



WATER

Climate and Disaster Risk Screening Reference Guide

This guide supports Task Teams in identifying potential climate and disaster risks and taking action to build resilience in Water Sector operations.



WORLD BANK GROUP
Climate Change



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CLIMATE AND DISASTER RISK SCREENING: AN OVERVIEW

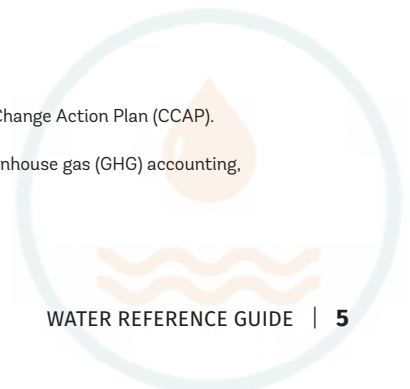
1.1 What is Climate and Disaster Risk Screening and Why is it Important?

Climate change puts the World Bank's goals of ending extreme poverty and promoting shared prosperity at risk. To achieve durable and sustainable development, all IBRD and IDA lending operations are required to be screened for climate and disaster risks during preparation.¹ These include Investment Project Financing (IPF), Development Policy Financing (DPF) and Program-for-Result (PforR) operations, including Additional Financing (AF), Multiphase Programmatic Approach (MPA), Emergency Operations, and Guarantees. Climate and disaster risk screening is one of the five corporate climate commitments.²

Screening is a process for identifying short and long-term risks to build resilience in development projects, policies, and programs. Risk identification and proactively incorporating resilience measures – at an early stage of project design – can help projects achieve their development objectives.

¹ Risk screening is required for IDA and IBRD operations under IDA17,18 and 19 policy commitments, and the WBG Climate Change Action Plan (CCAP). Screening has been a requirement for all IDA operations since July 1, 2014 and for all IBRD operations since July 1, 2017.

² The World Bank has five corporate commitments related to climate change: (i) climate and disaster risk screening, (ii) greenhouse gas (GHG) accounting, (iii) shadow price of carbon (SPC), (iv) climate co-benefits, and (v) climate indicators.



1.2 How Does Climate and Disaster Risk Screening Apply to Water Projects?

The physical effects of climate change are largely experienced through the hydrologic cycle.³ Nine out of ten natural disasters are water-related.⁴ Meanwhile, climate change is expected to exacerbate water challenges from both the supply and demand side – affecting quality, quantity, as well as the intensity of precipitation and runoff. For example:

- Climate change can degrade water infrastructure, such as increasing the sedimentation of water reservoirs, and extreme weather can damage or disrupt water services.
- Heavy precipitation and flooding can affect water sanitation and the spread of water-borne diseases.
- Extreme heat can increase evapotranspiration, heightening the demand on water supply, while droughts can decrease available water, affect sanitation/health, and place increasing stress on limited water resources.

Screening for risks and considering climate change and disasters – over the lifetime of a project – presents a way for project teams to identify risks and embed appropriate measures to manage those risks. The World Bank’s Climate Change Group has developed risk screening tools (FURL: CCSCREEN/) to support systematic integration of climate and disaster risks into early stages of an operation’s design and national/sectoral development planning.

The World Bank provides sector-specific versions of the screening tools in two modalities: (a) In-Depth Screening Assessment and (b) Rapid Screening Assessment. Users have the option of utilizing external resources as well, including those listed in the Screening Support and Resources section.

Table 1 | World Bank Climate and Disaster Risk Screening Tools (FURL: CCSCREEN/)

| Tools | Description | Sub-Sectors |
|--------------------------------------|---|--|
| In-Depth Screening Assessment | Recommended for all operations for a detailed consideration of climate and disaster risks. Also for users who are new to the screening process and would benefit from step-by-step guidance. | The in-depth and rapid Water screening tools include subsectors related to dams and reservoirs; land use and watershed management; riverine flood protection; wastewater; water supply; and sanitation. |
| Rapid Screening Assessment | For users who are familiar with the screening process and have a good understanding of the risks that may impact their project/program. Also for operations where climate and disaster risks are considered low or minimal. | |
| National Policy Tool | For Development Policy Financing, Program-for-Results Financing ⁵ , Systematic Country Diagnostics, Country Partnership Frameworks, national plans, multisector and sector-wide strategies | Select Water as a priority sector when using the National Policy Tool. |

In addition, the Water GP has developed guidance documents to include resilience considerations in project planning and decision making, in which climate risk screening is the first step, including:

- The **Decision Tree Framework**⁶ This framework adds to the **Climate and Disaster Risk Screening Tools** by offering analytical solutions to address the “so what question” when the climate screening suggests a project is at risk; it outlines a pragmatic bottom-up process for assessing project risks that can support decision making and project planning under uncertainty. The Decision Tree offers a 4-step approach, the first two (project screening and initial analysis) being similar to the climate and disaster risk screening, followed by an in-depth analysis and climate risk management responses.

