CAIP Climate Adaptation Investment Planning

ADB

LESSONS 1

The CAIP method involves a five-step approach.

STEP 1 starts with a country-context analysis, including planning and financing frameworks, and identifies the actors and entry points for adaptation.

STEP 2 builds on existing climate risk assessments to develop a strategic climate diagnostic.

STEP 3 develops the adaptation priorities into packages, based on urgency and sequencing.

STEP 4 assesses the benefits and the costs of these packages, including their potential economic and financial viability.

STEP 5 investigates the financing opportunities for each package, considers multiple sources, and matches each package with appropriate financial instruments.

Undertaking Climate Diagnostics for Climate Adaptation Investment Planning

Introduction to the Climate Adaptation Investment Planning Process

The Climate Adaptation Investment Planning (CAIP) program of the Asian Development Bank (ADB) aims to support selected developing member countries in adaptation investment planning. As part of the overall national adaptation plan (NAP) or nationally determined contribution (NDC) process, this takes identified adaptation priorities from these documents with the objective of developing investment packages that can unlock finance at scale for a priority sector or area.

To do this, the CAIP approach moves beyond small, individual projects to pipelines of bankable adaptation packages, taking a strategic and programmatic approach aligned with national and sector-based planning, economic, and fiscal frameworks. It then identifies opportunities for mobilizing finance from multiple sources, including public, private, and blended finance, as well as the enabling factors that might support these activities.

Throughout this process, the CAIP approach embeds stakeholder co-creation and identifies the enabling conditions needed to help deliver adaptation. The outcome of the CAIP process is a pipeline of potentially bankable projects/investment packages.

This note provides insights and lessons related to **Step 2** of the CAIP process. It draws on the experience of the first six CAIP countries.

CAIP Sector: **Agriculture**
Country: Armenia, Cambodia, Indonesia, Nepal
CAIP Sector: **Water**
Country: Bhutan, Mongolia



Photo by Jitendra Bajracharya, ICIMOD.

Background and Introduction

Developing countries in Asia and the Pacific recognize the urgency of scaling up investments in climate adaptation for advancing sustainable development. While the countries have taken actions to improve planning for adaptation, large gaps remain in turning the priorities identified in NDCs, NAPs, or equivalent documents into investments that can be funded and attract financing at scale.

One reason is that, although NDCs and NAPs assess future climate projections and climate risks—hazard, exposure, and vulnerability—to identify adaptation priorities, much of this work takes a predict-then-act approach. There is also a tendency to focus on climate model trends for a few key variables (temperature and precipitation) for the 2050s and even 2070s. Although this helps frame conditions for medium- to long-term planning, greater attention to climate variability is needed to inform nearer-term adaptation investments and build the case for financing now. This note summarizes some of the key lessons learned from Step 2 of the CAIP process, which focuses on strategic climate assessment.



Photo by Chenten Thinley.

Overview of Climate Diagnostics in the CAIP Process

The CAIP process takes a "policy-first" approach to adaptation. This starts with the intended development outcomes of adaptation investments, rather than a "science-first" method that begins with climate model projections to identify adaptation priorities.[1] CAIP also takes a more systems-based approach to climate risk assessment, including the use of climate-related multi-hazard risk analysis and considering risks experienced across different sectors.

[1] A science-first approach looks at the future climate first. It uses climate models to assess future climate risks then decides what to do based on those projections. A policy-first approach looks at development objectives first. It then uses climate model projections to evaluate how proposed investment options might perform under plausible climate conditions.

Step 2 of CAIP begins with an assessment of historical climate extremes and trends, including recent weather-related loss and damage. Some information can be obtained—even for data-sparse regions—from globally gridded observed climate and reanalysis data, such as CRU TS 4.09[2] and ERA5,[3] respectively. The analysis then considers future climate model projections, taking account of uncertainty as a guiding principle. These activities help to shape a holistic picture of present and future risks, including the types of climate hazard that are most likely to impact development outcomes. Importantly, this evidence helps guide the adaptation packages developed in Step 3. For example, information about historical climate damage and recent trends can help build the case for low-regret, early adaptation. Information about future climate change can strengthen the case for building climate resilience and identify future risks that might benefit from early adaptive management actions. This leads to an extended set of activities as part of a strategic or programmatic **climate diagnostic**.

