives. The concessional nature of the credit line would allow a participating bank to make a margin on loans it extended and still offer borrowers a lower interest rate than would otherwise be available.²⁷ This would be complemented by technical assistance to help lenders understand how to assess loan applications, with the intention of reducing the collateral requirements that banks would conventionally require. Borrowers would also require technical assistance to better understand the commercial benefits these technologies might offer. Box 7 describes how a similar model was pioneered in Tajikistan while Figure 12 provides a stylized depiction of the model.



²⁶ The only exception is that some commercial banks have provided loans to water bottling facilities.

²⁷ In principle, an alternative model to support lending into these areas would be a partial credit guarantee. However, stakeholder engagement suggests that the capital shortages in the Bhutanese banking sector (which is not entitled to issue bonds and must instead rely on customer deposits for its capital) means that this model would be less effective.

151. There is already some familiarity with this model in relation to other environmental and economic objectives in Bhutan. For example, Bank of Bhutan Limited is already working with the International Finance Corporation (IFC) to support the uptake of solar photovoltaics using this approach. RGoB has previously extended capital using a similar model under the Entrepreneurship Development Programme to support electric vehicle uptake. It is also using this model to stimulate economic activity more broadly under the Economic Stimulus Plan.²⁸ Key lessons from these prior initiatives concern the importance of ensuring that transaction costs are proportionate to the value of the loan sizes under consideration, and the need for sustained partnership and political support for the duration of any program.

Box 7: Intermediated Financing to Support Water Efficiency in Tajikistan

The Climate Resilience Financing Facility (CLIMADAPT), launched by the European Bank for Reconstruction and Development (EBRD) in 2016, was a pioneering initiative aimed at bolstering Tajikistan's resilience to climate change. With a total funding pool of \$10 million, the facility provided loans through five local partner financial institutions (PFIs): Bank Eskhata, Humo Microfinance Institution (MFI), IMON International, Arvand, and First Microfinance Bank. These PFIs extended financing to households, farmers, and micro, small, and medium-sized enterprises to invest in climate-resilient technologies and practices, particularly in sectors vulnerable to climate variability such as agriculture and water resource management.

The \$10 million combined concessional funds and resources from international financial institutions. This mix of finance helped lower the cost of borrowing for end users and enabled investments in technologies that would otherwise be out of reach for smallholders and low-income households.

A central pillar of CLIMADAPT was the promotion of water-efficient technologies. Approximately 36% of the 3,400 subprojects financed involved water-focused solutions, including drip irrigation systems, rainwater harvesting technologies, and improved irrigation infrastructure. These technologies supported more sustainable water use, reduced losses, and improved agricultural productivity.

To support the effective deployment of climate-resilient technologies, the program offered technical assistance to a wide range of stakeholders. Partner financial institutions received support in identifying eligible technologies, developing green lending products, and training loan officers in climate finance. At the same time, end borrowers—such as farmers and business owners—benefited from awareness-raising campaigns, advisory services, and technical guidance on selecting and maintaining suitable technologies. This combination of finance and tailored technical support helped ensure both uptake and sustainability of investments. CLIMADAPT's success laid the groundwork for the larger Green Economy Financing Facility (GEFF) Tajikistan II.

Source: EBRD (2017) and EBRD (2018).

152. The second model is appropriate for private-sector led activities where cash flows are riskier—e.g., start-ups looking to manufacture or supply water-efficient technologies. In this case, high risks will mean that either long-term, flexible equity or returnable grants, coupled with business incubation support, is more appropriate. The initial finance underpinning support for higher risk opportunities could come from a range of sources. For example, a proportion of resources allocated through the Economic Stimulus Plan could be allocated. Alternatively, or in addition, international partners

²⁸ The Economic Stimulus Programme, launched in 2024, is a Nu15 billion initiative to accelerate economic recovery following the COVID-19 pandemic. It aims to enhance domestic production, reduce youth unemployment, improve foreign currency reserves, increase new business ventures, and revive the tourism industry. The program is financially supported by the Indian government.

often support early stage/high-risk businesses that have high impact potential. For example, ADB Ventures has the SEED program, which offers reimbursable grants to early-stage companies to validate and de-risk pilots with a focus on technology-enabled solutions that address climate change and gender inequality. The private sector window of the ADF may also be a source of finance.

153. The development of this financial model will need to be closely aligned with the technical support for green entrepreneurship that is planned in the UNDP-GEF program Enhancing Climate Resilience of Urban Landscapes and Communities (UNDP/GEF 2025). Between 2025 and 2031—and working with the Department of Employment and Entrepreneurship (DoEE) in the Ministry of Industry, Commerce and Employment (MoICE), the program is intended to support community-based entrepreneurs in areas related to nature-based solutions, water management, and green and resilient construction (focusing on the Paro-Thimphu corridor). It will provide support such as training, incubation spaces, organizing networking and promotional events, offering facilitation and support to new start-ups, and acceleration. In turn, this program is building on support provided by the Startup and Incubation Unit within the DoEE. This includes the provision of entrepreneurship courses, boot camps, and a network of three start-up centers and five incubation centers in Bhutanese colleges. In 2025, about 50 businesses were being incubated through the three start up centers, including one providing rural drinking water solutions and two in hydroponics.
154. One critical next step in relation to both models would be a study to fully understand market needs and opportunities. This would help to assess the overall size of the potential sustainable market for both instruments—under different market conditions and especially related to water pricing—the distribution of ‘ticket sizes’ that may be required, the length of time any finance will need to be provided,²⁹ and likely capacity development needs for those that might access this financing. This could also help determine the appropriate institutional structure of these financing arrangements, such as for a credit line in which commercial banks might be involved and the appropriate role of the Royal Monetary Authority of Bhutan.
155. Many Bhutanese stakeholders, inside and outside of the finance sector, may see these opportunities as unorthodox. This reflects the strong role that the public sector has played in all aspects of the water sector historically. As such, following the completion of the market study a further potential preparatory step would be to develop a learning lab, giving financial institutions the chance to better understand the market opportunity, the drivers of bankability, and the likely needs of their prospective customers.
156. Given that immediate market opportunities may be modest, these initiatives may need to be one element within a wider program focused on increasing private sector financial flows for climate adaptation objectives, and extend beyond the water sector focus of the CAIP.

Enabling environment reforms

157. A fundamental prerequisite for unlocking maximum potential for private sector opportunities is to advance water pricing to incentivize resourcefulness, which would put a monetary value on water and stewardship initiatives in water use. At present, residential tariffs, where they exist, vary

²⁹ For example, one of the lessons from Department of Employment and Entrepreneurship loans (using RGoB budgetary resources) is that 1-year loan tenors are too short for start-ups. In future, the department is exploring the use of RGoB budgetary resources to provide more flexible financing to support start-up growth, but no decisions have yet been made.

from about Nu 1.2 to Nu 4.35 per cubic centimeter,³⁰ with commercial/institutional/industrial rates typically a little higher (especially in *thromdes* and for high consumption levels). On average, tariffs have not been updated in more than 10 years, and this has left prices significantly below the cost of water provision. There are three *dzongkhags* where there is no water pricing.³¹ Tariffs are also not imposed on irrigation water. Collectively, these pricing arrangements significantly undermine the current commercial rationale for investing in water efficiency (as well as complicating the water sector's financial sustainability). As such, these private sector opportunities are closely linked to the implementation of the publicly financed payment studies envisaged as part of the package. Any water pricing reform will be developed in a way that ensures the needs of the most vulnerable will continue to be protected, by considering both tariff design and the role of social protection. This reform also links closely to the enabling environment reforms discussed in relation to Package 8.

158. Various other reforms that could help accelerate private sector opportunities include:

- The establishment of a sovereign credit rating for Bhutan which will facilitate transparent pricing for any private sector lending activity. The Ministry of Finance is exploring this development.
- For RMA to explore whether current restrictions on commercial banks borrowing from external commercial sources might be relaxed.
- For the RMA to accelerate its work on supporting green finance in Bhutan (Box 8).
- For the DoEE to develop a formal entrepreneurship strategy to address key barriers facing all Bhutanese start-ups (including, but not limited to, those relevant to this package). These include ensuring access to testing facilities to allow firms to demonstrate their products meet international standards; the development of appropriate tax incentives to support start-ups, entrepreneurs, and prospective investors (potentially including preferential fiscal incentives for activities linked to climate and the environment); and addressing access to finance constraints.
- For the MoICE to advance work identified in the *Report on Business Regulatory Process Review*, which, with the support of the Bhutan Chamber of Commerce, identified a wide range of opportunities to create a more conducive environment for the private sector under the 13th plan. Although the report's sector recommendations do not focus explicitly on private sector opportunities related to water, its recommendations for improving the functioning of the Fiscal Incentives Act 2021 (simplifying administrative processes, monitoring effectiveness, and ensuring transparency) and for streamlining licensing and permit regulations, are very relevant to the private sector opportunities in this package.

³⁰ The exception is Paro, where residential tariffs increase to 30 Nu per cm³ for the most intensive consumers of water.

³¹ Data on tariffs from the Department of Water, Ministry of Energy and Natural Resources. On cost recovery, Financial Analysis. Bhutan: Water Flagship Program Support Project (ADB 2022b).

Box 8: Advancing Green Finance in Bhutan

The Royal Government of Bhutan has taken important steps to support green finance. In June 2022, the Royal Monetary Authority (RMA) developed a draft revision of the *Roadmap for Green Finance for Bhutan*, outlining potential actions to increase green finance flows. In April 2024, the Ministry of Finance published the *Green Taxonomy of Bhutan*, identifying climate-aligned activities to guide investment decisions. Although the taxonomy currently focuses on mitigation, expansion to adaptation is planned with ADB support. In the same year, Environmental and Social Risk Management guidelines were introduced.

However, green finance remains underprioritized, and gaps persist in the enabling environment. For example, commercial banks report limited understanding of green finance and uncertainty around how to apply the green taxonomy. There is now an opportunity to reinvigorate Bhutan's green finance agenda. Based on discussions with the RMA and commercial banks, potential actions include:

- Establishing a green finance committee within the RMA (reportedly planned as of April 2025) to lead initiatives and serve as a knowledge hub
- Supporting the development of dedicated green finance teams in commercial banks and building wider sector capacity
- Updating and implementing the green finance road map, potentially focusing on:
 - » Clarifying the taxonomy's role and application.
 - » Developing supportive policies, regulations, and guidelines (e.g., adjusting macroprudential rules or introducing fiscal incentives).
 - » Creating climate risk assessment and disclosure guidelines for banks, reflecting findings from the Environmental and Social Risk Management guidelines on links between climate and loan performance.
 - » Publishing data on green finance flows in Bhutan.
 - » Developing guidance for issuing green and sustainability-linked bonds.

These actions could generally support green finance flows in Bhutan as well as enhance the potential for private sector finance in relation to this package.

Source: RMA (2022), RGoB (2024b), RMA (2024).

Packages 2 and 3: Adaptation Policy and Planning/Research and Education

What are the packages?

159. This discussion combines financing models for two packages given the similarity in their plausible financial models and associated sources. These packages will allow the development of research and education assets such as a rainwater harvesting and treatment facility and a water research and services center. They also include operational activities such as the development and implementation of vocational training and strengthening the secretariat of the National Environment Commission (NEC). In combination, the expected costs of these activities amount to about \$10 million.

Balance between public and private sector

160. Many of these activities are expected to generate significant ‘positive externalities’ by increasing overall education and awareness around climate risks and adaptation solutions, including on optimal policies. Armed with this information, people will make choices that lower collective vulnerability (e.g., better land use, resilient infrastructure, disaster planning) reducing costs for society as a whole. In addition, there are strong equality grounds for ensuring widespread access to this information, education, and related services. As such, it is expected that activities within these packages will be largely publicly financed—i.e., they are in category D in Figure 11.

Public finance opportunities—instruments and specific opportunities

161. Some of the finance for these activities is expected to come from RGoB budgetary resources. Fiscal sustainability suggests that this should be focused on covering the operating costs associated with the activities in these packages.
162. The primary objective of these packages is to support climate adaptation. Following the framework in Figure 11, this implies a range of different technical assistance and grant-based resources from international partners may be available:
- The multilateral climate finance architecture frequently provides grant finance for activities related to climate change education, research and institutional strengthening. This can either be part of readiness funding or integrated into full projects. For example, the Green Climate Fund provided grant finance for a project implemented by KfW in Bangladesh to establish a national center of excellence for climate resilience infrastructure (GCF 2015). The Adaptation Fund—for which this investment package is an appropriate scale—would also be well suited for these activities, as would the new Accelerating Resilience Investments and Innovations for Sustainable Economies Program of the Climate Investment Funds.
 - The focus and size of this package also makes it well suited to support from bilateral development partners that have a particular focus on climate adaptation. For example, funding from the United Kingdom and the Danish International Development Agency helped establish the Nepal Climate Change Knowledge Management Center within the Nepal Academy of Science and Technology (weADAPT, undated).
 - IFIs could also enable this activity by drawing on trust fund resources to enhance the concessionality of their support, given its primary objective of climate adaptation. In line with several other packages, the adaptation thematic window of the ADF could be relevant, alongside the Japan Fund for Prosperous and Resilient Asia and the Pacific.
163. In relation to policy development, a further source of funding support could be international research and public policy grants, which might be accessed by the Centre for Climate Change and Environmental Law (at the Jigme Singye Wangchuck School of Law). This could be especially relevant for specific activities such as ‘Reviewing and revising policies and legislation for gaps and opportunities in effective integration and implementation of climate action’; setting up a monitoring and evaluation framework for the water sector; and conducting other policy-relevant and needs-based research for climate change adaptation.

Private sector financing models, opportunities, and precedents

164. In the short-term, the most likely role for private sector involvement in this package could be through ensuring that it contributes to the funding of some of the training schemes to help fiscal sustainability. This could be achieved through
- the introduction of earmarked training levies, either across the economy as a whole or within the sector that are expected to benefit from the additional training activities; or
 - requiring tuition fees as contributions from those who undertake training, where affordability can be demonstrated.
165. The development of these funding arrangements could, in the medium-term, facilitate a transition toward private companies providing training. However, this would rely on the development of sufficient knowledge and expertise on climate adaptation for a healthy ecosystem of alternative training providers to emerge, as well as complementary policy arrangements to ensure widespread inclusion.

Package 4: Flood Risk Management

What is the package?

166. This package mainly focuses on flood protection projects around the country. It has a total cost of about \$68 million, most of which are capital costs. These will provide benefits by avoiding losses associated with current climate variability and extremes, as well as future climate change, reducing risks to people and to infrastructure and other assets. Infrastructure service disruption, such as increased transport and travel times, caused by floods, and the associated loss/disruption of economic activity (businesses) are also reduced.