- **Building the Resilience of WSS Utilities to Climate Change and Other Threats – A Road Map**⁷ This document gives practical guidance to incorporate uncertainty into water supply and sanitation (WSS) utilities' alternatives—through design, planning, or operations. It aims to help Task Teams (i) design projects that consider current and expected climate change impacts and (ii) maximize their projects' adaptation and mitigation co-benefits. To help water utilities incorporate resilience and robustness in their choices, the Road Map proposes a process in three phases that can inform the design of strategies necessary to improve WSS services provision. The approach reveals the strengths and vulnerabilities of investment plans concisely and helps utilities invest robustly by identifying near-term, no-regret projects that can be undertaken now, while maintaining flexibility and adaptively as future conditions evolve.
- **The Resilient Water Utility Infrastructure Design Brief** This document provides general guidance on resilient design principles of specific assets within a broader water utility system to allow Task Teams to verify that Bank-financed infrastructure utilizes sound resilience design principles and contributes to the overall objective of utility resilience. It also complements the Road Map document mentioned above.

These guidance documents aim to help Task Teams allocate climate risk assessment efforts in a way that reflects various projects' sensitivity to climate-related (and other long-term) risks. When more in-depth analyses are needed, methodologies for decision making under uncertainty (DMU) are suggested, complementary to the in-depth screening assessment. These DMU methodologies help identify specific project vulnerabilities and solutions that may help alleviate uncertainties.

1.3 What is the Process for Climate and Disaster Risk Screening?

Project teams are encouraged to screen their projects at concept stage and update their screening as more project information/details become available.

The screening can be carried out by simply:

- Collecting basic project information such as the location of the project and its physical and non-physical components.
- Completing the Four Steps (See Figure 1):
 - 1. EXPOSURE** – evaluate the extent to which the project location will be exposed to climate change and disasters.
 - 2. IMPACT** – assess how these hazards may impact the project's physical investments and beneficiaries. Start to consider risk mitigation measures.
 - 3. ADAPTIVE CAPACITY** – examine how a project's non-physical and broader sector and development context may influence the level of risk posed to the project. Also consider impacts on vulnerable groups.
 - 4. OVERALL RISK RATING** – rate the overall risk to the project outcome based on the previous considerations.

³ Adams, R.M., and D.E. Peck. 2018. "Effects of Climate Change on Water Resources." *Choices* 23 (1): 12–14.

⁴ The Human Cost of Weather Related Disasters. The United Nations Office of Disaster Risk Reduction. 2015. https://www.unisdr.org/2015/docs/climatechange/COP21_WeatherDisastersReport_2015_FINAL.pdf

⁵ For PforRs that finance physical infrastructure and works, teams should use the in-depth or rapid Water sector assessment tool, as opposed to the National Policy tool.

⁶ Confronting Climate Change Uncertainty in Water Resources Planning and Project Design: The Decision Tree Framework. <http://documents.worldbank.org/curated/en/516801467986326382/Confronting-climate-uncertainty-in-water-resources-planning-and-project-design-the-decision-tree-framework>.

⁷ Building the Resilience of WSS Utilities to Climate Change and Other Threats : A Road Map. <http://documents.worldbank.org/curated/en/425871546231664745/Building-the-Resilience-of-WSS-Utilities-to-Climate-Change-and-Other-Threats-A-Road-Map>.

Figure 1: Climate and Disaster Risk Screening Four Steps

1) Exposure:

What types of climate and geophysical hazards might affect the project location?

2) Impacts:

What are the potential impacts of these hazards to the project's physical investments and beneficiaries?

3) Adaptive Capacity:

How might the non physical components of the project and the broader sector and development context reduce or increase risks? How might vulnerable groups be affected?

4) Overall Risk Rating:

What is the project's overall climate and disaster risk rating? How might project outcomes be affected?



The Four Steps are aimed at helping Task Teams design climate change and disaster-resilient projects. Addressing climate risks during project design can help protect project investments. For example, Task Teams can:

- Proactively optimize the use of water through better planning, pricing, and storage, as well as creating incentives for reuse and recycling that can enhance climate resilience.
- Support natural and engineered protective measures to reduce the impacts from increased or reduced levels of precipitation and contribute to watershed management. For example, using natural infrastructure, such as riparian buffer zones, to support healthy watersheds while strengthening resilience to flooding.
- Improve integration and knowledge sharing between water, land resource management, and urban planning, as well as enhance collaboration across local, national and regional levels of stakeholders.