The analysis in this note builds on existing NAP and NDC information, including national risk assessments and climate change scenarios. However, there is greater emphasis on assessing climate metrics that inform adaptation investments—to understand what really matters to development outcomes. This requires drawing on sources such as the following:

- Perspectives and local knowledge from stakeholder committees and working groups.
- Observed weather and climate data, including trend analysis.
- Baseline extreme weather events and their impacts.
- Media and community reports of relevant weather impacts.
- Global and regional climate model projections under various emissions scenarios.
- Portals providing maps, time series, and distributions of future climate scenarios.
- Peer-reviewed scientific literature on the regions and sectors of interest.
- Technical assistance and consulting reports on similar projects.

The CAIP process does not undertake a detailed analysis, such as complex modeling of climate and its impacts, because this could require considerable time and resources. At this stage, the focus is on understanding what matters for identifying investments to be prioritized for financing in the near term. More in-depth analysis can be undertaken later as part of detailed project preparation. The CAIP approach emphasizes faster but still robust analysis to inform adaptation investments. To facilitate this, the approach identifies key **indicators** of relevance for the development sector of concern (Box).

The analysis then scans for readily available indicators to quantitatively assess the influence of climate change. The indicators are selected through a review of key climate vulnerabilities. This is done to scope the most significant present and future climate risks without the need for detailed modeling or analysis.