Balance between public and private sector

167. The cash flow characteristics of these activities—with the benefits extending to a wide range of people/assets that it is difficult or unattractive to exclude from benefiting—means that most of these investments will require public finance, i.e., they are in category D of the framework in Figure 11. The main exceptions would be:
- In a few cases, private companies may have an incentive to invest in flood protection if it protects their assets or activities, including their supply chain and workforce
 - Individual projects could be financed through PPP arrangements as discussed in relation to Package 8, although in this case revenues to the successful bidder would be through direct payments from RGoB, rather than through customers—as would (partly) be the case in relation to PPPs in the water sector.
168. In total, it is estimated that about 10% of this investment package might be financed from private sources depending on the extent of enabling environment reform.

Public finance opportunities—instruments and specific opportunities

169. The most common financing model for large scale investments will be sovereign investment loans (or grants) provided by IFIs. For example, ADB is providing about \$300 million in finance to the Philippines which, across three river basins, will support construction of flood protection infrastructure, as well as improvements to strategic flood risk management planning and strengthening community-based flood risk management (ADB, 2023).
170. The terms for this financing are likely to be more concessional, the more it can be demonstrated that the flood protection infrastructure is needed exclusively because of the expected impacts of climate change or because the flood protection infrastructure will protect people who are particularly vulnerable to climate change. The sources for concessionality would be the same as those for Package 8.
171. Smaller scale flood protection (such as infrastructure implemented by communities) is likely to be financed through grants, potentially supported by in-kind contributions from the beneficiary communities. Sources of this grant finance could come from the Adaptation Fund (especially its Locally Led Adaptation initiative), or the Local Climate Adaptive Living Facility (LoCAL) of the United Nations Capital Development Fund (UNCDF) and LDC Group's Initiative for Effective Adaptation and Resilience (LIFE-AR), as well as including bilateral partners or philanthropy.
172. As with Package 8, it may be attractive to use some of the proceeds from the sale of credits from the Bhutan Climate Fund as (effectively) a source of grant finance toward these activities. This will likely be most compelling if it is used to finance flood protection infrastructure in local communities where the activity that generates carbon credits is taking place.

Private sector financing models, opportunities, and precedents

173. PPP models can be suitable for large-scale infrastructure projects where it is possible to attract several private-sector bidders who will compete to find innovative solutions that lower the cost of delivering the project. This is more likely to be the case where project characteristics are well understood, reducing the performance risks that private sponsors of the project would face. However, especially in cases where multiple bidders do not compete for these contracts, there is a risk that projects structured and financed in this way can end up costing RGoB (and its taxpayers) more than conventional public financing. It is also important that the contractual provisions in these PPPs account for increasing climate risks. The Office of Markets Development and Public-Private Partnerships in ADB and similar offices in other MDBs can provide technical advisory support to ensure that PPPs are designed appropriately and offer good value-for-money.
174. Beyond this, there are likely to be limited opportunities for engaging the private sector in this package. A more plausible model for engaging the private sector would be using land-value capture mechanisms to help *fund* the investments. This will be relevant in cases where the development of flood protection significantly increases the value of privately owned land benefiting from the protection. Alternatively, higher value publicly owned land may subsequently be leased to the private sector at higher rates.

Enabling environment reforms

175. Advancing the use of PPP models would require the same enabling environment reforms identified in relation to Package 8.
176. The development of land value capture mechanisms would require reforms to the current legal and administrative framework as well as the development of technical capacity to demonstrate and measure the value of the land value increase. The implementation of these reforms would allow these funding mechanisms to also be used for infrastructure developments not directly related to climate adaptation.

Package 5: Urban Planning, Stormwater Management, and Green Infrastructure

What is the package?

177. This package focuses on reducing risks associated with stormwater and (urban) flooding. The total cost is estimated to be about \$225 million, with many of the individual activities within this package emphasizing the importance of nature-based solutions and ecosystem-based adaptations. This will be complemented by gray infrastructure solutions, as well as softer activities focused on the capacity development of engineers, urban planners and architects, such that they can better account for these risks when undertaking their day-to-day duties.

Balance between public and private sector

178. Globally, about 80% of nature-based-solution projects are financed from public sources (UNEP 2023b). This reflects that it can often be difficult to identify and isolate a specific group of beneficiaries who are willing and able to pay for the benefits provided by nature-based solutions in a way that is considered 'bankable' by potential private sector investors. Likewise, the gray infrastructure solutions and softer activities are also likely to be difficult to finance privately. As such, the bulk of the investment in this package will likely be derived from public sources.
179. At the same time, there is growing interest in private sector investment in nature-based solutions with studies suggesting that, globally, private sector investment in such solutions has grown by a factor of 11 in the 4 years to 2024 (Smith et al. 2024). This reflects growing awareness of the benefits available from investments in these opportunities, as well as greater awareness of risks private sector actors will face from a deterioration in nature and biodiversity. There is also the potential to adopt PPP models for some of the green and gray infrastructure projects envisaged in this package.
180. Given this, the analysis indicatively suggests that about 35% of the opportunities within this package might be possible to finance from private sources.
181. Furthermore, even in cases where *finance* is provided publicly, there may be opportunities for the private sector to provide the *funding* that allows for repayment of any finance. For example, there may be options to consider increasing the levies applied to international tourists when they enter/leave Bhutan. A further source of funding might be through leasing land/permit fees for ecotourism developments. In other cases, water users will benefit from the introduction of

nature-based solutions and it may be feasible for these beneficiaries to provide financial resources toward the activities. This can involve scaling up individual schemes that already exist in Bhutan. For example, in Dopshari Gewog, hoteliers and other installations pay for various nature-based solutions watershed management activities that help to ensure the protection of drinking water.

Public finance opportunities—instruments and specific opportunities

182. Many of the public financing opportunities are very similar to those for package 4 with concessional IFI lending being a key opportunity. However, the specific focus of this package means that some of the specific trust funds available to lower financing costs may be different. For example, within ADB, the Urban Environmental Infrastructure Fund may be particularly relevant. Likewise, the World Bank's Global Facility for Disaster Reduction and Recovery has a Global Program on Nature-Based Solutions for Climate Resilience, while the City Climate Finance GAP Fund, implemented by the World Bank and European Investment Bank, provides advisory and technical assistance for low-carbon and climate-resilient urban planning and projects, with a strong focus on nature-based solutions. The ADB's Nature Solutions Financing Hub—which has an explicit focus on project origination and pipeline development, innovative finance and capacity and policy development—could also provide this support.
183. In addition, several multilateral funds channel public finance through a range of implementing entities for nature-based solutions. Many of these are the same institutions as identified for other packages (GCF, Adaptation Fund and so on). In addition, the Global Environment Facility (including the Global Biodiversity Framework Fund) is particularly relevant for this package, while smaller scale funding is available from the Global Ecosystem Based Adaptation Fund managed by the IUCN.

Private sector financing models, opportunities, and precedents

184. As with Package 4, some of the discrete projects within this package could be financed through a PPP model. For example, the Chang'an River project in Guangdong Province, part of the growth of China's Sponge Cities, has been implemented through a PPP arrangement (Chan et al. 2022). The same advantages and disadvantages as discussed in relation to package 4 would also apply here.
185. In addition, smaller-scale private-sector financing of nature-based solutions could be implemented through scaling up Bhutan's existing payment for ecosystem services (PES) models, using these mechanisms to mobilize activity/investment by either local companies or civil society and local communities. Payments by water users might be complemented by carbon credit sales and hypothecated taxes (including those linked to tourism) and could be channeled to specific activities through a dedicated coordinating mechanism such as the Bhutan Trust Fund for Environmental Conservation. These financial resources could then be allocated to private companies or other entities, either as upfront finance or on a results-basis. This could be supported by the UNDP/GEF's Enhancing Climate Resilience of the Urban Landscapes and Communities in Thimphu-Paro Region of Bhutan (ECRUL) project which intends to develop/enhance a nature-based solutions accelerator program that will target support on communities, youth, women and vulnerable populations (UNDP/GEF 2025). Philanthropies such as The Nature Conservancy (TNC) also support these initiatives.

186. Further small-scale nature-based solutions consistent with this package might be encouraged through supporting individual building owners (households, hotels, offices) invest in green buildings such as green roofs, permeable paving, install rainwater harvesting, and the like. In these cases, households could source financing from retail banking loans or it could come from corporate finance sources.

Enabling environment reforms

187. In addition to improving the environment for PPPs, as discussed in relation to packages 2 and 3, other key enabling environment reforms to support this investment package include:
- Exploring the opportunities to offer fiscal incentives for the small-scale nature-based solutions and requiring new developments in areas at risk of flooding to include them.
 - Enhancing knowledge of nature-based solutions among real-estate developers, construction firms and other private developers, including of accreditation schemes.

Package 6: Disaster Management and Emergency Response

What is the package?

188. This package focuses on making sure that Bhutan is better prepared to respond to disasters. Specific activities include operationalizing the Multi-Hazards Risk Decisions Support System Training; providing capacity development to disaster management committees; developing a strategy for the protection of critical infrastructure; and awareness raising. This package accounts for a relatively small proportion of the total costs of the adaptation investment plan, at about \$20 million.

Balance between public and private sector

189. These activities will need to be publicly financed. It would be either technologically difficult or ethically undesirable to exclude people from benefiting from these investments, implying it will be difficult for the investments to generate revenues that would repay private investors. In other words, these activities are in category D in Figure 11.

Public finance opportunities—instruments and specific opportunities

190. Part of the financial resources for this package will likely come through an RGoB contribution. Given that the package largely consists of operating costs, it would be fiscally prudent for any RGoB contribution to be met by taxes/reallocation of existing budgets rather than through new borrowing. However, these resources will likely be insufficient to meet the full objectives of this package and there will be a need to draw upon international resources, which can also help to provide the expertise to overcome some of the technical/capacity barriers identified in this report.
191. Several multilateral initiatives provide grants/technical assistance to support countries in this area. These include the Fund for Responding to Loss and Damage and the Global Facility for Disaster Reduction and Recovery (administered by the World Bank). The United Nations Office for Disaster Risk Reduction also runs programs that explicitly target the focus of this investment package.

192. Several bilateral partners specialize in the themes covered by this adaptation package including Japan which has already supported programs related to this package and the EU.³²
193. IFI partners can also support this adaptation package, with the most common modality being through using trust fund resources to provide support for these activities, as a component of a larger operation. In the context of ADB, the Japan Fund for Prosperous and Resilient Asia and the Pacific and the adaptation and disaster risk reduction thematic window of the ADF are among the most likely sources of finance.

Private sector financing models, opportunities, and precedents

194. Given the strong public finance focus of these activities, these topics are less relevant for this package.

Package 7: National Climate Services and Early Warning Systems

What is the package?

195. This package focuses on strengthening and modernizing the provision of climate services with a total cost of just over \$60 million. Both the activities and financing models can be grouped into three components:
- Improving the underlying collection of data and research capacity. This is the largest component of the cost, estimated to be about \$50 million.
 - The development and provision of early warning systems (especially in eastern basins) and upgrading existing early warning systems for glacial lake outburst floods.
 - The provision of other weather and climate services, including probabilistic and sector forecasts.

Balance between public and private sector

196. Most of these activities will need to be publicly financed. It would be either technologically difficult or ethically undesirable to exclude people from benefiting from the services offered by these investments. This implies that it will be difficult for the investments to generate revenues to repay private investors. They are therefore in category D of the Figure 11 decision tree.
197. However, while most governments choose to ensure a ‘basic’ level of weather and climate services is provided using public finance, there is potential for the private sector to step in with ‘value-added’ services. This might include, for example, highly localized or frequently updated weather forecasts, seasonal climate outlooks, pest and disease risk alerts, planting and harvesting advice, irrigation scheduling, and so on. It might also include financial services such as parametric insurance or digital services related to sourcing high-quality inputs and market information. At present, this type of offering is not widespread in Bhutan, although companies such as Banglamark Shango demonstrate potential. As discussed below, the relative nascency of these types of firms—both in Bhutan and elsewhere—means that they are very likely to require some form of blended finance support, placing them in category C of Figure 11.

³² The EU funds the EU-South Asia Capacity Building for Disaster Risk Management Program, which is implemented by the Global Facility for Disaster Reduction and Recovery (GFDRR).

198. Given these considerations, it is provisionally estimated that around 5% of the costs associated with this package could be privately financed in future.

Public finance opportunities—instruments and specific opportunities

199. RGoB has already committed some budgetary resources to these activities. The optimal role for these resources is to support the operating costs associated with these activities, to ensure sustainability into the medium-term.
200. In addition, there are additional international sources of public finance available to support the expansion of observational and research activity:
- The Systematic Observations Financing Facility has already provided grant support to Bhutan to advance this agenda (Kuensel 2024). There may be opportunities to continue to access this financing source in future, although Bhutan's graduation from LDC status will make this more challenging.
 - Finance from IFIs typically makes some use of internally managed trust funds to enhance the concessionality of that finance. For example, in the case of ADB, the e-Asia and Knowledge Partnership Fund (EAKPF) could be a relevant source of concessional funds given its focus on digital and ICT technologies. The clear primary objective of supporting adaptation and disaster risk reduction would make these activities a strong candidate for support from this thematic window within the ADF.
201. In relation to the development of an early warning system (EWS), a wide variety of international public sources might be relevant:
- The Climate Resilience and Early Warning Systems (CREWS) initiative provides dedicated funding to support EWS development through various means. However, its primary focus is on LDCs and small island developing states, so access to this source may be threatened in future.
 - IFIs, with or without support from the multilateral climate finance architecture, also finance and support the development of weather and climate services. As with the development of the observational network, these activities are well aligned to the adaptation thematic window of the ADF. ADB is exploring the development of a new EWS facility to provide the inputs needed for identifying, developing, and implementing EWS investments (ADB, 2024e).
 - Other climate finance sources, such as the GCF, SCCF, GEF, the Adaptation Fund, and the Accelerating Resilience Investments and Innovations for Sustainable Economies Program of the Climate Investment Funds are also likely to provide grant or highly concessional finance to enhance climate and weather services and EWS.
 - Bilateral programs, such as the United Kingdom Met Office's WISER program, which expanded its geographic remit from sub-Saharan Africa to Asia and the Pacific in 2023.
 - Technical assistance support might be provided by GFDRR (as discussed in relation to Package 7) given its specific priority area of hydromet services and EWS.
202. It will be prudent to ensure the government budget allocates sufficient funding to allow for the ongoing operation of these EWS (which can often be as high as the capital costs over a typical 10-year lifetime (World Bank 2022b). However, as weather and climate services develop, some of these costs might be funded through selling data to others such as hydropower operators or farmers.