AFTER RISK SCREENING

SCREENING RESULTS CAN HELP INFORM MORE CLIMATE AND DISASTER-RESILIENT PROJECT DESIGN. ADDRESSING RISKS DURING PROJECT PREPARATION CAN HELP IMPROVE PROJECT OUTCOMES. SEE SECTION ON NEXT STEPS FOR FURTHER GUIDANCE.

1.4 Who Does What and When During the Screening Process?

To incorporate results from risk screening in the Project Concept Note (PCN), Project Appraisal Document (PAD), or Project Paper (PP), Task Teams should:

- 1) Summarize identified climate and disaster risks in the “Country Context,” “Sectoral and Institutional Context” and/or “Key Risks” sections of project documents.
- 2) Where risks exist, teams should discuss resilience-enhancing measures in appropriate sections, such as the “Project Description” section, the Theory of Change/Results Chain, and the Results Framework.

Screening good practices for project teams include:

• At Concept Stage

- o Engage early with Global Practice (GP) and regional focal points on integrating climate and disaster risk considerations in project design. See the [Water GP Operational Services webpage](#) for resources.
- o Incorporate the key data and findings from the screening in the PCN document, discuss screening results at the PCN review meeting and record your decision on potential risks and corresponding risk levels in the PCN.

• At Project Appraisal Stage

- o Design project components to integrate resilience measures that address identified risks.
- o Discuss key climate and disaster risks and resilience considerations at the appraisal stage and document risks and resilience measures in the PAD or PP.
- o Update the previous climate and disaster risk screening as further project information/details become available, for example at the Decision Meeting stage.

Figure 2 depicts roles and responsibilities for the Task Team, Climate Change Group, Global Practice (GP) focal points, and regional focal points on risk screening at key points in the project cycle.

Figure 2: Climate and Disaster Risk Screening Roles and Responsibilities

| | Concept Review Stage | Decision Meeting Stage | Board Approval Stage |
|------------------------------|--|--|---|
| Task Team | Carries out the climate and disaster risks screening of projects. Summarizes risks in the PCN. In the Operations Portal, marks the operation as screened and whether potential resilience-enhancing measures have been identified in the PCN (where risks exist.) | Conducts a more detailed risk assessment as needed/ identifies further opportunities to integrate resilience measures. Updates the summary of risks and resilience measures in the PAD. In the Operations Portal, confirms the operation is marked as screened and that resilience-enhancing measures have been identified in the PAD. | At board stage, ensures that risks and resilience measures are integrated in the PAD and that screening flags are updated in the Operations Portal. |
| Climate Change Group | Provides guidance and customized support to Task Teams on climate and disaster risk screening. (This includes the WB Climate and Disaster Risk Screening Tools, Climate Change Knowledge Portal, training, and technical advice on demand through the Help Desk.) Tracks compliance with the risk screening commitment on a quarterly basis. | | |
| Global Practice Focal Points | Provides GP-specific technical advice and support to Task Teams on climate and disaster risk screening (varies across GPs). Ensures compliance with the risk screening commitment through follow-ups with Tasks Teams and liaising with CCG on a quarterly basis. | | |
| Regional Focal Points | Provides region-specific technical advice and support to Task Teams on climate and disaster risk screening (varies across regions). | | |

1.5 How Does Risk Screening Link with Other Climate Change Commitments?

Risk Screening and Climate Co-Benefits

Screening for climate and disaster risks in World Bank projects has direct linkages with climate co-benefits⁸ – particularly for adaptation.⁹ Adaptation co-benefits are assigned to project activities when the project document: (i) sets out the climate change vulnerability context of the project; (ii) makes an explicit statement of an intent to address the identified climate vulnerabilities as part of the project; and (iii) articulates a clear and direct link between specific project activities and the project’s objective to reduce vulnerability to climate change. This means the project document must reflect these three key steps to receive adaptation co-benefits. More detail on climate co-benefits methodology, including GP-specific guidance, can be found on the [co-benefits webpage](#) (FURL COBENEFITS/), and in the [Water GP Guidance Note on Climate Change Adaptation and Mitigation Co-benefits Tracking](#).¹⁰