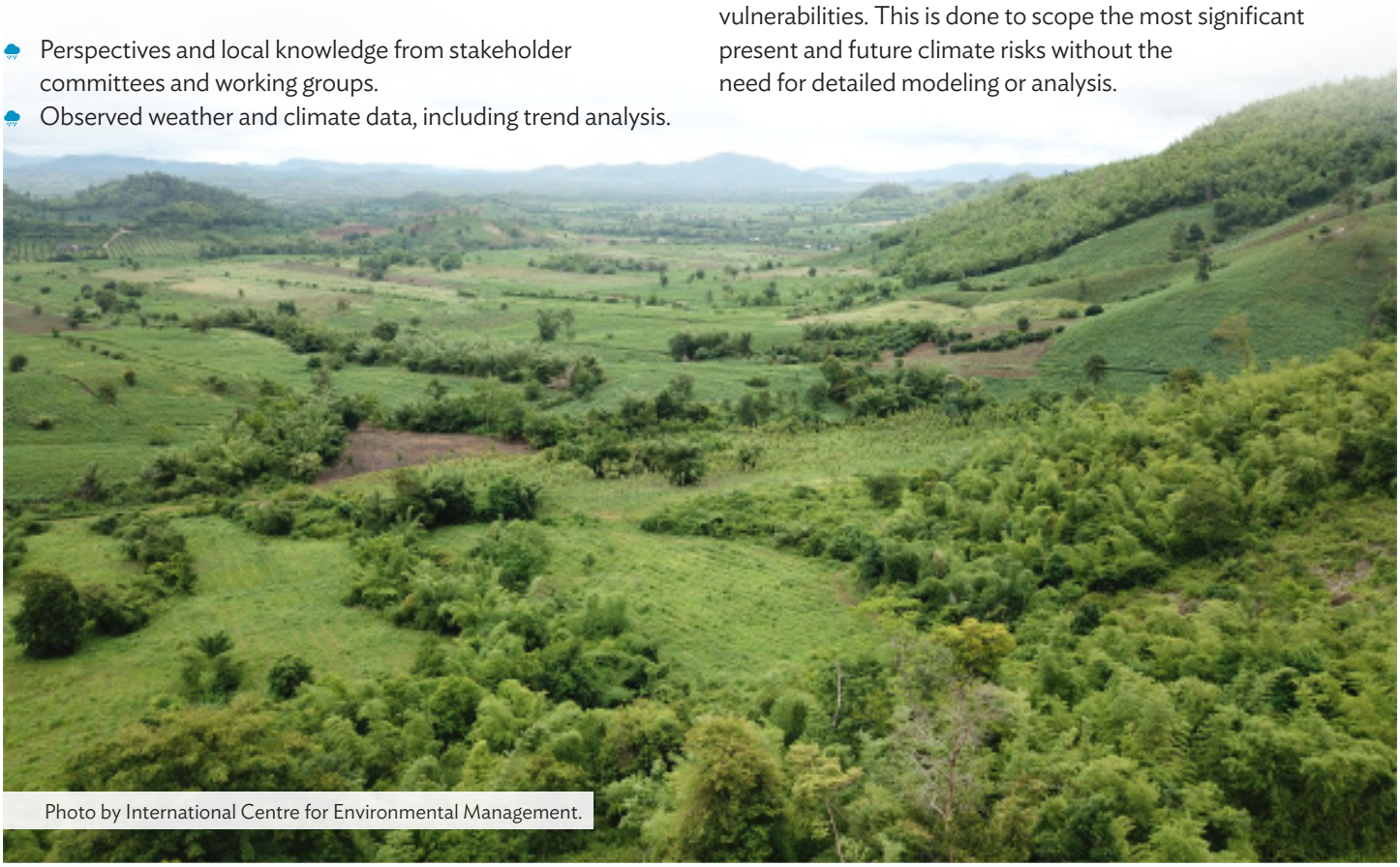


Photo by International Centre for Environmental Management.

[2] Climatic Research Unit (University of East Anglia) and Met Office. n.d. CRU TS Version 4.09 https://crudata.uea.ac.uk/cru/data/hrg/cru_ts_4.09/ (accessed 17 July 2026).

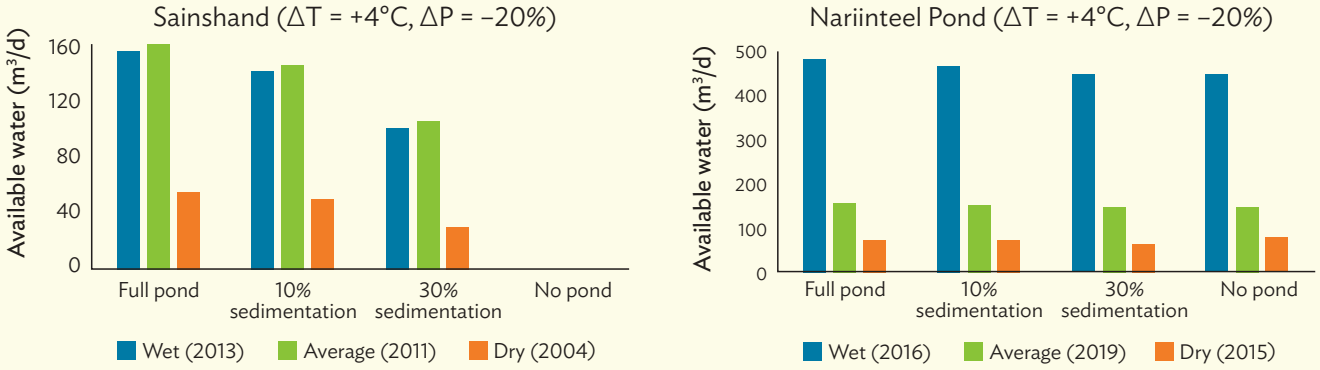
[3] Copernicus Climate Change Service. n.d. *ERA5 Hourly Data on Single Levels from 1940 to Present*. https://cds.climate.copernicus.eu/datasets/reanalysis-era5-single-levels (accessed 17 July 2026).

For instance, Table shows the seven indicators used in a climate diagnostic for the water sector CAIP for Bhutan. All of these were derived from historical data and climate model projections of daily precipitation and temperature, with only modest amounts of post-processing. They included counting the number of days above or below a temperature

Box: Climate-Smart Siting, Design, and Operation of Water Harvesting Ponds in Mongolia

Mongolia's Vision 2050 called for the creation of ponds and underground reservoirs on natural landforms and river basins to collect water from precipitation, springs, melted snow and ice. New ponds are meant to improve rural water availability for livestock, small-scale vegetable growers, and irrigated fodder. However, rising air temperatures and greater evaporation, combined with decreasing summer rainfall, are contributing to loss of snow and ice, thawing permafrost, shrinking and drying up of small lakes, and periods of below-average runoff and protracted drought. Risks of extreme summer rainfall, flash flooding, landscape erosion, and sedimentation are also rising.

The CAIP climate diagnostic was used to evaluate whether prospective sites for water harvesting ponds can improve water availability despite climate variability and change. This was tested using model simulations of pond water balance, reliability, and yields under hotter, drier, wetter, and average rainfall conditions at illustrative runoff-fed (Sainshand) and spring-fed (Nariinteel) sites. The impact of sedimentation on ponds was also assessed.