Private sector financing models, opportunities, and precedents

203. The financing models for private sector firms adding value from observation and forecast data will be different. Occasionally, these firms may be able to rely entirely on private finance. For instance, BharatAgri, received Series A finance from a range of venture finance investors, led by Capria Ventures, a venture capital firm focusing on the Global South (CAPRIA, 2023).
204. However, especially for the most nascent companies, there may be a need to draw on blended finance which is willing to absorb more risk or have somewhat lower return expectations or that can complement capital with the provision of capacity development/technical assistance to support firm growth. For instance, ADB Ventures SEED provides reimbursable grants to validate and de-risk pilots and promote expansion into frontier Developing Member Countries (DMC) markets that early-stage companies might otherwise not prioritize. A related option, under the ADB-managed High-Level Technology Fund is the 'Technology Innovation Challenge'. This offers competitively allocated grants to technology providers located in developing countries to advance innovative technologies and solutions, with climate change adaptation as a specified area of focus. Other financial instruments that could support the growth of private-sector offerings in this package include revenue-based finance (which allows repayments to flex with revenue growth) and convertible grants (where grants convert to debt or equity when predefined triggers are met).

Enabling environment reforms

205. A lack of digital access and digital literacy could act as a significant barrier to the success of this investment package. Both public and private-sector led investment to improve rural connectivity will help to address these challenges, as will ensuring that extension services cover basic digital literacy.

Package 8: Climate-Resilient Water Systems

What is the package?

206. Package 8 focuses on delivering climate resilient water system investments. This includes a set of planned improvements to water supply, transmission, distribution, and treatment in urban and rural systems. It also includes activities to reduce non-revenue water (i.e., water that is pumped and then lost or unaccounted for), which can also help increase water availability. It further includes technological improvements to help the performance of water distribution and allocation, as well as storage capacity.
207. The total cost of this adaptation package is estimated to be about \$159 million, making it one of the most expensive packages. The bulk of the costs are associated with a range of capital investments such as treatment plants and distribution networks, with the remaining costs associated with 'softer' measures to help reduce non-revenue water and develop climate-resilient water safety plans.

Balance between public and private sector

208. Conventionally in Bhutan—as in many other countries—these activities would be financed publicly, which places them in category D of Figure 11. This reflects a desire to retain public ownership of the water sector on the expectation that this is the most likely route to ensuring that as many households as possible can access piped water supply and sewerage services.
209. However, there are also various opportunities for engaging the private sector in water supply and sewerage services, as set out below. Models (a) to (c) may offer potential for improving the efficiency and management performance of the supply of water, but would not result in private capital supporting the financing of new infrastructure. Adoption of these models would require changes in the regulatory and enabling environment—i.e., they would fall into category B in Figure 11. By contrast, in models (d) to (g) private finance would support new and improved infrastructure assets and could well require supportive blended finance (category C in Figure 11).
- (a) **Service contracts.** Where private companies are hired for specific tasks such as billing or maintenance activities under short term (1–3 year) contracts.
 - (b) **Short-term management contracts.** Where private companies are responsible for managing water supply and sanitation assets and services, typically for 3–5 years, but do not undertake any investment. The private sector company receives its revenue from the public authority that provides the contract.
 - (c) **Leasing (affermage) contracts.** Water/sanitation assets are leased to the private sector company, which may pay a fee. The company then undertakes operating and maintenance activities and collects water charges for the lifetime of the lease contract (typically 5–8 years). The public sector remains responsible for all new capital investment.
 - (d) **Build-operate-transfer (BOT models).** A contract for a specific asset which the private sector designs, finances, operates and owns for a set period. During this time, the private sector actor will often receive payments directly from the public authority. At the end of the contract term, ownership for the assets transfers to the public sector.
 - (e) **Concession agreements.** A long-term contract (of about 20 years) between the public authority and a private sector company. During the contract's lifetime, the private sector company is responsible for all aspects of the water/sewerage system, including undertaking capital investment, and it collects tariffs from water users. However, the public sector retains ownership of the assets.
 - (f) **Joint ventures.** Public and private entities form a partnership, sharing all ownership and responsibilities. This is similar to the model Bhutan is using in the energy sector.
 - (g) **Full privatization.** The private sector owns and operates the entire water system.
210. At present, 100% of this package would likely be met through public finance sources. With enabling environment reforms, it may be plausible for 25%–30% to be met through private finance flows.

Public finance opportunities—instruments and specific opportunities

211. The most common financing model for this type of package would be an investment lending operation from an IFI, with the bulk of finance provided on generalized terms that the IFI would offer to a country at Bhutan's income level and degree of indebtedness. This reflects the broad-based development benefits that the package provides (regardless of future climate change).
212. Many IFIs would be able to use additional, more-concessional resources to support this investment package. For example, the Water Financing Partnership Facility supports ADB water sector investments, with its Pillar 1 providing complementary grants. Accessing this finance will require identifying the specific elements of the package that best align to the Facility's guiding principles of building resilience and adaptive capacity, promoting gender inclusiveness and gender equality, embracing environmental sustainability, improving governance, and fostering innovation and technological advancement (Water Financing Partnership Facility, 2024).
213. Further concessional resources will likely be available for those elements most clearly linked to delivering adaptation as their primary objective, either because they respond to changing climatic conditions or because they benefit people who are particularly climate vulnerable. This might include investments in innovative technologies such as rainwater harvesting. This additional climate finance might be sourced from resources managed by IFIs—for example, within ADB, the adaptation thematic window of the ADF—and externally managed resources such as from the Green Climate Fund (GCF), Special Climate Change Fund (SCCF), or the United Nations Capital Development Fund. Another option, depending on how it is designed, could be the Accelerating Resilience Investments and Innovations for Sustainable Economies Program of the Climate Investment Funds.
214. Regardless of the financing source, several complementary reforms could be made to enhance the effectiveness of investments. These are closely linked to some of the activities identified in Package 1. To reduce transaction costs, and in recognition of the thematic overlaps, financing for Package 8 could be combined with support for these types of reform in one of two ways:
 - Either the investment loan would be programmed alongside a complementary package of TA resources,
 - Or a sector development program could be considered.³³ This would combine an investment loan (relevant for this package) with a policy-based lending operation. In this case, a policy-based lending operation provides general budget support to public sector borrowers but this is only disbursed when the borrower completes policy reforms or actions that have been agreed with the lender.
215. Another potential source of finance to help reduce the need for loan finance would be to re-allocate some of the proceeds realized from the sale of carbon credits by the Bhutan Climate Fund (BCF). Since many carbon credit buyers want to be confident their purchases will benefit local communities, this source of finance could be particularly relevant for some of the rural water supply schemes within the package. Carbon credit proceeds might be complemented by grant finance from funds focused on local adaptation, such as LoCAL or LIFE-AR.

³³ This uses the ADB's language for this financial product. Other multilateral development banks offer similar products.

Private sector financing models, opportunities, and precedents

216. A decision on the appropriate role and model for private sector capital within the Bhutanese water sector requires a more detailed policy assessment than is possible within the CAIP process. Private sector engagement can be important for securing investments that would not otherwise be made, especially when competition between different private partners for a contract can encourage innovative approaches and cost reductions. On the other hand, in some cases the value of payments made to private contractors may be higher than the amount of direct public financing that would have been required, meaning that taxpayers bear additional costs in delivering the investment.
217. If there is a preference for engaging the private sector in financing large new infrastructure assets—i.e., models (d) to (g) on [paragraph 209]—then it may be that early experience could be gained from using the model (d) build-operate-transfer (BOT) model for specific assets and lessons learned from this process to consider wider opportunities for private sector engagement. This is the route that has been taken in Rwanda (Box 9).

Box 9: Kigali Bulk Water Supply Project: Engaging the Private Sector in Water Supply through BOT Contracts

The Kigali Bulk Water Supply Project is Rwanda's first major water public–private partnership (PPP), and a pioneering example of how private sector engagement can deliver climate-resilient water infrastructure. Developed under a 27-year build-operate-transfer (BOT) agreement between the Government of Rwanda and Kigali Water Limited (a subsidiary of Metito), the project includes the design, financing, construction, and operation of a 40,000 m³/day water treatment plant serving over 500,000 people in Kigali and surrounding areas.

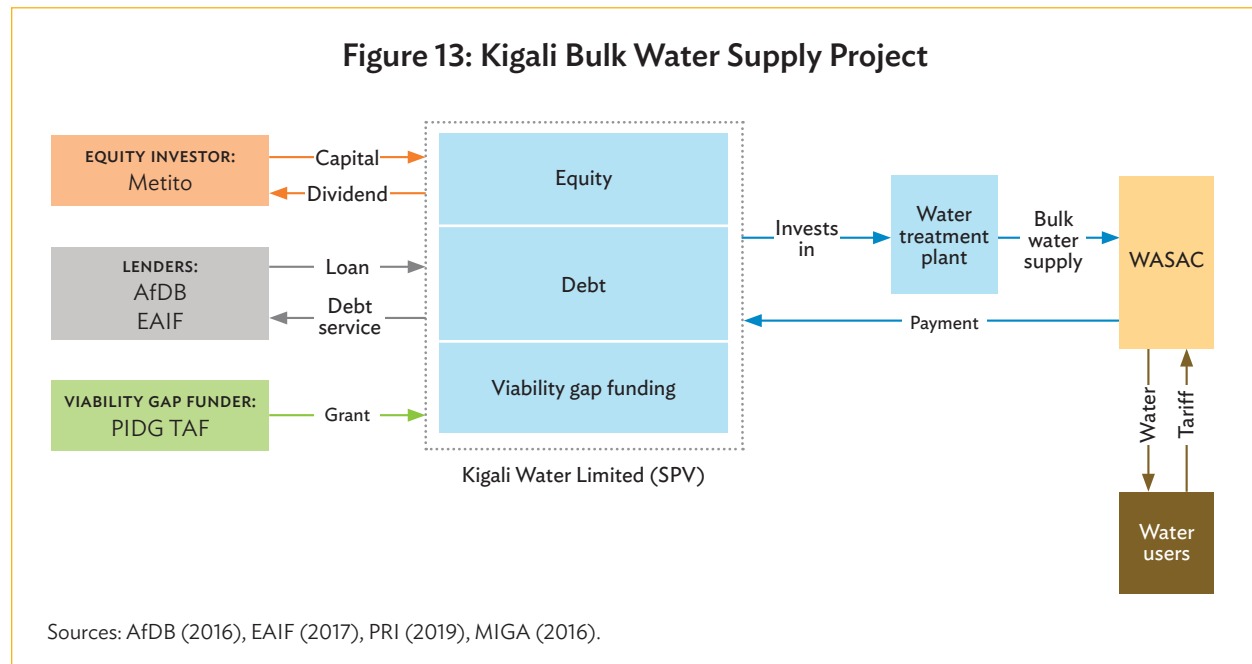
The finance for the project comes from a range of sources:

- Private Equity Investment: Metito, through its subsidiary Kigali Water Limited (KWL), contributed equity financing to the project
- Debt Financing: The Emerging Africa Infrastructure Fund (EAIF) and the African Development Bank (AfDB) provided senior debt facilities.
- Viability Gap Funding: To enhance project bankability and ensure affordable water tariffs, the Private Infrastructure Development Group's Technical Assistance Facility (PIDG TAF) provided a \$6.25 million grant. This was critical in reducing the capital cost, thereby lowering the tariff that needed to be collected from water users
- Risk Mitigation: The Multilateral Investment Guarantee Agency (MIGA) issued guarantees totaling approximately \$9.97 million. These guarantees cover against risks such as transfer restriction, expropriation, war and civil disturbance, and breach of contract.

Rwanda's national utility WASAC (Water and Sanitation Corporation), entered into a 25-year take-or-pay contract with Kigali Water Limited (KWL), the private operator. At the end of the contract, the facility will be transferred to public ownership.

Sources: AfDB (2016), EAIF (2017), PRI (2019), MIGA (2016).

Figure 13 illustrates key elements of these arrangements.



218. This financing model could tap the small but growing interest among private investors interested in water infrastructure assets, such as the Meridiam Sustainable Water and Waste Fund. There are also publicly financed vehicles looking to mobilize private investors to invest in climate resilient water supply, including by absorbing additional risks (Climate Investor Two is an example) or by supporting project preparation and providing viability gap financing, such as the GCF-IFC Scaling Resilient Water Infrastructure Facility (GCF 2024).
219. In addition, for some specific rural and urban investments within the package, and regardless of whether they are financed by the public or private sector, there may be potential to use carbon market revenues as an additional source of funding to make the investment more financially viable. Carbon market revenues are being used in this way for drinking water projects in Pakistan (Box 10).

Box 10: Using Carbon Market Revenues to Make Water Sector Projects More Financially Viable

Republic of Korea-based ATR Inc., in partnership with the Punjab Saaf Pani Authority—a government agency responsible for installing and operating water filtration plants in Pakistan’s Punjab province—has secured a Host Country Approval (HCA) for a water filtration project under Article 6.4 of the Paris Agreement.

The project entails the deployment of 250 advanced water filtration units between 2026 and 2035 and is expected to deliver potable water to over 4 million residents.

By removing the need for boiling water, the initiative is projected to yield 1.5 million tonnes of CO₂ emission reductions as internationally tradable Article 6.4 Emission Reductions (A6.4ERs).

Source: Carbon Units (2025).

Enabling environment reforms

220. Regardless of the balance between public and private finance used to take this package forward, there are some critical reforms to the organization and management of the water sector that could help enhance the effectiveness of this package. Box 11 discusses these in more detail.

Box 11: Enhancing the Effectiveness of Investment in Climate-Resilient Water Systems

Investing in climate-resilient water and sewerage systems offers strong returns, with economic internal rates of return typically about 10%–20%. However, Bhutan's current water sector setup may not fully capture these benefits—especially over the long term. Two key challenges stand out:

- As noted above, current water pricing does not cover full operations and maintenance costs. This weakens incentives for efficiency, undermines network maintenance, and threatens the financial sustainability of future investments.
- Daily management is left to *dzongkhags* and *thromdes*, which limits access to skilled staff, creates bureaucratic inefficiencies, and results in uneven service standards. It also makes transitioning to financial sustainability harder to achieve.

Addressing these challenges requires establishing payment mechanisms and revising the 2011 Water Policy and vision. Drawing on international models (e.g., Israel, Namibia, Uganda), a three-part reform approach could include:

- **Ring-fenced utilities.** Establishing operationally independent municipal corporations for water services, with the possibility of a separate corporatized entity for bulk supply. This would centralize expertise and improve focus. Consolidation across utilities could also drive efficiencies.
- **Independent oversight.** Creating a nongovernment body to oversee sector development and regulate tariffs and performance. This separates day-to-day pricing decisions from political influence, while maintaining government control over strategic direction.
- **Cost recovery.** Moving toward cost-reflective tariffs across water, sewerage, and irrigation, using tariff design and social protection measures to limit negative impacts on low-income users.

Sources: World Bank (2017); Ndokosho, Zvikomborero, and Makurira (2007); and Watasa (2009).

221. Additional enabling environment reforms will be needed to open up these private sector financing opportunities. Key reforms include:
- The planned update to foreign direct investment rules will need to be expedited.
 - MoICE reports that complementary liberalization of immigration rules could help improve flows of foreign direct investment.
 - MoICE also identifies the importance of further reforms to enhance the use of BOT and other PPP models. This includes the importance of streamlining approval through clear guidelines and online platforms, strengthening government capacity through training and specialized units, and fostering public awareness.