A thorough risk screening can help Task Teams establish the project’s climate vulnerability context – the first required step to achieve adaptation co-benefits according to the [Joint MDB Methodology for tracking climate adaptation finance](#). Task Teams are also able to fulfil the other two required steps (clear intent to address climate vulnerability and risk; linkage between project activities and the vulnerability context) by including project activities that increase resilience to identified risks. For example:

- Project activities that help cities meet future water demand and enhance resilience against water scarcity and flooding, such as through efficiency and maintenance upgrades, may be eligible for adaptation co-benefits. The Baghdad Water Supply and Sewerage Improvement Project ([P162094](#)) received adaptation co-benefits for actions such as construction of a reservoir that improves the quality and reliability of water supply (eliminating high pressure variation from direct pumping into the distribution network) as well as supporting water efficiency through leak repair, service connection replacement, and monitoring systems in targeted municipalities that were vulnerable to drought. Rehabilitation of the current sewage systems to strengthen resilience in the event of flooding, exacerbated by climate change, also contributed to adaptation co-benefits.
- Project activities that support climate resilient design in irrigation management strategies and system performance assessments may be attributed adaptation co-benefits. The Indonesia - Strategic Irrigation Modernization and Urgent Rehabilitation Project ([P157585](#)) was eligible for adaptation co-benefits for activities such as conducting a water needs assessment that included changes in the hydrological cycle due to climate change and conducting of climate smart agriculture pilot projects to increase agricultural production in the event of droughts.
- Project activities, such as incorporating climate considerations into the design of rural water supply systems – catchment management for soil and water conservation as well as riverbank restoration – may be eligible for adaptation co-benefits. The Integrated Water Management and Development Project in Uganda ([P163782](#)) addressed vulnerabilities to flash floods and droughts by providing access to gravity-fed irrigation and drainage services. The Lower Shire Valley Landscape Project in Malawi ([P158805](#)) was eligible for adaptation co-benefits for strengthening management of wetlands/protected areas and increasing access to water supply services while using solar power for pumping water. The Benin Rural Water Supply Universal Access Program ([P164186](#)) achieved adaptation co-benefits by strengthening resource management through improved monitoring of groundwater levels and extractions as well as establishing performance-based contracts with regional operators.

Other examples can be found on the [Climate Co-Benefits Dashboard](#) (FURL: CLIMATEBASHBOARD/) by viewing projects under the Water “GP View” option.

Risk Screening and Climate Indicators

Climate and disaster risk screening can help identify risks to the project, which can inform associated resilience building measures and aid with the selection of relevant climate indicators.¹¹ Indicators allow Task Teams to define and measure an operation's progress on whether the desired result was achieved, whether an activity was conducted, or whether short-term/medium-term/long-term change occurred. These indicators can be both PDO-level or intermediate-level results indicators. Appropriate climate change-related indicators are rooted in the project's theory of change. Task Teams have the flexibility of designing a results framework that is most appropriate for their operation, including whether these indicators are outcome or output oriented.

For IDA and IBRD operations with over 20 percent climate co-benefits, the incorporation of at least one climate indicator is required under the IDA19 policy commitment and WBG 2025 Targets and Actions¹² For an indicator to be considered a climate-related indicator, it must explicitly refer to a climate-related output or outcome e.g., "Number of farmers using climate-resilient practices." For more information, see visit the [Resilience Monitoring and Evaluation \(ReM&E\) Portal](#) (FURL: Resilience/) and the [Climate Indicators Page](#) (FURL: CIndicators/).

Risk Screening and the Environmental and Social Framework

Climate and disaster risk screening can help to inform the Environmental and Social Framework (ESF) process, though these are separate requirements. The climate corporate commitment requires Task Teams to undertake climate and disaster risk screening for all IBRD/IDA lending operations, ideally at concept stage, including Investment Project Financing (IPF), Development Policy Financing (DPF), Programs for Results (P4R), and guarantees. The ESF only applies to IPFs, including technical assistance projects, and IPF components of P4Rs. It requires borrowers to comply with ten Environmental and Social Standards (ESS), some of which have direct and indirect linkages to climate and disaster risk screening.

Screening can help identify, inform, and address relevant climate and disaster risks as applicable.¹³ For example, the risk screening might identify an increased risk of flooding, which could then impact the occupational health and safety of workers. Thus, Task Teams are encouraged to share screening results with their Environmental and Social Specialists. For more information on how climate and disaster risk screening is directly and indirectly related to specific elements of the ESF, please see the [Linkages between the Environmental and Social Framework and the Climate and Disaster Risk Screening Corporate Commitment](#) kiosk announcement, and the [Technical Note on Climate and Disaster Risk Screening and ESF](#).