The model experiments showed the amount of water (cubic meters per day) that could be provided by ponds under climate variability and change. This was found to depend on the amount of water in the pond at the start of summer, the timing of summer rainfall-runoff, whether the source is rainfall-runoff or spring flow, and the rate of pond sedimentation. The results showed much greater benefits from runoff-fed (left) than spring-fed (right) ponds.

These insights led to the development of a checklist for climate-smart pond siting, design, and management. This is intended to reduce the risk of ponds filling with sediments, running out of water, or being damaged by floods. Simulations of increased water availability were also used in the economic valuation of pond benefits.

CAIP = Climate Adaptation Investment Planning.
Source: Authors.

Table: Climate Change Indicators for the Bhutan Water Economy

Indicator	Explanation	Interpretation for the Bhutan water economy
Annual frequency of T_{min} < 0°C (days)	Count of the number of frost days	Likelihood of permafrost thaw, snow and ice melt, glacial lake outburst floods, and damage to infrastructure
Average spring air temperatures (°C)	Proxy for pre-monsoon (March–May) snow and ice melt	Likelihood of reduced areas of snow and ice, increased river flows
Growing season length (days)	Span in number of days with daily mean temperature >5°C	Increased productivity and yields of crops
Maximum 1-day rainfall total (mm)	Proxy for flash flood 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, reservoir sediments
Maximum dry spell length (days)	A proxy for meteorological drought	Risk of less soil moisture, increased demand for irrigation water, and risk of reduced spring flows
Reference crop evapotranspiration	A proxy for crop water demand	Modest increase in evapotranspiration by crops is expected due to higher air temperatures

T_{min} = minimum daily air temperature.
Source: Authors.

threshold; deriving annual precipitation maxima; or calculating evapotranspiration from an empirical equation. Despite their simplicity, these indicators provide valuable insights into evolving risks from flash floods, droughts, snow and glacier melt, soil erosion, land instability, and increased crop water demand. They are also readily customized for different sectors. A similar set of indicators was developed for the agriculture sector in the Cambodia CAIP. More extensive lists of climate impact drivers and extremes are available in the Intergovernmental Panel on Climate Change's latest list,[4] or in a critique of widely adopted hydroclimate indices.[5]



Photo by Jitendra Bajracharya, ICIMOD.

Adapting to Uncertain Climate Variability and Change

Conventional climate diagnostics typically focus on changes in annual or seasonal means of temperature and precipitation. However, future climate change is uncertain because of ambiguity about natural climate variability, emissions of greenhouse gases, and climate model accuracy. Although uncertainty is not a reason for inaction, it is critical to consider it in adaptation investment planning because the ultimate objective is to mobilize financing for implementation. The CAIP process addresses this uncertainty by focusing on two key issues.

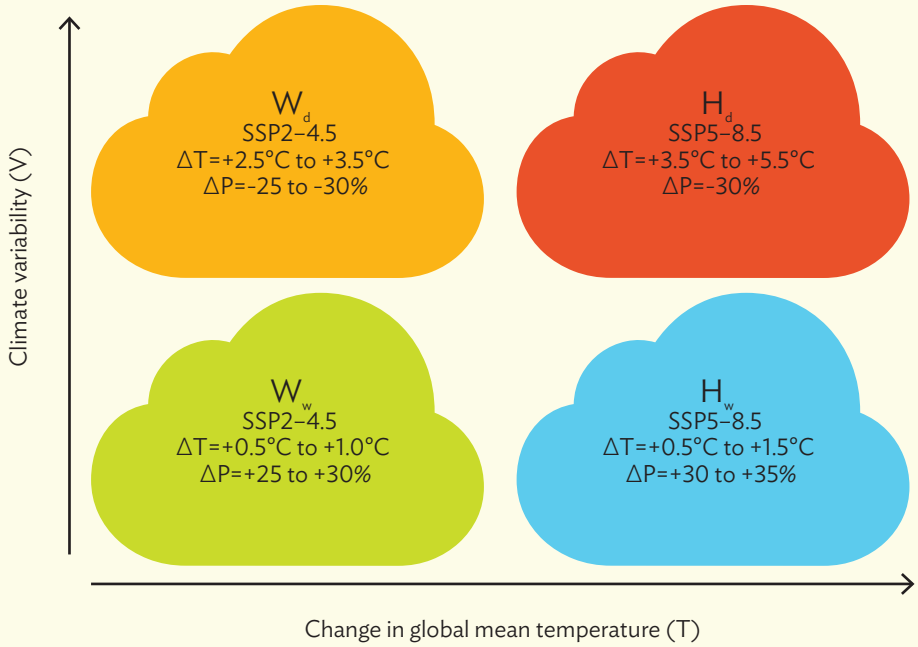
First, when looking at gradual changes, around which there is high confidence in the direction of change—such as for air temperature or sea level rise—the approach works with the ensemble mean or a percentile (such as the 5th or 95th percentile) of the climate-model range. Up to the 2050s, there is little difference in annual mean temperature projections among various emissions scenarios.