- Furthermore, the use of PPP models for long-lived infrastructure that is subject to climate risks—such as for water supply—requires further specialized inputs to ensure the climate resilience benefits they offer are maximized. Inputs include, for example, contractor expertise in promoting climate resilience in the bid evaluation process (both prequalification and tendering); the need for output/performance standards about how well the contractor performs in the aftermath of a climate-related hazard; requiring bidders to prepare disaster and climate response plans; and ensuring there is clarity on force majeure clauses related to climate events. Several international partners, such as ADB's Office of Markets Development and Public Private Partnership, are available to support implementation of these reforms.
222. This package also includes sewerage systems. These can be taken forward using the same financing models as for climate resilient water supply. Hence, they are likely to be largely financed through conventional IFI financing, but with some potential for securing private finance if contractually secure funding is put in place. It will be crucial to ensure that any infrastructure investment is supported by a climate risk assessment and that, as necessary, climate risk allowances are built into the design. This will be undertaken as a matter of course if these investments are financed by IFIs. However, there may be scope to include complementary technical assistance in any IFI program to embed these approaches both within broader public investment management processes and the national codes and standards that govern infrastructure development.

Other water supply and demand investment packages

223. Potential financial arrangements for the remaining packages identified in the CAIP process are summarized here. Given these have opportunities to seek financing from other (non-adaptation) sources, a higher-level discussion is provided.
224. **Package 9, Forestry.** Historically, forestry activities in Bhutan have been financed publicly. The financing arrangements that RGoB is already exploring in relation to the Bhutan for Life initiative—which is seeking to generate \$25 million of domestic funding for conservation activities—will also be relevant. However, especially in relation to afforestation/ reforestation and plantations, private finance could be attracted to the revenue that can be realized from the sale of carbon credit and timber. This includes public and philanthropic investors who are willing to absorb more risk and accept lower returns (e.g., Mirova Climate Fund for Nature, TNC's NatureVest, or IUCN's Nature+Accelerator Fund). Private capital flows into these opportunities may require additional clarity on land tenure and the liberalization of exports of plantation timber (while complying with strict guidance to maintain the environmental integrity of forest-based activities).
225. **Package 10, Energy projects** (hydroelectricity). Some projects may be advanced through the conventional model of bilateral loans from India, whereas some IFIs are active in this sector, including ADB and the World Bank. However, opportunities also exist to attract private sector capital. At present, this is through a joint venture modality, where private companies can assume up to a 49% stake in specific project finance structures. For example, the 126 MW Dagachu Hydropower Project was developed as a joint venture between Druk Green Power Corporation (59%), Tata Power (26%), and Bhutan's National Pension and Provident Fund (15%). In the future, there may be opportunities to further liberalize the power sector by opening up the possibility for majority private ownership of assets, potentially starting at lower capacity projects to build familiarity with the model. The success of this will depend on the establishment of credible power

purchase agreements, which may require support through guarantees provided by IFIs. In addition, there may be a potential to leverage carbon finance through the Bhutan Climate Fund. This could serve as either a direct source of financing if the carbon credits are purchased in advance, or as a supplementary funding mechanism if the credits are bought only as they are generated. If the hydro plants can demonstrate clear adaptation benefits, such as facilitating water storage, they may also be able to sell Adaptation Benefit Units as an additional means of monetizing project impacts. However, that mechanism remains nascent with demand for units very unclear. All hydroelectric plants should benefit from the climate risk assessment and the development of climate risk allowances plus efforts to improve the resilience of operations to changing inflows and water/energy demands.

226. Package 11, Irrigation. Large scale irrigation finance is likely to be financed using IFI loans, with the expectation that the increased crop yields that this program supports will generate additional economic activity and hence tax revenues. Funding can be further bolstered by charging arrangements for irrigation water abstraction. As with the other packages, more concessional finance might be blended with these loans where it can be demonstrated that the investment has the primary objective of responding to risks from climate change. Potential sources for this more concessional finance could include the adaptation thematic window of ADF14, or external sources of climate finance such as the Green Climate Fund. There is greater scope to explore private finance solutions for smaller-scale irrigation solutions—such as drip irrigation or solar water pumps—making use of the same financing models discussed in relation to private sector opportunities in the IWRM package.

227. Table 7 summarizes the key financing and funding opportunities across each of the packages, exploring both private and public finance potential. Some of the key overarching insights provided by the table include:

- With supportive reforms to the enabling environment, there are significant opportunities the mobilizing private sector finance. While, at present, it is estimated that less than 10% of the identified investment needs might be met by the private sector, this could increase to 25%–33% with the appropriate reforms. Eight out of the eleven investment packages provide private sector opportunities.
- To realize this potential, some of the enabling environment reforms that will need to be prioritized include moving toward more rational water pricing, accelerated green finance reform, and regulatory reform to support innovative funding models (e.g., land value capture and payment for ecosystem services).
- A range of blended finance models will also likely be required, including concessional credit lines, returnable grants/patient equity, and guarantee structures.
- PPPs will also play important role in efforts to scale up private finance flows (especially in the water sector, flood management, and urban stormwater management). These will need to be carefully assessed to ensure they offer good value for money, and the contractual provisions will need to account for increasing climate risks.
- At the same time, public finance will still account for the significant majority of the total financing needs of the packages. Some of this may come from domestic sources, but the bulk will likely need to come from the international community. It will be easiest to attract the most heavily concessional finance for those elements of the packages for which adaptation is the primary objective.

Table 7: Potential Finance Models and Sources of Finance for Adaptation Investment Packages

Package	Potential private/blended finance models and sources	Potential public finance models and sources
IWRM and planning		
1. IWRM	Water storage, water ventures, water-efficient technologies all have the potential to attract private finance, likely using blended finance. Where cash flows are relatively stable this may be a concessional credit line facility; for high-risk (startups) patient equity or returnable grants are more appropriate. Credit lines could be sourced through international financial institutions (IFIs) who could make use of concessional climate finance to ensure terms are sufficiently attractive. Reimbursable grants may be sourced from ADB Ventures, private sector window of ADB's Asian Development Fund (ADF), or domestically from the Economic Stimulus Plan. These models can be facilitated through ongoing green finance reforms including taxonomy development, climate risk assessment, disclosure guidelines, and so on.	Budgetary resources plus TA grants or as a component in larger policy-based or investment loans from IFIs. TA resources might be source from ADB-managed Water Financing Partnership Facility or Japan Fund for Prosperous and Resilient Asia and the Pacific or bilateral partners such as the European Union (EU), the Danish International Development Agency, and the Japan International Cooperation Agency (JICA). Dedicated providers of concessional climate finance providers e.g., the Green Climate Fund (GCF), the Special Climate Change Fund (SCCF), the Adaptation Fund, and the Global Environment Facility (GEF).
2 and 3. Adaptation policy and planning/ Research and education	Potential use of training levies or fees to enhance funding sustainability might facilitate a transition toward private sector provision of training in the medium term.	Domestic public budgets to cover operating costs plus, for expansion, international public finance (grants or highly concessional loans) from international climate finance from multilateral sources such as GCF, the Adaptation Fund, and GEF, or bilateral—e.g., JICA, EU, or IFIs, most likely using trust funds such as those within ADB—e.g., the ADF or Japan Fund for Prosperous and Resilient Asia and the Pacific. Some scope for international academic resourcing opportunities.
Addressing water-induced disasters		
4. Flood risk management	Where it offers good value for money, and climate risks have been reflected in contractual provisions, potential for a public-private partnership (PPP) model for specific assets, with credit enhancement and other forms of blended finance. Potential to explore land value capture mechanisms as funding mechanism to support sustainability.	For large scale investments, IFI finance with additional internally or externally managed climate finance for infrastructure that is needed exclusively because of the expected impacts of climate change or to protect the most climate vulnerable. In these cases, relevant climate finance resources include ADF or external resources from GCF, SCCF, United Nations Capital Development Fund (UNCDF), or the new Accelerating Resilience Investments and Innovations for Sustainable Economic Program of the Climate Investment Funds (CIF), depending on the design. For smaller (rural) investments, Adaptation Fund (especially Locally Led Adaptation Initiative), LoCAL (UNCDF), LIFE-AR (LDC Group), bilateral partners (e.g., EU, JICA), GCF, and SCCF.

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Table 7 *continued*

Package	Potential private/blended finance models and sources	Potential public finance models and sources
5. Urban planning, stormwater management (including nature-based solutions and EBA)	Potential of a PPP model for specific assets, with credit enhancement and other forms of blended finance. (As with Package 4, there is a need to ensure models represent value for money and account for climate risks.) Scale up of Payments for Ecosystem Services models, with payments by water users complemented by carbon credit sales and hypothecated taxes, potentially channeled through centralized mechanism—e.g., the Bhutan Trust Fund for Environmental Conservation—and provided to (private-sector) implementers on an upfront or results basis. Bank finance and existing balance sheet resources to support individual building owners to implement small scale nature-based solutions. Ongoing fiscal incentives may be required.	For large scale investments, IFI finance with additional internally or externally managed climate finance. Relevant climate finance sources include the ADF (ADB), Urban Environmental Infrastructure Fund (ADB), prospective Nature Solutions Financing Hub (ADB), Global Facility for Disaster Reduction and Recovery (World Bank), GAP Fund (World Bank and European Investment Bank). Nature Solutions Financing Hub, GFDRR, and GAP focus on advisory and technical assistance. Multilateral climate finance funds including GEF, GCF, Adaptation Fund, Global Ecosystem Based Adaptation Fund (small scale).
6. Disaster Management and Emergency Response	Primarily public finance.	Grant and technical assistance resources from dedicated multilateral actors working on this theme—e.g., GFDRR and UNDRR. Bilateral partners providing grants and technical assistance—e.g., JICA, EU. IFIs, often making use of internally managed trust fund resources to provide grants or highly concessional loans—e.g., for ADB, relevant trust funds including Japan Fund for Prosperous and Resilient Asia and the Pacific and the Adaptation and Disaster Risk Reduction thematic window of the ADF.
7. National Climate Services and Early Warning Systems	Value-added services: Some scope for private finance—predicated on a funding model where data can be sold to users—but likely need for blended finance that is willing to absorb more risk/has lower return expectation. Sources of blended finance might include ADB Ventures, private sector window of the ADF, GSMA Innovation Fund, High Level Technology Fund (managed by ADB). Need for complementary investments in digital literacy.	Observation facilities: Domestic public budgets (for ongoing costs) plus, to support scale up, international public finance on grant or highly concessional terms (as adaptation/disaster risk reduction is the primary objective)—e.g., the UN's Systematic Observations Financing Facility (SOFF), the Climate Risk and Early Warning Systems Initiative (CREWS), and the Adaptation thematic window of the ADF. EWS and basic WCS: Domestic public budgets (for ongoing costs) plus, to support scale up, international public finance on grant or highly concessional terms (as adaptation/disaster risk reduction as primary objective) e.g., CREWS, adaptation thematic window of ADF, bilateral partners (e.g., Indonesia) and dedicated financing support—e.g., the GSMA Innovation Fund. Potential to enhance fiscal sustainability through sale of data.

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Table 7 continued

Package	Potential private/blended finance models and sources	Potential public finance models and sources
Water supply and demand		
8. Climate resilient water and sewerage systems	Public-private partnerships using blended finance related to specific assets e.g., build-operate-transfer models with credit enhancement and other forms of blended finance to help secure private investment flows, while keeping water tariffs affordable. Need to ensure offers good value for money and account for climate risks. Guarantees from private sector window of the Asian Development Fund; blended finance vehicles such as Climate Investor Two and Green Climate Fund-International Finance Corporation's Scaling Resilient Water Infrastructure Facility.	Conventional IFI finance with additional internally or externally managed climate finance resources for specific elements related to adaptation or other policy objectives. Concessional resources could be sourced from Water Financing Partnership Facility or the Asian Development Fund (of the ADB) or externally managed sources such as GCF, GEF, UNCDF, new Accelerating Resilience Investments and Innovations for Sustainable Economies Program of the CIF (depending on design). For rural water supply, use of proceeds from sales of credits from BCF (any sector, including the water sector), potentially supported by Adaptation Fund (especially Locally Led Adaptation Initiative), LoCAL (UNCDF), LIFE-AR (LDC Group).
9. Forestry	Some potential to attract private sector finance through timber and carbon credit sales. May require blended finance from philanthropic investors to absorb risks or support returns—e.g., Mirova Climate Fund for Nature, TNC's NatureVest, IUCN's Nature+ Accelerator Fund.	Domestic public financing models that are being explored by Bhutan for Life.
10. Energy (hydro)	Private finance through existing Joint Venture modality in the short-term, with possibility of allowing for majority private finance within (some) projects in future. The latter may depend on contractually secure power purchase agreements being established, possibly supported by IFI guarantees. Potential funding stream through the sale of carbon credits in the Bhutan Climate Fund.	Public sector loans, such as from Government of India or IFIs like ADB and the World Bank.
11. Agricultural Irrigation	Concessional credit line model for smaller scale irrigation solutions—e.g., solar water pumps, drip irrigation (integrated into Package 1 model).	For large scale irrigation investment, IFI finance with additional internally or externally managed climate finance (for those elements where it can be demonstrated that adaptation is a primary objective). Within ADB, internally managed concessional resources from adaptation thematic window of the Asian Development Fund. External resources: GCF, SCCF, GEF, new Accelerating Resilience Investments and Innovations for Sustainable Economies Program of the CIF.

7 Enabling Factors and Next Steps

Key Messages

- Adaptation can often be hindered by barriers and constraints. These can be overcome with enabling factors that can help strengthen the planning, implementation, and financing of adaptation. The CAIP has identified the key enabling factors.
- First, capacity building and institutional strengthening. Detailed capacity building and training activities are included for each package (and costed), alongside broader strengthening of adaptation investment planning for relevant ministries and departments. Second, opportunities exist to improve cross-sector working and coordination, building on the integrated approach used to develop this investment plan. Third, policies and reforms could make financing of the water adaptation investment plan more sustainable. This includes water pricing reform to support financial stability and stronger incentives to conserve water.
- Other supporting activities would help ensure delivery and implementation of the plan. This includes the socialization of the plan with potential funders and financiers, as well as internally across RGoB. Also, the need exists to establish governance arrangements to take the plan forward and commit resources for next steps. Implementation of the plan would also benefit from a more harmonized development partner support. An initial mapping of current and future support to the water sector of Bhutan has been undertaken. This reveals that there is already considerable investment in the packages in this plan, but also opportunities for improved coordination among the development partners.
- Finally, the activities and packages in the CAIP could be linked to the development of the Bhutan Climate Fund. At its simplest, proceeds from the carbon credits from the fund could support the adaptation investment packages. However, there may be greater opportunity from developing a more explicit adaptation component of the fund. This could include a centralized unit and country platform to coordinate and harmonize adaptation finance activities, a preparation facility to develop opportunities, and a domestic adaptation fund, drawing on successful examples of such activities from other countries. This would enhance ownership and coordination, build capacity, and increase mobilization of external resources for climate adaptation behind a unified set of country-led priorities.