⁸ Climate Co-Benefits refer to the share of WBG lending at commitment that contributes to climate change mitigation and/or adaptation. The calculation for climate co-benefits is based on the joint Multilateral Development Bank (MDB) methodologies for tracking climate finance in climate change adaptation and mitigation.

⁹ Mitigation co-benefits are determined based on a positive list of activities that are compatible with low-emission pathways that have been agreed upon by MDBs to be classified as climate mitigation finance. Adaptation co-benefits are assigned to activities that reduce the risks or vulnerabilities posed by climate change and increase resilience using a three-step approach.

¹⁰ Note that Task Teams are not expected to calculate climate co-benefits as these calculations are performed by the climate co-benefits assessment team in the CCG.

¹¹ Climate Indicators monitor and track the progress of climate results, measuring outputs or outcomes of mitigation and/or adaptation interventions.

¹² As the final climate co-benefits percentage is calculated after project approval, project teams are highly encouraged to include an indicator to monitor and track their progress if financing a climate intervention.

¹³ Risk Screening has direct linkages with the following ESS's: Assessment and Management of Environmental and Social Risks and Impacts (ESS1), Resource Efficiency and Pollution Prevention and Management (ESS3), Community Health and Safety (ESS4), and Biodiversity Conservation and Sustainable Management of Living Natural Resources (ESS6). Risk Screening has indirect linkages with the following ESS's: Labor and Working Conditions (ESS2), Land Acquisition, Restrictions on Land Use, and Involuntary Resettlement (ESS5), Indigenous Peoples / Sub-Saharan African Historically Underserved Traditional Local Communities (ESS7), Cultural Heritage (ESS8), Financial Intermediaries (ESS9), and Stakeholder Engagement and Information Disclosure (ESS10).

Risk Screening and the Resilience Rating System

The resilience rating system is designed to create incentives for donors and countries to engage in more and better climate adaptation, as well as enhance transparency and effective reporting on what the WBG and clients are doing to manage risks.

Screening can help inform the two dimensions of resilience that the rating system will cover: the “resilience of the project,” or the extent to which a project’s financed assets have considered climate and disaster risks in their design, and the “resilience through the project,” or how a project is enhancing the resilience of the targeted sector and/or beneficiaries through its interventions. While the rating system will be different for each sector, higher ratings are given to projects that show an in-depth understanding of potential climate and disaster risks, incorporate risk considerations in the economic or financial analysis, and take steps to proactively manage these risks. For more information on the resilience rating system, please see the Resilience Rating System: [A Methodology for Building and Tracking Resilience to Climate Change](#).



Photo: World Bank



Photo: World Bank



2

HOW TO CONDUCT A CLIMATE AND DISASTER RISK SCREENING

This section will walk through the four steps of risk screening, highlight key questions, provide prompts for when to reference further information, and include relevant climate and disaster risk information that may be useful to transportation projects. The screening tools follow the **Four Steps**:

1. Exposure
2. Impact
3. Adaptive Capacity
4. Overall Risk Rating



Step 1.

Exposure of the Project Location to Climate and Geophysical Hazards

- **Overview.** This step assesses the current and future exposure of the project location to relevant climate and geophysical hazards. See Table 2 for a list of climate hazards, a description of how they might impact water projects, and examples of risk mitigation measures.
- **Information needed.** The assessment should be based on knowledge of the project location and components as well as climate and disaster risk information from global, quality-controlled sources. These include:
 - o **Climate Change Knowledge Portal**¹⁴ (FURL: CCKP/) is the World Bank’s ‘one stop shop’ for global data on both historic and future climate trends, vulnerabilities, and sectoral impacts for all countries. **Country profiles** and subnational data are also available.
 - o **ThinkHazard!**¹⁵ developed by the World Bank Global Facility for Disaster Reduction and Recovery (GFDRR), provides historic hazard level ratings for all countries and sub-national units. Rated hazards including extreme heat, water scarcity, flooding, earthquakes, landslides, tsunamis, cyclones, and wildfires, can help identify a project location’s baseline exposure to risks.
 - o **National meteorological agencies** often provide more localized climate information. To access these, search by country via the World Meteorological Organization (WMO) member page.
- **Key questions and considerations.**
 - *What have been the historical trends in temperature, precipitation, flooding, and drought conditions?*
 - *How are these trends projected to change in the future in terms of intensity, frequency, and duration?*
 - *Has the location experienced sea-level rise, strong winds and/or geophysical hazards (earthquakes, landslides, tsunamis), in the past that may occur again in the future?*
 - *Given climate projections and geophysical hazards, is this an appropriate location for this project? How can the project adapt to these risks?*
- **Goal:** Task Teams will understand, rate, and justify their analysis based on the exposure of their project location to hazards.
- **Rating Guide:** Task Teams are advised to base the “current” exposure risk rating on the hazards identified by **ThinkHazard!** for the countries and sub-national units relevant to the project location. Complementary information can be found in the CCKP under the “Climate Data > Historical” and “Vulnerability” tab of the relevant country page. For the “future” exposure risk rating, Task Teams can consult the CCKP for projections of sector-relevant climate indices under the “Climate Data > Projections” tab of the relevant country page. Task Teams should identify exposure to each hazard for “current” exposure, then depending on this baseline, maintain, increase or decrease their rating for “future” exposure. Task teams should justify their selected ratings based on this information. Where national or local level climate and disaster information is available from national agencies or locational studies, Task Teams are also encouraged to draw on these. Note that if the project location is highly exposed to even one hazard either in the current timeframe or in the future, then select the “High” rating. Also select a “High” rating if exposure is “Low/Moderate” in the current timeframe but is projected to become “High” in the future. Table 2 outlines different indices related to climate and geophysical hazards available in the CCKP and their implications for water projects.