Second, for climate parameters such as rainfall or extreme weather events, the changes projected from climate models need to be seen in the context of existing high year-to-year **variability**. In many regions, climate change signals may be swamped by larger seasonal variations in weather driven by phenomena such as warm and cool phases of the El Niño–Southern Oscillation (ENSO), the Indian Ocean Dipole, or positive and negative phases of the North Atlantic Oscillation.

[4] Intergovernmental Panel on Climate Change. 2021. *Annex VI: Climatic Impact-driver and Extreme Indices. In Climate Change 2021: The Physical Science Basis.* Cambridge University Press. pp. 2205–2214. https://doi.org/10.1017/9781009157896.020.

[5] M. Ekström et al. 2018. *Robustness of Hydroclimate Metrics for Climate Change Impact Research.* WIREs Water. 5 (4). e1288. https://doi.org/10.1002/wat2.1288.

Figure: Climate Change Story lines for Northwestern Cambodia



ΔP = change in annual mean precipitation, ΔT = change in annual mean temperature, Hd = hot–dry, Hw = hot–wet, SSP = Shared Socioeconomic Pathway, V = regional climate variability, Wd = warm–dry, Ww = warm–wet.
Note: The four story lines combine projected changes in global mean temperature and regional climate variability during El Niño and La Niña conditions by the 2050s. Ww and Hw represent La Niña and La Niña+ conditions; Wd and Hd represent El Niño and El Niño+ conditions. El Niño+ and La Niña+ represent the expected changes in temperature and precipitation under higher global mean warming. The annual mean temperature (ΔT) and precipitation (ΔP) changes for 2041-2070 relative to 1991-2020 were based on the 95% range of variability in CMIP6 climate models with low or high equilibrium climate sensitivity, under SSP245 and SSP585. Lower bound values were based on output from NorESM2; the upper bound is from UKESM1. Temperature changes are rounded to the nearest 0.5°C; precipitation to the nearest 5%. This approach captures the range in uncertainty to climate variability (ENSO), model physics, and greenhouse gas emissions to the 2050s.
Source: Authors.

These global and regional-scale climate patterns can have profound impacts on the local likelihood and severity of cyclones, floods, heat waves, and droughts, as well as associated hazards from wildfires, debris flows, avalanches, pests, and diseases.

The CAIP process takes account of such factors—for example, as with the analysis of the agriculture sector in the Cambodia CAIP. During El Niño episodes, the weather in the country tends to be hotter and drier, whereas during La Niña phases there is more rainfall than normal. This variability leads to periodic droughts, floods, extreme heat, and wildfires. It is often these periods of variability around the average climate that drive major agricultural impacts and so should inform decision-making for investments. An analysis of future climate change, therefore, needs to consider the extra risks from changes in variability as well as in the mean climate. To illustrate, by the 2050s, annual mean temperatures in Cambodia are projected to increase by as much as 2°C, and annual rainfall could change by about 5%. However, much larger changes may occur during El Niño or La Niña years—in this case, more than 5°C warming and about 30% above or below mean rainfall. The combined effect of climate variability and change is an increased likelihood of more severe weather events, and it is critical that these are considered when planning adaptation investments.

To address this, the Cambodia CAIP used four story lines to consider alternative global warming futures as well as the effects of regional climate variability (Figure). This looked at alternative emission scenarios and the potential effects on changes in temperature (ΔT) and precipitation (ΔP) for scenarios where (i) the world achieves the Paris Agreement goals of limiting warming to below 2°C, or (ii) there is much higher warming. The story lines are represented on the horizontal axis, along with the potential changes in climate variability (from ENSO), represented on the vertical axis.

The results help decision makers in the agriculture sector to consider a much broader range of climate conditions than would otherwise be suggested by the projected changes in mean climate. This can include the effects of El Niño episodes on top of high warming scenarios (top right), as well as the potential increased rainfall from global warming with La Niña phases and associated high flood risks (lower right).