228. Various economic, political economy and governance barriers and constraints can hinder the planning, implementation, and financing of adaptation. These can arise from information, market, policy, and governance failures—which can be potentially overcome with enabling factors.

229. The NAP Global Network identifies six enabling factors for adaptation (NAP Global Network 2023). These are: (a) leadership, (b) institutional arrangements, (c) engagement, (d) data, knowledge, and communications, (e) skills and capacities, and (f) financing. Similarly, recent systematic review of enabling factors (Brullo et al. 2024) highlight that some factors are particularly important. These include proactive leaders, awareness of climate risks, and adaptation knowledge, coordination, institutional support, social capital, and communication (as well as finance).
230. There are also complementary conditions that can create the enabling environment for adaptation, including for finance (OECD 2024). These include planning, policy, and regulatory actions or reforms. Examples include providing regulatory incentives or removing distorting subsidies; updating technical codes and standards; integrating economic regulation; altering allocation or charging retimes, and so on. They can also include support for private investment, such as targeted incentives, intellectual property frameworks, adaptation taxonomies, and support for project development.
231. The CAIP considered three types of enabling factors and conditions that are critical for Bhutan:
- Capacity building and institutional strengthening.
 - Coordination.
 - Policies and regulatory reforms, especially for unlocking finance.
232. The first enabling factor is around capacity building and institutional strengthening. It is critical to ensure these capacity building activities (and the costs to deliver these) are included in the overall investment plan. Such investments will, in turn, deliver benefits by increasing the efficiency and effectiveness of adaptation implementation (LSE 2016).
233. There are various capacity building and training activities included in each of the packages (Box 12). However, there is also a need for broader capacity building across relevant ministries and departments, and in all aspects of adaptation investment planning. Capacity building will also be required in the concepts, planning, and implementation of adaptive management. Government training could be taken forward through the Academic Institutions or Professional Development Centre or the Royal Institute for Governance and Strategic Studies. A focus on capacity building and institutional strengthening will be critical to ensuring that climate resilience is embedded across core functions and mainstreamed into development planning in the water and disaster risk management sectors.
234. There is also a need to integrate the adaptation investment packages into the *Fourteenth Five Year Plan* (which will likely span July 2029 to June 2034). This will require capacity and support.
235. The second enabling factor is to ensure improved cross-sector working and coordination by building on the integrated approach used to develop this investment plan. The implementation of the plan and the delivery of finance at scale will require associated changes in approach. This will involve moving away from a focus on individual projects, toward a more holistic and programmatic approach that seeks to take the packages forward. This will be particularly important in advancing the overall set of water sector investments. This might be advanced through a strategic governance function for the water sector.

Box 12: Examples of Training and Capacity/Policy Activities Identified

- Training of water engineers on the “planning, designing, and implementation of the climate resilient water infrastructure.”
- Assessment studies of “non-revenue water.”
- Digitization of water supply systems for selected schemes under the four *thromdes*.
- Develop or update Guidelines/SOPs/Standards/Specifications related to water infrastructure including sensitization to the relevant stakeholders and communities.
- Preparation of guidelines/standards—infrastructure planning and design of flood disaster adaptation/mitigation measures.
- Capacity development of engineers, urban planners, architects and GIS officers in climate resilience/adaptive (nature-based) planning, designing, digitization, and implementation
- Green building codes for stormwater management.
- Smart water meter including improvement of Water Billing System and Software.
- Capacity building for all engineers and technicians involved in water and wastewater management.
- Institutional strengthening and capacity building for irrigation planning and developing Irrigation Information Management Systems.
- Enhancing Water Distribution network system (CST) incorporating ICT.
- Development of water resources engineering laboratory/Water Research and Services Center.
- Curriculum review and program accreditation for water and climate.
- Establish National Weather and Flood Warning Center and Scientific Facilities.
- Set up a functional multisector disaster response team/community-based.
- Operationalization of Multi-Hazard Risk Decision Support System (MHRDSS).
- Establish training props, coordinate SAR training, and purchase equipment
- Capacity development of disaster management committees and LGs.
- Conduct public education and awareness on disaster risk management.
- Review and revise policies and legislation for gaps and opportunities in effective integration and implementation of climate action.
- Strengthen the National Environment Commission Secretariat (CCD/DECC) in supporting the NCCC (human resources, training, resources).
- Set up a monitoring and evaluation framework for the water sector along the lines of the Bhutan Water Security Index.
- Development of climate change learning module and curriculum—Vocational Education Curriculum Development for Climate Mitigation and Adaptation.
- Establish payment mechanisms for water services and explore investment opportunities.
- Assess climate vulnerability and risk for priority water sectors and develop climate-resilient water infrastructure guidelines.
- Explore and assess possible avenues for abstraction for conjunctive use in the surface water-scarce areas.
- Promote and adopt emerging water-efficient and innovative technologies.
- Revise the water policy and vision 2008, and the Water Act 2011.
- Strengthening and upscaling Payment for Ecosystem Services (review of framework and field guide).

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Box 12 continued

- Enhancing capacity of key stakeholders in managing the impacts of climate change on water.
- Conduct forest fire prevention awareness campaigns and coordination meetings/conduct capacity building for forest officials on fire management practices, suppression principles, and investigative skills.
- Application of nature-based solutions for climate adaptative approaches.
- Develop national climate vulnerability indicators for resilience measurement.
- Design a National Climate Vulnerability Map.

Source: Authors.

236. The third set of enabling factors is around planning and policy reforms. These can also include incentives. The potential for additional policy reforms that can especially help with financing have also been considered for each of the packages, along with some promising areas with have potential to be considered as part of policy-based lending approaches (Table 8).

Table 8: Potential Enabling Factors

Package	Possible enabling factors
Cross-cutting	Advancing Bhutan's public financial management to make this increasingly climate responsive, as outlined in the <i>PFM Reform Strategy and Action Plan</i> and building on the findings of the Climate PEFA. Explore the development of a project preparation facility that can help prepare projects to attract public or private finance. Thus, the facility could support all climate adaptation investments, not just the water sector. Update and implement the <i>Roadmap for Green Finance in Bhutan</i> (including clarifying purpose of and expanding sector of green finance taxonomy, consideration of adjustment to macroprudential rules, guidelines for climate risk assessment and publishing data on green finance flows). Development and implementation of Entrepreneurship Strategy. Advance the work identified in the <i>Report on Business Regulatory Process Review</i> to establish a more conducive environment for the private sector Foreign Direct Investment—expedite planned update to policy and consider whether complementary reforms related to immigration (as identified in Ministry of Industry Commerce and Employment analysis).
1. IWRM	Expansion of water pricing models to incentivize water efficiency (also relevant for Climate Resilient Water Supply).
2. Adaptation policy	See cross cutting activities above.
3. Research and education	Explore and develop levy/fee-based mechanisms to make vocational education more sustainable (applies beyond CAIP).
4. Flood risk management	Develop necessary legal and administrative framework and skills/technology to robustly apply land value capture finance mechanisms.

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Table 8 *continued*

Package	Possible enabling factors
5. Urban stormwater management and green infrastructure	Expand water pricing to support watershed management. Explore domestic fiscal sources that could fund/finance scale up of Payment for Ecosystem Service models (e.g., increasing taxes on international travelers or leasing/permitting arrangements in relation to ecotourism).
6. Disaster Management and Emergency Response	Continue capacity building and development, to ensure arrangements and initiatives are sustainable.
7. Weather and Climate Service	Enhance digital access and digital literacy, including awareness raising and training for the private sector, as well as increased connectivity.
8. Climate resilient water supply	Review organizational and governance structure of the water sector to consider corporatization and the establishment of a nongovernment body to guide sector development and regulate tariffs and performance (and support the move to cost recovery).
9. Forestry	Examine opportunities to increase clarity on land tenure.
10. Energy	Explore the possibility of increasing private participation in electricity generation (potentially for assets below a certain capacity in the first instance).
11. Agriculture irrigation	Ensure water use for irrigation is subject to appropriate pricing incentives.

237. The most important opportunities include water pricing reform (taking care to protect the needs of the most vulnerable); land value capture mechanisms to fund flood defense; scope for selling weather and climate service data/forecasts; and mechanisms based on levies or fees to make vocational education more sustainable. It would also be useful to further develop the regulatory incentives for climate-resilient infrastructure.
238. Other activities are also needed to ensure the delivery and implementation of this adaptation investment planning process (and the opportunities it has identified). This includes the socialization of the plan with potential funders and financiers—including with global climate funds—and bilateral and multilateral development partners active in Bhutan. This would ensure the plan becomes the primary document and basis for mobilizing climate finance for the water sector. It would also include the internal socialization of the plan across RGoB.
239. There will also be a need to set up governance arrangements that take the plan forward and to commit resources for the next steps. These activities would benefit significantly from continued development partner support (from ADB or others). Support could include continued technical assistance, ideally with an embedded TA function, as well as an adaptation project preparation facility. A monitoring and evaluation framework for the CAIP would also help ensure delivery.
240. To support this, an initial mapping of the current ADB portfolio, as well as the future ADB pipeline, is included in this report, presented in Table 9. This reveals that some of the identified investments are already being supported or that there are plans to support them, but also that there are opportunities for improved coordination and integration among the development partners to deliver adaptation at scale into the water sector.

241. Finally, the actions to take forward the CAIP and replicate to other sectors could be linked to the development of the BCF. At the simplest level, proceeds of carbon credits from the fund could support the adaptation investment packages. For example, providing government finance that could leverage broader adaptation finance.
242. However, developing a more explicit adaptation component of the BCF may present a greater opportunity. This could include a centralized unit to coordinate and harmonize adaptation finance activities, including a project/investment preparation facility for developing programmatic and project opportunities. This could even extend to a domestic adaptation fund with fund management capabilities. Successful examples of these types of activity include the Rwanda Green Fund.³⁴ This has set up and capitalized a dedicated national fund, set up public and private project preparation facilities, and leveraged adaptation finance at scale (from bilateral development partners, climate funds, and MDBs), and the Ethiopia Climate Resilient Green Economy facility.³⁵ Linked to this, examples are now emerging of coordination facilities, often termed ‘country platforms’, such as the new, ADB-supported Bangladesh Climate and Development Platform.³⁶ These can take forward the development of programmatic investment as part of a structured and harmonized approach that includes high government ownership backed up by coordinated development partner support, building on international success stories for such approaches (Gul et al. 2025).

Table 9: Mapping of Development Partner Landscape for Climate Adaptation Plan Packages

Investment Packages	Portfolio / Ongoing / Current	Pipeline
Integrated Water Resources Management (IWRM)	Climate-Resilient Omchhu River Basin Project (ADB)	Securing Water and Enhancing Climate Resilience in Thimphu (Rural District) (AF)
	Scaling and Strengthening Spring Shed Management in Bhutan (ICIMOD)	Climate Resilient Water Resources Management and Enhanced Adaptive Capacity in Drangmechhu River Basin (FAO)
	Adaptation to Climate-Induced Water Stresses through Integrated Landscape Management in Bhutan (AF), with Agriculture	
Climate Resilient Water Systems	Water Flagship Program Support Project (ADB)	Inclusive and Resilient Urban Development Project (ADB)
	Bhutan Secondary Towns Urban Development Project (ADB)	Climate Resilient Water Resources Management and Enhanced Adaptive Capacity in Drangmechhu River Basin of Bhutan - Concept Note (GCF)
	Advancing Climate Resilience of the Water Sector in Bhutan (GEF)	Thimphu City Water Distribution Network (WB)

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³⁴ Rwanda Green Fund.

³⁵ Ethiopia Climate Resilient Green Economy.

³⁶ International Monetary Fund. 2023. [Bangladesh and Its Partners are Launching the Bangladesh Climate and Development Platform to Leverage Adaptation and Mitigation Investments](#). Press Release 23/420, 3 December.

Table 9 continued

Investment Packages	Portfolio / Ongoing / Current	Pipeline
Flood management and urban / disaster and emergency	Bhutan Phuentsholing Township Development Project (ADB)	
	Building Adaptation and Resilience in the Hindu Kush Himalayas - Bhutan and Nepal (ADB)	
	Climate-Resilient Omchhu River Basin Project (ADB)	
	Inclusive and Resilient Urban Development Project (ADB)	
	DRIVE (Development Related Infrastructure Investment Vehicle) Gelephu Flood Protection Project (Government of Netherlands)	
	Enhancing the Climate Resilience of Urban Landscapes and Communities in the Thimphu - Paro region (ECRUL) (UNDP)	
	Bhutan Climate and Disaster Resilience DPF with CAT DDO (WB)	
	Stormwater and Flood Management Plan (World Bank)	
National Climate Services	Roadmap for Institutional Strengthening and Modernization of Hydromet and Multihazard Early Warning Services in Bhutan (WB)	Building Resilience to High-Impact Hydrometeorological Events through the Strengthening of Multihazard Early Warning Systems in Bhutan - Concept Note (GCF)
	Strengthening Risk Information for Disaster Resilience (WB)	
	SOFF Investment Phase (UN SOFF)	
Forestry	Bhutan for Life (GCF)	Conduct forest fire prevention awareness campaign and coordination meeting before the onset of dry season (IKI)
Energy	Green Power Project Readiness Enhancement (ADB)	Bunakhka Green Power Development Project (ADB)
	Distributed Solar for Public Infrastructure Project (ADB)	Smart and Green Grid Program (ADB)
	Solar Farm Expansion Project (ADB)	
	Dorjilung Hydroelectric Power Project (WB)	Nyera Amari Hydropower Project (ADB)
	90MW Jomori HEP (Construction) + 26MW Druk Bindu HEP I & II (Construction) (JICA)	
Agriculture	Supporting Climate Resilience and Transformational Change in the Agriculture Sector in Bhutan (UNDP and GCF)	Agriculture Resilient Livelihood Commercial Enhancement Program (CARLEP) implemented by the MoAL (IFAD)
	Strengthening Risk Information for Disaster Resilience (Agromet) (WB)	Innovative Adaptation Financing to Build Resilience and Adaptive Capacity of Smallholder Farmers in Bhutan (AF)
	Building Resilient Smallholder Commercial Agriculture (BRECSA) implemented by the MoAL - IFAD	Inclusive Markets, Production, Agricultural Commercialization and Transformation Project (IMPACT) (IFAD)
	Food Security and Agriculture Productivity Project (WB)	
	Financial and Agribusiness (IFC)	
	Commercial Agriculture Resilient Livelihood Enhancement Program (CARLEP) implemented by the MoAL (IFAD)	

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Table 9 continued

Investment Packages	Portfolio / Ongoing / Current	Pipeline
Agriculture	Enhancing Food Security through Smallholders' Climate Adaptive Potato (ADB JFPR funded)	
Policy & Cross Cutting	Strengthening Banking and Capital Markets Reforms Program, Subprogram 1 (ADB)	Enhancing Green Fiscal Consolidation Program, Subprogram 1 (ADB)
	Building Adaptation and Resilience in the Hindu Kush Himalayas – Bhutan and Nepal (ADB)	Strengthening Banking and Capital Markets Reforms Program, Subprogram 2 (ADB)
	Operationalizing Paris Alignment in the Country Programming Processes (ADB)	Enhancing Green Fiscal Consolidation Program, Subprogram 2 (ADB)
	Supporting the Implementation of ADB's Climate Change Action Plan through Enhancing Climate Finance Plans (ADB)	
	Strengthening Programmatic and Evidence-based Approaches for Resilience and Sustainability in South Asia (ADB)	
	Promoting Evidence-based Approaches and Knowledge Solutions for South Asia (ADB)	
	Climate Adaptation, Resilience, and Engagement in Local Governments (CARE-LG) (GCF)	
	Bhutan Climate Fund (WB)	

LEGEND:

ADB Portfolio
ADB Pipeline
Other DP Portfolio
Other DP Pipeline

ADB = Asian Development Bank, AF = Adaptation Fund, CARE-LG = Climate Adaptation, Resilience, and Engagement in Local Governments, Cat-DDO = Catastrophe Drawdown Option (World Bank), FAO = Food and Agriculture Organization, GCF = Green Climate Fund, GEF = Global Environment Facility, HEP = Hydroelectric Power, IFAD = International Fund for Agricultural Development, IFC = International Finance Corporation, IKI = International Climate Initiative, JFPR = Japan Fund for Prosperous and Resilient Asia and the Pacific, JICA = Japan International Cooperation Agency, MoAL = Ministry of Agriculture and Livestock, MW = megawatt, SOFF = Systematic Observations Financing Facility, UNDP = United Nations Development Programme, WB = World Bank.