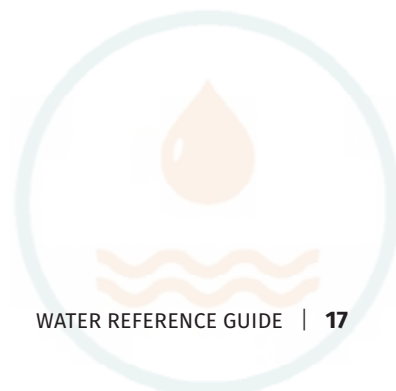
¹⁴ The World Bank climate and disaster risk screening tools link directly to climate information for the selected project country. The information in the table below can be found by visiting the FURL: CCKP/; selecting the project country; and visiting tabs on “Climate Data,” “Climate by Sector,” “Vulnerability,” “Impacts,” and “Adaptation.” Task Teams can also view global CCKP climate information organized by watershed.

¹⁵ The risk screening should reflect all countries/subnational units for which the project takes place.

Table 2 | Climate and Geophysical Hazard Relevant to Water Projects

| Climate and Other Hazards | Examples of Relevant Climate Information | Impacts on Water Projects |
|----------------------------------|---|---|
| Extreme Temperature | <ul style="list-style-type: none"> - Change in annual/monthly mean temperature - Change in monthly maximum and minimum temperature - Change in evapotranspiration - Average annual basin temperature | <ul style="list-style-type: none"> - High temperatures can exacerbate water shortages and increase water demand (such as for irrigation or cooling in energy generation) - Warming temperatures can affect evapotranspiration and shifts in the amount and timing of flow and runoff - Rising temperatures can increase algal blooms and pathogens, decrease dissolved oxygen and harm aquatic life in waterways |
| Extreme Precipitation & Flooding | <ul style="list-style-type: none"> - Change in annual/monthly precipitation - Change in maximum cumulative rainfall - Days of consecutive wet days - Days of rainfall above 20 and 50mm - Change in 5-day maximum rainfall over a 25-yr period | <ul style="list-style-type: none"> - Heavy precipitation can cause erosion and sedimentation in waterways, reducing reservoir capacity - Greater precipitation can increase runoff and introduce new contaminants into the water supply, increasing the pollutant load - Heavy rainfall events can cause sewers to overflow, releasing untreated sewage into lakes, rivers and coastal waters |
| Droughts | <ul style="list-style-type: none"> - Change in maximum number of consecutive dry days - Changes in mean annual runoff - Changes in annual base flow and storage - Annual mean drought index (SPEI) - Annual severe drought likelihood - Change in annual rainfall range - Change in mean annual irrigation deficit | <ul style="list-style-type: none"> - Droughts can reduce recharge to surface and ground water supplies - Lower water levels can lead to higher concentrations of contaminants - Lower water levels can result in lack of supply to meet water pumping and irrigation needs - Droughts may lead to degradation of water and sanitation services |
| Strong Winds/ Storms | <ul style="list-style-type: none"> - Wind speed - Coastal flooding extent - Change in storm surge height | <ul style="list-style-type: none"> - Strong winds/storms can lead to the overtopping of dams and reservoirs - Strong winds/storms can disrupt electricity supply, impacting pumping and water treatment systems |
| Sea Level Rise | <ul style="list-style-type: none"> - Sea level rise extent - Historical sea level anomaly | <ul style="list-style-type: none"> - Sea level rise can damage the structural integrity of embankments, levees, and dikes, and can cause saltwater intrusion into freshwater aquifers |
| Natural Hazards ¹⁶ | <ul style="list-style-type: none"> - Average annual hazard occurrence | <ul style="list-style-type: none"> - Natural hazards may cause physical damage to the structural integrity of water supply infrastructure, dams, levees, and dikes. |

¹⁶ Wildfire, earthquakes, tsunami, volcanoes, land subsidence, etc.