Locally relevant combinations of readily available indicators and uncertainty analysis were used in the various CAIPs to identify key risks and stresses that adaptation should prioritize. As an example, agriculture in Cambodia needs to address threats posed by: (i) higher peak temperatures causing reduced crop



Photo by Rigzin Yeshi Jamtsho.

yields; (ii) extreme heat and humidity impacts on farmer health and productivity; (iii) increased wet season variability impacting crop choice, planting and harvesting dates; (iv) more extreme rainfall and floods damaging rural infrastructure; (v) higher temperatures increasing energy demand for cool storage of agricultural produce; and (vi) changes in the availability of water supplies, crop water demand, and the overall water balance.

With these risks in mind, it was then possible to prioritize measures and shape robust adaptation investment packages in the following steps of the CAIP process. For example, recognition of rising extreme heat stress on agricultural workers in Cambodia prompted calls for adaptation investments in early warning systems, awareness-raising and health promotion, labor standards, regulations, and mechanization. Nonetheless, simple ready indicators may overlook more complex, compounding hazards such as heat waves with droughts. They also tend to foreground climate hazards and background socioeconomic vulnerability. NDCs and NAPs identify high-level priorities—the most vulnerable sectors, people, and places—that the CAIP process can then examine in depth and translate into investment packages.

Concluding Lessons and Insights

The application of this approach to the specific investment packages in different countries, including for various sectors, identified several lessons and insights:

Stakeholder engagement and local inputs are vital for identifying key climate vulnerabilities and sources of information. Local experts are also crucial for spotting any omissions in the climate diagnostic and in ground-truthing adaptation priorities. Such interactions create formal and informal opportunities for two-way capacity development for both local and international technical assistance teams.

Synopses of loss and damage from recent or historical extreme weather provide useful starting points for the climate diagnostic. These synopses help ground analyses in "lived experiences" and uncover opportunities for early, low-regret adaptation, such as strengthening hydrometeorological networks, enhancing early warning systems, or improving hazard maps. These activities yield benefits regardless of the pace and direction of climate change and so are likely to attract financing.

Natural climate variability and climate model accuracy are the most important sources of uncertainty in regional climate projections to the 2050s. Therefore, it makes sense to focus on these components within the Step 2 climate diagnostic of CAIP. This can be achieved by evaluating ranges of climate conditions from the latest ensembles of climate models rather than concentrating on seasonal and annual means. However, details about the specific climate model(s) or ensemble, emissions scenario(s), baseline, future period, range of the distribution

covered, and any other post-processing, should always be made explicit. This helps make the underpinning assumptions transparent for future reference or audit.

Readily available indicators provide useful proxies for present and projected climate risks without having to undertake detailed impact modeling. For example, changes in the annual maximum 1-day rainfall total can be used as an indicator of flash flood, landslide, and erosion risks. These indicators can also be used for quick comparative analysis of changes in different areas. This can help to prioritize adaptation investments in places experiencing the most rapid changes or relatively high risk. Other indicators—such as the number of days with maximum temperatures above 35°C—may highlight risks to the health of workers from heat waves or economic impacts from reduced capacity for outdoor labor.

Story lines are useful for describing the future climate and other major drivers of change in a more holistic way. As mentioned, the climate diagnostic should capture climate variability and change—especially in regions where climate modes like ENSO are associated with hazards such as floods, droughts, and heat waves. Story lines may also be applied at the system level, for instance, to articulate how changes in headwater land use (driven by drought and wildfires) can have ramifications for the downstream operating and maintenance costs of adapting to cascading impacts such as flash floods, landslides, and sediment transport and deposition.

Unprecedented weather hazards and impacts could still occur—even beyond the ranges of climate variability and change envisaged by readily available indicators and story lines. This means that the adaptation portfolios considered in Step 3 of CAIP should have a mix of reactive, short-term disaster preparedness and response; incremental, long-term disaster risk reduction measures; and early steps for more transformative adaptations that address the drivers of vulnerability at the system level.

The Climate Adaptation Investment Planning (CAIP) program helps developing member countries translate their adaptation priorities into strategic investment packages and bankable project pipelines. The CAIP Lessons Series shares practical insights from applying the five-step CAIP approach in the program's first six participating countries.

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