Source: Authors.



Tsho Phu (Twin Lakes)
at Soe Jangthang, Paro
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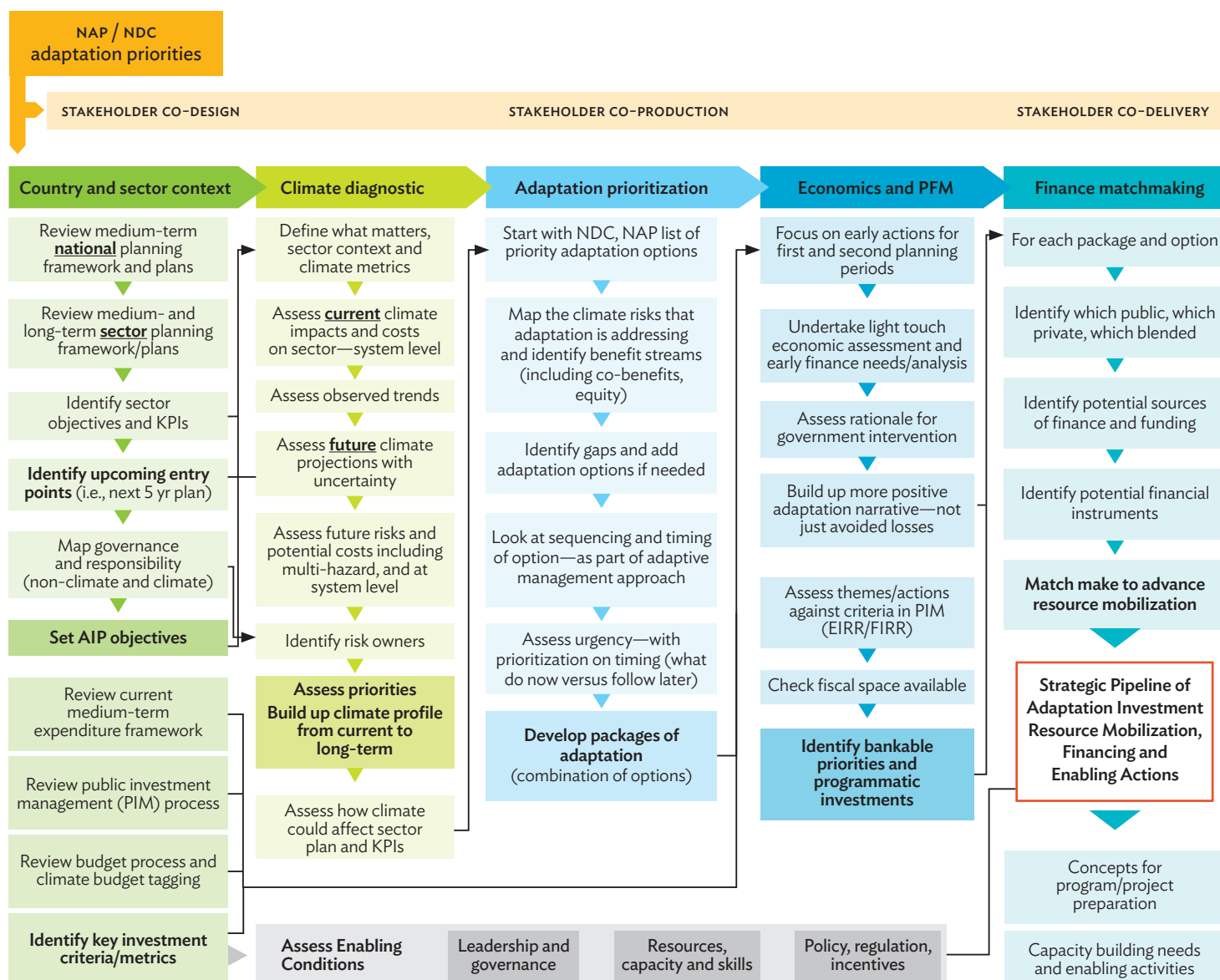
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Appendix 1: Detailed Method Overview



Practical demonstration on discharge measurement to the local government leaders of 6 eastern dzongkhags at Yakpongang Stream in Mongar Dzongkhag (photo by Sangay Choden).



Appendix 2: NAP Water Sector Costs

Summary of the Estimated Cost

DETAILED ADAPTATION PRIORITIES		
SI No.	Activity	Estimates in USD
A	Water	
1	Improve natural capacity for infiltration, water recharge, and water buffer for prevention of fast runoff and erosion	500,000
2	Strengthen and upscale PES. Review PES framework and field guide	100,000
3	Conduct feasibility studies to build emergency storage, bypasses, and controlled releases from glacial lakes. River basin management and planning for basin optimization	62,000
4	Promotion of water efficient technologies Conduct advocacy on water efficient technologies	23,500
5	Ensuring proper monitoring, planning, and supply of drinking water	123,000,000
6	Exploring volume of rainwater generated at water stressed areas for domestic use Developing assessment guide for integration of holistic use of water resources	200,000
7	Reduction of Non-Revenue Water losses	6,500,000
8	Strengthen database/inventory on drinking water supply schemes	4,000,000
9	Improve planning, designing and implementation of climate resilient irrigation	70,000,000
10	Robust water resources planning and monitoring system	18,000
11	Strengthening research on water resource management including	25,400
12	Strengthening research on water resource management including groundwater resources. i. Research on water resource management including groundwater resources and soil moisture ii. Enhance hydrological and groundwater modelling iii. Carry out studies on the options for household/institution level rainwater harvesting or creating additional water storage capacity. iv. Assess climate risk on water intensive industries (168 water intensive industries as of 2022)	183,000
13	Enhancing capacity of key stakeholders in managing the impacts of climate change on water	135,000
14	Capacity development of flood and storm water management from river flooding and urban floods	150,000
	SUBTOTAL WATER	204,896,900

Source: RGoB (2021).



Tributary stream of the
Gangtey-Phobjikha
Wetland in Phobjikha,
Wangdi Phodrang
Dzongkhag (photo by
Damudar Dahal).

Appendix 3: Objectives and Activities in the Water Sector Roadmap for Implementing Bhutan's NAP (2024)

Proposed Goal: Enhance the climate resilience of Bhutan's water sector while achieving equitable, sustainable water allocation among competing sectors by 2040	
Objective 1: Strengthen Water Governance	1.1 Amend existing water policies, laws, and regulations to incorporate emerging climate issues and challenges in the water sector.
	1.2 Assess and update progress of Bhutan's NIWRM 2016 Plan
	1.3 Strengthen research on water resource management including groundwater resources.
Objective 2: Strengthen Stakeholder Engagement	2.1: Establish/strengthen water user associations (WUAs) to enable community engagement in water allocation decisions.
	2.2: Institutionalize training for water managers, WUA chair, and policymakers in conflict resolution and adaptive management.
	2.3: Create/strengthen transparency mechanisms for water allocation decisions to ensure all stakeholders are informed.
	2.4: Regularly update and involve stakeholders and communities in the water allocation plans to reflect changing needs and priorities.
Objective 3: Enhance Water Use Efficiency And Reduce Water Loss Across All Sectors	3.1 Upgrade and maintain water infrastructure to reduce water loss.
	3.2 Improve irrigation management practices to reduce agricultural water consumption.
	3.3 Incentivize industries to reduce water use and increase recycling practices through tax breaks or subsidies.
	3.4 Promote water efficient domestic use awareness campaigns.
	3.5 Introduce stricter building codes that mandate water-saving technologies in new constructions and major renovations, prioritizing government owned facilities first.
	3.6 Optimize water release schedules from hydroelectric dams to align with periods of peak power demand, minimizing unnecessary water spillage and improving the water-use footprint of power generation.
Objective 4: Invest in Water Allocation Monitoring and Enforcement Mechanisms	4.1 Develop and deploy a network of water usage sensors and gauges across critical points in water distribution networks.
	4.2 Set up a centralized data base to monitor water allocations and usage in real time.
	4.3 Ensure compliance with water allocation policies, including the capacity to impose penalties on non-compliance.
	4.4 Conduct regular reviews of water allocation efficiency and adjust policies based on data-driven insights.

continued on next page

Table continued

Proposed Goal: Enhance the climate resilience of Bhutan's water sector while achieving equitable, sustainable water allocation among competing sectors by 2040	
Objective 5: Ensure the Environmental Sustainability of Water Sources	5.1 Implement ecosystem-based management practices that support the sustainability of water resources.
	5.2 Mandate environmental flow requirements in water allocation to preserve aquatic ecosystems
	5.3. Carry out water resources assessments/inventory at regular intervals to monitor the flow volume and water quality
	5.4 Rehabilitate and protect critical watersheds and aquifers to ensure long-term water availability
Objective 6: Develop and implement a disaster management plan for the water sector	6.1: Map and model water resource vulnerabilities to anticipate and mitigate the impacts of climate-induced disasters such as floods and droughts.
	6.2 Develop disaster management plan and guidelines for water sector
	6.3: Upgrade infrastructure with climate-resilient materials and design flood barriers and water storage facilities to withstand extreme weather events.
	6.4 Enhance capacity of key stakeholders in responding to climate change disasters that impact the water sector:
Objective 7: Strengthen Water Quality Management to Protect Public Health	7.1: Ensure proper monitoring, planning and supply of drinking water
	7.2: Launch public awareness campaigns on the importance of water conservation and the impact of pollution on health, targeting both urban and rural populations.
	7.3: Introduce incentives for industries and agriculture to adopt cleaner processes and environmentally friendly practices that reduce water contamination.

Annex 4: Full Pipeline of Investment Activities (Results from the Workshop)

Activities	New Package	Total \$ millions	Prioritization		13th Five Year Plan	14th Five Year Plan	15th Five Year Plan
			Very High	Low, Medium, High			
AGENCY: Department of Infrastructure Development (DoID)							
Construction of intake, transmission main, distribution network and Water Treatment Plant for Bajo extended town, Wangdiphodrang Dzongkhag.	CR Water supply and distribution	2.530		High	Yes	No	No
Talo and Guma Water Supply Scheme.	CR Water supply and distribution	3.253		High	Yes	No	No
Construction of raw water mains, WTP and water distribution lines for Jalikhar, Dekiling, and Chamkhar (LAP-3) , Bumthang Dzongkhag.	CR Water supply and distribution	3.470		High	Yes	No	No
Construction of Amochu WTP including pumping main, SCADA, etc.	CR Water supply and distribution	6.084		High	Yes	No	No
Construction of Intake, Transmission, Distribution network and Water Treatment Plant for Gedu town, Chhukha Dzongkhag.	CR Water supply and distribution	2.169		High	Yes	No	No
Upgradation of existing WTP at Bajo Town, Wangdiphodrang Dzongkhag.	CR Water supply and distribution	0.241		High	Yes	No	No
Construction of RWSS for Gaseypey/Kemji under Wangdiphodrang Dzongkhag.	CR Water supply and distribution	0.181		Medium	Yes	No	No
Construction of a distribution network at Nobding town, Wangdiphodrang Dzongkhag.	CR Water supply and distribution	0.120		Medium	Yes	No	No
Construction of raw water main, water Treatment Plant and distribution network for Trongsa Town.	CR Water supply and distribution	0.843		Medium	Yes	No	No
Construction of water supply at Punakha LAP and Changyuel under Punakha Dzongkhag.	CR Water supply and distribution	0.723		Medium	Yes	No	No
Construction of Water Supply from Taklai Upstream, Chuzergang Gewog, Sarpang Dzongkhag.	CR Water supply and distribution	0.241		Medium	Yes	No	No
Construction of water supply scheme for Gelephu gewog, Sarpang Dzongkhag.	CR Water supply and distribution	0.060		Medium	Yes	No	No
Construction of Distribution network at LAP 2 and LAP 3 in Damphu town, Tsirang Dzongkhag.	CR Water supply and distribution	0.181		Medium	Yes	No	No