Step 2

Impact on the Project's Physical Infrastructure and Assets

- **Overview.** This step incorporates the identified climate and geophysical hazards from the previous step with the user's sector expertise to assess the current and future impacts on the project's physical investments as currently designed and on beneficiaries. Task Teams are also encouraged to consider possible risk mitigation measures.
- **Information needed.** Task Teams should understand risks identified in Step 1 and project location/ components.
- **Key questions and considerations.**
 - *Does the project design consider recent trends and future projected changes in the identified climate and geophysical hazards?*
 - *How might the structural integrity, materials, longevity, and overall effectiveness of project investments be impacted by climate change and disasters?*
 - *How might climate change impact water infrastructure through extreme precipitation and floods? What threshold is the infrastructure designed to withstand?*
 - *How might gradual changes in seasonal or annual patterns of temperature, solar radiation, and drought impact the physical assets of the project?*
 - *Does the design "lock in" certain decisions for the future?*
 - *What are the implications of climate and disaster impacts to project beneficiaries and stakeholders?*
 - *How should strategic plans, engineering design, implementation, operation and maintenance of water infrastructure consider the impacts of climate change and natural disasters as well as impacts by other sectors on the surrounding watershed?*
- **Goal:** The Task Team will understand the climate and geophysical hazard risks to project infrastructure/ physical assets, rate the risk based on the extent to which the current design has accounted for potential impacts from these hazards, and justify their analysis. This step can help to inform whether further work may be required to manage these risks.¹⁷
- **Rating Guide:** Based on the rating(s) from Step 1 (Exposure), determine the degree to which the project may be affected by identified hazards. For example, if the project plans to incorporate risk mitigation measures, the project's risk rating may be adjusted. However, if a project "locks-in" infrastructure in a location that is considered highly exposed, the risk rating might be elevated or remain high. Note that if any aspect of risk to the project's physical investments/assets may be highly impacted by even one hazard either in the present or in the future, then select the "High" rating.

If there is insufficient information, Task Teams are highly encouraged to conduct a location-specific vulnerability assessment on climate change and disaster impacts and/or update the screening as more project information becomes available. See Table A.1. in Annex 1 for examples of impacts from climate and geophysical hazards on water sub-sectors and Table A.3 for examples of risk mitigation measures.

¹⁷ Note: If the project includes soft components only (no physical infrastructure/assets), this step can be skipped in the tool to move directly to Step 3 – Adaptive Capacity.

Step 3.

The Project's Adaptive Capacity

- **Overview.** This step assesses how risks from climate and geophysical hazards, identified in Steps 1 and 2, can be increased or reduced from a project's non-physical components (Step 3A) and broader vulnerability/resilience in the project's sector and development context (Step 3B). This step also considers vulnerable groups that may be disproportionately affected by climate change and natural disasters.
- **Information needed.** Task Teams should understand risks identified in Step 1 and 2 as well as project non-physical components/the wider sector and development context.
- **Key questions and considerations.**
 - *Do project components impact the larger water sector policy context (or other related sectors) to help better manage climate risks?*
 - *What role (if any) is the project playing in addressing climate change and disaster risks? Are the project components expected to mitigate or exacerbate these risks?*
 - *How might climate change affect key beneficiaries and stakeholders, including women¹⁸, children, the elderly, people with disabilities, migrants and displaced populations?*
 - *How does the broader socioeconomic context and institutional capacity augment or alleviate risks?*
- **Goal:** Task Teams will come away with an understanding of how non-physical project components and the project's overall sector and development context may either reduce or increase the risks from climate and geophysical hazards (identified in Steps 1 and 2) and justify their analysis.
- **Rating Guide:** The right kind of non-physical components, such as institutional capacity building, sectoral policies, guidelines for maintenance financing, standards and codes, or emergency planning can increase preparedness and long-term resilience while reducing risk. Conversely, non-physical components that do not consider impacts from climate change and disasters can raise the level of risk. For example, maintenance protocols that ignore potential increases in damage from future climate impacts, long-term planning that does not consider sea level rise and other future changes, implementation of design standards that are based solely on historical events, etc. Table A.2 in Annex 1 provides examples of actions for reducing risk and enhancing a project's adaptive capacity through policy development, long-term strategic planning, maintenance and operations, emergency planning, capacity building training and outreach, data gathering and information management, and support to vulnerable populations.