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Table continued

Activities	New Package	Total \$ millions	Prioritization		13th Five Year Plan	14th Five Year Plan	15th Five Year Plan
			Very High	Low, Medium, High			
Construction of Water Treatment Plant (WTP) for Royal Guest House (VVIP) and Institutions under Tsirang Dzongkhag.	CR Water supply and distribution	0.060		Medium	Yes	No	No
Construction of Rural Water Supply Scheme (RWSS) for Dhalgolia under Dzamlingzor Chiwog (15km approx), Tsirang Dzongkhag.	CR Water supply and distribution	0.090		Medium	Yes	No	No
Construction of Rural Water Supply Scheme (RWSS) for Upper Lapsaybotay under Pelrithang Chiwog (10km approx) under Tsirang Dzongkhag.	CR Water supply and distribution	0.060		Medium	Yes	No	No
Construction/rehabilitation/extension of Rural Water Supply (RWSS) Scheme under 20 dzongkhags.	CR Water supply and distribution	18.524		Medium	No	Yes	Yes
Implementation of climate resilient water safety plan for 20 dzongkhags and 4 thromdes (5 schemes per dzongkhag per 5-year plan)	CR Water supply and distribution	10.000		High	Yes	Yes	Yes
Skilling of the plumbers, operators, caretakers, technicians on the “Operation and Maintenance of the Water supply systems” covering 20 dzongkhags and 4 thromdes.	CR Water supply and distribution	3.250		High	Yes	Yes	Yes
Training of the water engineers on the “Planning, designing and implementation of the climate resilient water infrastructure” including innovative technologies—rain water harvesting, pumping, SCADA, etc. (20 dzongkhags and 4 thromdes).	CR Water supply and distribution	3.250		High	Yes	Yes	Yes
Strengthening of the WaSIS (Water and Sanitation Information System).	CR Water supply and distribution	1.084		High	Yes	Yes	Yes
Training of the engineers and technicians on “Non-revenue Water assessment”.	CR Water supply and distribution	0.650		High	Yes	Yes	Yes
Reduction of “Non-revenue water” through assessment studies and implementation of the remedial measures for selected critical areas under Thimphu, Samdrupjongkhar, and Phuntsholing Thromde.	CR Water supply and distribution	9.036		High	Yes	Yes	Yes
Digitization of the water supply systems for selected schemes in Phuntsholing, Samdrupjongkhar, and Thimphu Thromdes.	CR Water supply and distribution	1.446		High	Yes	Yes	Yes
Develop or update Guidelines/SOPs/Standards/Specifications related to water infrastructures including sensitization to the relevant stakeholders and communities.	CR Water supply and distribution	0.542		High	Yes	Yes	Yes
Construction of transmission main, Water Treatment Plant and distribution network for Phaling Thromde, Lhuntshe Dzongkhag	CR Water supply and distribution	0.723		High	Yes	Yes	No
Construction of transmission main, Water Treatment Plant and distribution network for the Autsho Yenlag Throm, Lhuntshe Dzongkhags.	CR Water supply and distribution	0.723		High	Yes	Yes	No

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Table continued

Activities	New Package	Total \$ millions	Prioritization		13th Five Year Plan	14th Five Year Plan	15th Five Year Plan
			Very High	Low, Medium, High			
Construction of Nagamphu pumping system under Sangkama Chiwog, Mongar Dzongkhag.	CR Water supply and distribution	0.241		High	Yes	Yes	No
Construction of Ringphu pumping system under Mudungkhar Chiwog, Mongar Dzongkhag.	CR Water supply and distribution	0.241		High	Yes	Yes	No
Construction of Intake, Sedimentation tank and Transmission main line from alternative water source for Trashigang town.	CR Water supply and distribution	0.723		High	Yes	Yes	No
Construction of integrated drinking and irrigation water supply system from Tshongtshongma-juk to Bartsham, Trashigang Dzongkhag.	CR Water supply and distribution	1.422		High	Yes	Yes	No
Construction of intake, transmission mainline, WTP and distribution network for Yangtse town, Trashiyangtse Dzongkhag.	CR Water supply and distribution	0.964		High	Yes	Yes	No
1.Pumula to Woluna Integrated Irrigation and Drinking Water Supply under Maedwang Gewog, Thimphu Dzongkhag. 2.Construct Changtagang Water Supply under Dagala Gewog, Thimphu Dzongkhag. 3.Construction of Helela Water supply at Chamgang under Dagala Gewog, Thimphu Dzongkhag. 4.Construction of Rama Water Supply under Chang Gewog, Thimphu Dzongkhag.	CR Water supply and distribution	1.500		High	Yes	Yes	No
Construction of sewerage systems for Autsho town, Lhuntse Dzongkhag.	Sewerage systems	0.506		High	Yes	No	No
Construction of sewerage systems for Gedu town (Zero point and Lhaptshakha), Chukha Dzongkhag.	Sewerage systems	0.542		High	Yes	No	No
Construction of sewerage systems for peripheral areas under Samtse Dzongkhag.	Sewerage systems	0.120		High	Yes	No	No
Construction of sewerage systems for Haa town.	Sewerage systems	1.084		High	Yes	No	No
Construction of sewerage systems for Chamkhar LAP under Bumthang Dzongkhag.	Sewerage systems	0.723		High	Yes	No	No
Construction of sewerage systems for Lhaimoizhingkha town under Dagana Dzongkhag.	Sewerage systems	0.446		High	Yes	No	No
Construction of sewerage systems for Dagana Throm under Dagana Dzongkhag.	Sewerage systems	0.663		High	Yes	No	No
Construction of sewerage systems for Paro town under Paro Dzongkhag.	Sewerage systems	0.916		High	Yes	No	No
Extension of sewerage network for core town LAP under Mongar Dzongkhag.	Sewerage systems	0.120		High	Yes	No	No
Construction of sewerage systems for Pangbang town under Zhemgang Dzongkhag.	Sewerage systems	1.084		High	Yes	No	No
Construction of sewerage systems for Bajo extended town under Wangdiphodrang Dzongkhag.	Sewerage systems	1.084		High	Yes	No	No

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Activities	New Package	Total \$ millions	Prioritization		13th Five Year Plan	14th Five Year Plan	15th Five Year Plan
			Very High	Low, Medium, High			
Strengthen human resource capacity at all levels for safe sanitation management (20 dzongkhags and 4 thromdes).	Sewerage systems	1.807		High	Yes	No	No
Develop or update Guidelines/SOPs/Standards/ Specifications related to water infrastructures including sensitization to the relevant stakeholders and communities.	CR Water supply and distribution	0.542		High	Yes	No	No
Construction/ major rehabilitation for sewerage systems including sludge treatment facilities in urban areas (20 dzongkhags and 4 thromdes).	Sewerage systems	60.723		High	Yes	No	No
AGENCY: Department of Energy (DoE)							
DPR Investigation of Basochhu PSHP.	Mitigation (energy)	4.217		Medium	No	No	No
DPR Investigation of Pangbang PSHP.	Mitigation (energy)	4.217		Low	No	No	No
40MW Parochhu Small Hydroproject (integrated multipurpose).	Mitigation (energy)	73.000	Very high		Yes	Yes	No
5 MW green hydrogen plant with onsite refueling facility in Gidawom, located next to the Gidakom Mini Power Plant, located between Thimphu and Paro.	Mitigation (energy)	5.800		Medium	No	Yes	No
AGENCY: Department of Human Settlements (DHS)							
Implementation of DRIVE (Development Related Infrastructure Investment Vehicle) Gelephu Flood Protection Project—Nu 600 million approved in the 13th Five Year Plan.	Disaster management (prot and plan)	9.640		High	Yes	No	No
Implementation of flood protection works (Lhamoizingkha, Gelephu Mindfulness City [GMC]).	Disaster management (prot and plan)	3.665	Very high	High	Yes	No	No
Implementation of flood management plan (Mau, Paro, Samtse, Punakha, Thimphu, Gasa, Haa, Kerongchu, Rongchuthang, GMC)—(\$ 2.9 million proposed in GEF for Paro).	Disaster management (prot and plan)	26.000	Very high	Medium	No	Yes	Yes
Preparation of National capital region Linked Urban Centers (planning, transport, water supply, sewer, stormwater, green open space)—(Samtse-Phuntsholing, Samdrup Jongkhar-Nganglam).	Urban water stormwater management and green infra	2.500	Very high	High	Yes	No	No
Implementation of National capital region Linked Urban Centers (planning, transport, water supply, sewer, stormwater, green open space)—(Samtse-Phuntsholing, Samdrup Jongkhar-Nganglam).	Urban water stormwater management and green infra	7.230		Medium	No	Yes	No

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Activities	New Package	Total \$ millions	Prioritization		13th Five Year Plan	14th Five Year Plan	15th Five Year Plan
			Very High	Low, Medium, High			
Implementation of Water Services Master Plan by improving the stormwater management system and introduction of nature-based solutions and ecosystem-based adaptations to reduce urban flooding—\$3.544 million proposed in ECRUL.	Urban water stormwater management and green infra	71.370		Medium	No	Yes	Yes
Preparation of Linked Urban Centers (planning, transport, water supply, sewer, stormwater, green open space)—(Bmthang-Trongsang, Trashigang-Mongar).	Urban water stormwater management and green infra	2.500		Medium	No	Yes	No
Implementation of Linked Urban Centers (planning, transport, water supply, sewer, stormwater, green open space)—(Bumthang-Trongsang, Trashigang-Mongar).	Urban water stormwater management and green infra	7.230		Low	No	No	Yes
Preparation of flood management plan (Tashiyangtse, Trashigang, Pemagatshel, Chhukha, Lhuentse, Trongsang, Bumthang, Punakha, Dagana, Gasa).	Disaster management (prot and plan)	2.000		Medium	Yes	Yes	No
Implementation of flood management plan (Tashiyangtse, Trashigang, Pemagatshel, Chhukha, Lhuentse, Trongsang, Bumthang, Punakha, Dagana, Gasa).	Disaster management (prot and plan)	27.000		Medium	No	Yes	Yes
Preparation of guidelines/standards-infrastructure planning and design of flood disaster adaptation/mitigation measures.	Disaster management (prot and plan)	0.100	Very high	High	Yes	No	No
Implementation of stormwater management plans for Thromdes (Phuntsholing, Samdrup Jongkhar, Gelephu).	Urban water stormwater management and green infra	40.254		Low	No	Yes	Yes
Capacity development of engineers, urban planners, architects and GIS officers in climate resilience/adaptive (nature-based) planning, designing, digitization, and implementation.	Urban water stormwater management and green infra	10.000		High	Yes	Yes	Yes
Green Infrastructure and open spaces including Wangchhu River Corridor - 317 Nu 150 million proposed under an Indian government PTA and Nu 167 million under ECRUL project (GEF)—Flood plain (Disaster Mgt.)—Water sensitive urban design—nature-based solutions.	Urban water stormwater management and green infra	72.000		High	Yes	Yes	No
Water services, green infrastructures and waste for all dzongkhags other than thromdes—Nu 1 billion approved in the 13th Five Year Plan.	Urban water stormwater management and green infra	12.050	Very high	High	Yes	No	No
Implementation of Disaster Management and Contingency Plan (Stockpiling of emergency shelter items, water and sanitation items, and bridge parts, revision of current DMCP)—Nu 300 million approved in the 13th plan.	Contingency plan	12.050	Very high	High	Yes	Yes	Yes

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Activities	New Package	Total \$ millions	Prioritization		13th Five Year Plan	14th Five Year Plan	15th Five Year Plan
			Very High	Low, Medium, High			
Conduct research on climate smart city planning, digitization, nature-based solution and climate adaptive measures in stormwater, sewer, water supply, and floods.	Urban water stormwater management and green infra	0.200		Medium	Yes	Yes	Yes
Green building codes for stormwater management	Urban water stormwater management and green infra			High			
Climate and geo-information development to promote risk informed urban planning.	Urban water stormwater management and green infra			High			
AGENCY: Thimphu Thromde							
Reviving the Core Thimphu Thromde water distribution Network (Including Smart device and SCADA)—Proposed under World Bank Project.	CR Water supply and distribution	3.614		High	No		
Smart water meter (Automad Meter Reading—Both Bulk meter and Household meter) including improvement of Water Billing System and Software—Proposed under PTA, Indian government funding.	CR Water supply and distribution	0.723		Medium	Yes		
Construction of Water Distribution network at Serbithang Area—Proposed under PTA, Indian government project.	CR Water supply and distribution	0.361		High	Yes		
Construction of Water Distribution network and Water Treatment Plant at Nubding area. Proposed under PTA, Indian government project.	CR Water supply and distribution	0.840		High	Yes		
Reviving old water treatment plant (Motithang and Jungshina WTP), Proposed under PTA, Indian government project	CR Water supply and distribution	0.723		Medium	Yes		
Improvement of water distribution network at Changzamtog Proposed under PTA, Indian government project.	CR Water supply and distribution	0.550		High	Yes		
Realignment of water line from Chamgang Balancing Tank to Semtokha Bridge Proposed under PTA, Indian government project.	CR Water supply and distribution	0.430		High	Yes		
Restoration of Water Supply Infrastructure damaged by flash flood at Dechencholing WTP.	CR Water supply and distribution	0.181		High	No		
Debsi Borewell restoration to Augment water supply to Babesa.	CR Water supply and distribution	0.070		High	Yes		
Research and implement a riverbank filtration system as the backup plan, Thimphu Thromde.	CR Water supply and distribution	0.843		Medium	No	Yes	
Capacity Building for all engineers and technicians involved in water and wastewater management in the city.	CR Water supply and distribution	0.241		High	No	Yes	Yes
Digitize the water distribution network for Thimphu City in GIS format.	CR Water supply and distribution	0.120					

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Activities	New Package	Total \$ millions	Prioritization		13th Five Year Plan	14th Five Year Plan	15th Five Year Plan
			Very High	Low, Medium, High			
Enhance and implement a Water Safety Plan for Thimphu City.	CR Water supply and distribution	0.120					
Conduct research on the effectiveness of the existing sewage treatment plant (STP) and design and construct an optimized STP for Thimphu Thromde.	Sewerage systems	2.410		High	No	Yes	
Conduct the capacity of the sewerage network and design, construct an optimized sewerage system including the Household connection for Thimphu Thromde.	Sewerage systems	2.410		Medium	No	Yes	
AGENCY: Department of Agriculture (DoA)							
Construction of 11 new irrigation channels of 56 km length, 380 command area benefitting 525 households.	Irrigation	3.660		Low	Yes	Yes	Yes
Construction of 95 new irrigation channels of 419 km length, 2374 command area benefitting 1962 households.	Irrigation	27.670		Medium	Yes	Yes	Yes
Construction of 67 new irrigation channels of 307 km length, 4021 command area benefitting 2424 households.	Irrigation	20.600		High	Yes	Yes	Yes
Renovation of 14 existing irrigation channels of 35 km length, 144 command area benefitting 191 households.	Irrigation	2.400		Low	Yes	Yes	Yes
Renovation of 155 existing irrigation channels of 434 km length, 6011 command area benefitting 5980 households.	Irrigation	28.900		Medium	Yes	Yes	Yes
Renovation of 131 existing irrigation channels of 383 km length, 7167 command area benefitting 5207 households.	Irrigation	26.200		High	Yes	Yes	Yes
Install solar pumps for lift irrigation (at Nu 40 million per site), Nyalakha in Rubisa, Thangu and Rinchengang in Thetsho, Wangduephodrang district and Bjimthang in Dzomi, Mendegang in Dzomi, Phaduna, Zomlingthang, Dochu Ritsa and Changyul in Guma, Chimipang in Barp, Punakha district and Lhamoizingkha in Dagana.	Irrigation	5.800		High	Yes	Yes	Yes
Support water-efficient irrigation (drip and sprinkler) with solar-powered storage tank and automation systems for commercial vegetable cultivation (20 sites at Nu 35 million per site).	Irrigation	8.500		High	Low	Yes	Yes
Project studies and preparation.	Irrigation	6.400		High	Yes	Yes	Yes
Annual operations and maintenance costs of the developed irrigation facilities.	Irrigation	5.000		High	Yes	Yes	Yes
Land development and agricultural mechanization.	Irrigation	38.200		Low	Yes	Yes	Yes

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Activities	New Package	Total \$ millions	Prioritization		13th Five Year Plan	14th Five Year Plan	15th Five Year Plan
			Very High	Low, Medium, High			
Institutional strengthening and capacity building.	Irrigation	5.830		High	Yes	Yes	Yes
Develop an irrigation information management system.	Irrigation	2.000		High	Yes	Yes	Yes
AGENCY: College of science and technology (CST)							
Rain water Harvesting and treatment facility.	Research and education	0.050		High	Yes		
Enhancing Water Distribution network system (CST) incorporating ICT—research-based project.	Research and education	0.045		High	Yes		
IoT based Smart agriculture in different climatic zone.	Research and education	0.040		High	Yes		
Development of water resources engineering laboratory—Construction of physical facilities, Purchase of lab equipment.	Research and education	1.500	Very high	High	Yes	Yes	
WRE and other faculty capacity building.	Research and education	0.300	Very high	High	Yes		
Ground Water—Recharge zonation—research-based project.	Research and education	0.100		Medium	Yes	Yes	
Curriculum review and program accreditation.	Research and education	0.050	Very high	High	Yes		
Establishment of a Water Research and Services Center.	Research and education	0.500		medium	Yes	Yes	
Teaching learning materials: Computers and software, journals and e-books, e-learning.	Research and education	0.450	Very high	High	Yes		
Knowledge dissemination: Conferences, and publication, trainings of stakeholders, Masters and PhD scholarships.	Research and education	0.450		Medium	Yes		
Research on wastewater/recycling, environment and climate research, exchange programs.	Research and education						
AGENCY: Hydromet Infrastructure and data center (NCHM)							
Establishment National Weather and Flood Warning Center and Scientific Facilities.	NCHM	2.800	Very high	High	Yes	Yes	
ICT infrastructure upgradation.	NCHM	12.000	Very high	High	Yes	Yes	
Develop a cloud-based data storage system.	NCHM	5.000		Medium	Yes	Yes	
Enhancing central data base management.	NCHM	3.000	Very high	High	Yes	Yes	
AGENCY: Modernization of National Hydromet Observation Network and Infrastructure (NCHM)							
Upgradation and standardization of existing hydromet network.	NCHM	6.000	Very high	High	Yes	Yes	
Hydromet Instrument calibration.	NCHM	1.500	Very high	Medium	Yes	Yes	
Establishment of new hydromet station.	NCHM	1.700		Medium	Yes	Yes	
Install and monitoring ambient water quality monitoring and automatic sediment monitoring sites.	NCHM	1.000		Medium	Yes	Yes	

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Table continued

Activities	New Package	Total \$ millions	Prioritization		13th Five Year Plan	14th Five Year Plan	15th Five Year Plan
			Very High	Low, Medium, High			
Weather radars including civil works and infrastructure (tower, generator, UPS, and so on).	NCHM	7.000	Very high	High	Yes	Yes	
Upper air station.	NCHM	4.470	Very high	High	Yes	Yes	
Establishing new synoptic stations (including civil works and provision of services, capacity building).	NCHM	2.300		High	Yes	Yes	
AGENCY: Enhancing Cryosphere Monitoring and Research in Bhutan Himalaya (NCHM)							
Study and generate information on contribution of dominant sources (glacier melt, snow, rain and groundwater) in surface runoff in major river systems.	NCHM	0.450		High	Yes	Yes	
Monitoring of bench-mark glaciers (mass balance and terminus status) to determine the impact of climate change on the cryosphere.	NCHM	0.120			Yes	Yes	
Reduce Glacial lake outburst flood hazard from Thorthormi Lake in Lunana, using Siphon technology.	NCHM	1.040	Very high	High	Yes	Yes	
Conduct research to determine the status of glaciers in Bhutan in near future due to climate change.	NCHM	1.000		Medium	Yes	Yes	
Long Term monitoring of Benchmark glaciers and impact of climate on the cryosphere.	NCHM	0.550		Medium	Yes	Yes	
Establish regular avalanche risk and warning services in selected areas.	NCHM	0.250		Medium	Yes	Yes	
Modeling of glacial lake outburst flooding scenarios from potentially dangerous glacial lakes (PDGLs)	NCHM	0.240		High	Yes	Yes	
Conduct a risk assessment of glacial lake outburst flooding in the head waters of the Drangmechhu, Nyera Ama Ri, and Jomori basins.	NCHM	0.150			Yes	Yes	
Establish a network of stations to monitor permafrost in Bhutan Himalaya.	NCHM	0.100		Medium	Yes	Yes	
Expand cryosphere monitoring stations in the high altitude region.	NCHM	0.580			Yes	Yes	
Establishment of a glacial lake outburst flood monitoring and cryosphere research facility in Lunana.	NCHM	0.500		High	Yes	Yes	
AGENCY: Hydrological and Early Warning Services (NCHM)							
Expand the EWS for eastern basins.	NCHM	1.380		High	Yes	Yes	
Upgradation of the existing early warning monitoring network and communication system for glacial lake outburst flooding.	NCHM	0.350	Very high	High	Yes	Yes	
Hydrological, hydrodynamic and dynamic riverbed modeling.	NCHM	0.590		High	Yes	Yes	
Development of a river information system.	NCHM	1.000		Medium	Yes	Yes	

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Activities	New Package	Total \$ millions	Prioritization		13th Five Year Plan	14th Five Year Plan	15th Five Year Plan
			Very High	Low, Medium, High			
Development of a flash flood forecasting system.	NCHM	2.000	Very high	High	Yes	Yes	
AGENCY: Weather and Climate Services (NCHM)							
Developing probabilistic forecasting, impact-based forecasting (with disaster risk management), nowcasting, and sector-based forecasting.	NCHM	2.000	Very high	High	Yes	Yes	
Enhance climate services (Medium range, agromet and climate projection).	NCHM	2.000		High	Yes	Yes	
AGENCY: DLGDM							
Set up a functional multisector disaster response team/community-based.	Disaster response	0.061		High	Yes		
Operationalization of Multi-Hazard Risk Decision Support System (MHRDSS).	Disaster response	0.051		High	Yes		
Establish training props, coordinate SAR training, and purchase equipment.	Disaster response	6.100		High	Yes		
Capacity development of disaster management committees and local governments.	Disaster response	1.200		High	Yes		
Development of a strategy for the protection of critical infrastructure.	Disaster response	0.121		High	Yes		
Implement community-based disaster risk management in vulnerable communities.	Disaster response	0.365		High	Yes		
Conduct public education and awareness on disaster risk management.	Disaster response	0.250		High	Yes		
AGENCY: DECC							
Develop TOR and mandates and identify climate change units in line with climate change policy and NEPA 2007 Institute climate change units in national agencies.	Adaptation policy and planning	0.025	Very high	High	Yes	Yes	
Develop TOR and mandates for climate change, disaster, poverty Gender, Environment, Climate Change, Disaster, and Poverty (GECDP) units in line with climate change policy and NEPA 2007 and LG Act, and of gender, environment, climate.	Adaptation policy and planning	0.050		High	Yes	Yes	
Review and revise policies and legislation for gaps and opportunities in effective integration and implementation of climate action.	Adaptation policy and planning	0.100	Very high	High	Yes	Yes	
Strengthen the NEC Secretariat (CCD/DECC) in supporting the NCCC (HR, training, resources) Regular briefings to NCCC on climate change adaptation and NAP process as necessary. Annual review of NAP process by NCCC (based on Climate Change Coordination Committee, C4, reports).	Adaptation policy and planning	0.010	Very high	High	Yes	Yes	
Prepare annual progress report on the implementation of the NAP—Capture best practices and lessons learned in the implementation of the NAP—Iteratively prepare 2nd NAP.	Adaptation policy and planning	0.300	Very high	High	Yes	Yes	

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Activities	New Package	Total \$ millions	Prioritization		13th Five Year Plan	14th Five Year Plan	15th Five Year Plan
			Very High	Low, Medium, High			
Review and enhance the approach in “Climate Change vulnerability analyses and mapping for NAP formulation process in Bhutan” for measuring vulnerability and adaptive capacity at a national level and across sub-national <i>dzongkhags</i> and gewogs. Develop a tool for assessing adaptive capacity and vulnerability to climate change to assist planners and practitioners in planning and implementing adaptation projects and programs.	Adaptation policy and planning	0.300	Very high	High	Yes	Yes	
Set up monitoring and evaluation framework for the water sector along the lines of the Bhutan Water Security Index (BWSI).	Adaptation policy and planning	0.100		High	Yes	Yes	
Conduct policy-relevant and need-based research for climate change adaptation through “Strategic Imperative I: Tackle issues which matter”.	Adaptation policy and planning	5.000		High	Yes	Yes	
Development of climate change learning module and curriculum—Vocational Education Curriculum Development for Climate Mitigation and Adaptation—Creating awareness for students and their parents to understand climate change adaptation as a career option.	Adaptation policy and planning	0.300		High	Yes	Yes	
Strengthen linkages with government, academia and extension capacity of nongovernment organizations and civil society organizations operating in natural resource management/ agriculture space; Develop and implement a public sensitization program on Indigenous Knowledge Systems (IKS) across the community level; Develop a repository of all traditional and IKS,	Adaptation policy and planning	0.600		High	Yes	Yes	
AGENCY: Department of Water (DoW)							
Develop and implement national integrated water master plan (IWMP) and river basin management plans (RBMP) for Punatsangchhu, including updates	IWRM	0.250	Very high	High	Yes	Yes	Yes
Develop and implement IWMP and RBMP for other 3 river basins (Drangmechhu, Mangdechhu, and Amochhu), including updates of above three plans and Wangchhu RBMP.	IWRM	1.000	Very high	High	Yes	Yes	Yes
Institutionalize training for water managers, WUA office bearers, and policymakers in conflict resolution and adaptive management.	IWRM	0.100		High	Yes	Yes	Yes
Community based water resources management WUAs.	IWRM	0.100		High	Yes	Yes	Yes

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Table continued

Activities	New Package	Total \$ millions	Prioritization		13th Five Year Plan	14th Five Year Plan	15th Five Year Plan
			Very High	Low, Medium, High			
Explore and develop potential natural and built water storage.	IWRM	1.500		Medium	Yes	Yes	
Implement suitable nature-based solutions for watershed conservation and restoration for sustainable water supply (50 springsheds per 5 year).	IWRM	11.000		High	Yes	Yes	Yes
Establish payment mechanisms for water services and explore investment opportunities.	IWRM	0.150		High	Yes	Yes	
Assess climate vulnerability and risk for priority water sectors and develop climate-resilient water infrastructure guidelines.	IWRM	0.350		High	Yes	Yes	
Explore and assess potential groundwater and recharge areas, and possible avenues for abstraction for conjunctive use in the surface water-scarce areas.	IWRM	0.250		High	Yes	Yes	
Promote and adopt emerging water-efficient and innovative technologies.	IWRM	0.250		high	Yes	Yes	
Create avenues for water-based ventures.	IWRM	0.200		High	Yes	Yes	Yes
Institute a knowledge bank on water resources management.	IWRM	0.560	Very high	High	Yes		
Revise the water policy and vision 2008, and the Water Act 2011.	IWRM	0.125	Very high	High	Yes		
Conduct monitoring on the implementation of water guidelines and regulations.	IWRM	0.100	Very high	High	Yes	Yes	Yes
Improve natural capacity for infiltration, water recharge, and water buffer for prevention of dust runoff and erosion.	IWRM	0.500		High	Yes	Yes	
Strengthening and upscaling payments for ecosystem services (including review of framework and field guide).	IWRM	0.200		High	Yes	Yes	
Conduct feasibility studies to build emergency storage, bypasses, and controlled releases from glacial lakes. River basin management and planning for basin optimization.	NCHM	0.620		High	Yes		
Promotion of water-efficient technologies. Conduct advocacy on water-efficient technologies.	IWRM	0.025		High	Yes	Yes	Yes
Introduce incentives for industries and agriculture to adopt cleaner processes and environmentally friendly practices that reduce water contamination.	IWRM	0.100		Medium	Yes	Yes	
Exploring the volume of rainwater generated at water-stressed areas for domestic use. Developing an assessment guide for integration of holistic use of water resources.	IWRM	0.200		High	Yes	Yes	

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Table continued

Activities	New Package	Total \$ millions	Prioritization		13th Five Year Plan	14th Five Year Plan	15th Five Year Plan
			Very High	Low, Medium, High			
Strengthen drinking water quality monitoring and surveillance.	IWRM	1.820		High	Yes	Yes	Yes
Strengthen data base/inventory on drinking water supply schemes.	IWRM	0.100	Very high	High	Yes	Yes	
Robust water resources planning and monitoring system	IWRM	0.018		High	Yes	Yes	
Strengthening research on water resource management: i. Research on water resource management including groundwater resources and soil moisture. ii. Enhance hydrological and groundwater modeling. iii. Carry out studies on the options for household/institution-level. rainwater harvesting or creating additional water storage capacity. iv. Assess climate risk on water-intensive industries (168 water-intensive industries as of 2022).	IWRM	0.200		High	Yes		
Enhancing capacity of key stakeholders in managing the impacts of climate change on water.	IWRM	0.135		High	Yes	Yes	Yes
Wetland assessment and inventory.	IWRM	0.500		High	Yes	Yes	
Conduct national water resources inventory including watershed assessment.	IWRM	5.000		High	Yes	Yes	Yes
AGENCY: Department of Forests and Park Services (DoFPS)							
Explore the installation of a water storage system or the creation of dams at strategic points in the high forest fire risk region (6 dzongkhags).	Forest wildfire risk management	0.220		High	Yes	Yes	
Conduct fire hotspot mapping to accurately delineate fire-prone areas and model the prediction of forest fire occurrences across the country.	Forest wildfire risk management	0.006		High	Yes	Yes	
Initiate the formation of community-based forest fire management groups in fire-prone areas and train them in scientific fire management practices and suppression measures.	Forest wildfire risk management	0.012		High	Yes	Yes	
Initiate measures to reduce the fuel load within the wildland-urban interface (Scientific thinning and prescribed/controlled burning) in fire-prone dzongkhags.	Forest wildfire risk management	0.018		High	Yes	Yes	
Conduct forest fire prevention awareness campaigns and coordination meetings before the onset of dry seasons	Forest wildfire risk management	0.018		High	Yes	Yes	

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Table continued

Activities	New Package	Total \$ millions	Prioritization		13th Five Year Plan	14th Five Year Plan	15th Five Year Plan
			Very High	Low, Medium, High			
Conduct capacity building for forest officials on fire management practices, suppression principles, and investigative skills	Forest wildfire risk management	0.012		High	Yes	Yes	
Explore and install early warning and detection for wildfire in high risk areas	Forest wildfire risk management						
Establishment of nurseries (west, central, east)	Forestry plantations						
Creation and maintenance of valuable timber species plantations (2,000 hectares)	Forestry plantations	9.390		High	Yes	Yes	
TOTAL		846.90					