¹⁸ Women are often disproportionately affected by climate change impacts. Gender-responsive climate programming requires an understanding of the roles and responsibilities of women and men in diverse sectors and country contexts, along with their rights and entitlements to relevant resources, assets and networks that aid in reducing vulnerability to the impacts of climate change. In poorer countries, more women die in disasters than men.

Step 4.

Risk to Project Outcome/Service Delivery

- **Overview.** This step assesses the overall risk to the project outcome based on ratings from the previous steps: the project’s exposure to climate and geophysical hazards (Step 1), the extent to which the impact of relevant hazards has been considered in the design of the project’s physical investments/assets (Step 2), and the project’s adaptive capacity and broader sector and development context (Step 3).
- **Information needed.** The ratings are based on information from the previous steps: hazard exposure information, subject matter expertise, knowledge of project components (physical and non-physical) and beneficiaries, and the broader sector and country development context.
- **Key questions and considerations.**
 - *What risks have been identified in the previous steps? How have they been rated?*
 - *Taken together, do the project components and sector/development (socioeconomic and policy) context increase or reduce climate and disaster risks based on the project location and target beneficiaries?*
 - *Keeping those risks in mind, what is the overall risk to the project/development intervention?*
 - *What actions can enhance the project’s resilience to identified risks?*
- **Goal:** Project teams will understand, rate, and justify their analysis for the overall risk to the project outcome based on the previous three steps. The results, which indicate what components are most at risk, can inform a strategy for reducing climate and disaster risks and be integrated into project design and project documents. See the [Next Steps](#) section for further information.
- **Rating Guide:** Based on the initial exposure rating in Step 1 and impact to the project in Step 2, determine whether the project’s physical and non-physical project components, as well as broader sector and development context may increase or reduce risk. For example, an initial “High” risk exposure in Step 1 could be reduced to an overall “Moderate” or “Low” risk rating in Step 4 if the project incorporates components that mitigate risks or build resilience. Similarly, a “Low/Moderate” exposure rating from Step 1 may increase in the Step 4 overall rating if a project “locks-in” design features that may not be able to withstand or adapt to future climate trends and broader development challenges that may be exacerbated by climate impacts.

Overall Project Rating and Explanation

| | |
|-----------------------------------|---|
| HIGH RISK | <ul style="list-style-type: none"> • For areas of <i>High Risk</i>, you are strongly encouraged to manage or reduce those risks alongside a more detailed risk/vulnerability assessment. |
| MODERATE RISK | <ul style="list-style-type: none"> • For areas of <i>Moderate Risk</i>, you are encouraged to build on the screening through additional studies, consultation and dialogue, and incorporate risk management measures. This initial screening may be supplemented with a more detailed risk/vulnerability assessment to better understand the nature of the risk to the project. |
| LOW/NO RISK | <ul style="list-style-type: none"> • If you are confident that climate and geophysical hazards pose <i>Low or No Risk</i> to the project, continue with project development. However, keep in mind that this is a high-level risk screening at an early stage of project development. Therefore, you are encouraged to monitor the level of climate and geophysical risks to the project as it is developed and implemented. |
| INSUFFICIENT UNDERSTANDING | <ul style="list-style-type: none"> • One of the purposes of the risk screening is to identify knowledge gaps. Task Teams are encouraged to update the risk screening as more information becomes available and/or conduct a more detailed risk/vulnerability assessment. |

Next Steps

After completing a risk screening, what's next? The screening tools provide a structured and systematic process for understanding climate and disaster risks. Understanding which project components are at risk– at an early stage in the project cycle – can be used to inform project design and consultations around risk management measures. Key next steps include:

1) Consider measures or strategies that can mitigate and manage these risks. Refer to water sector specific resources on the [Water GP Operational Services webpage](#). Also refer to Tables A.2 and A.3 in [Annex 1](#) for examples broken down by subsector. Key considerations for resilience measures include:

- Does the project support a system for ongoing adaptive management? Resilience plans should allow investments to respond adaptively to newly emerging conditions and information and appropriate budget allocation for maintenance should be built in.
- Are there opportunities for the project to support building resilience of the broader community, ecosystem, or asset network? Conducting local stakeholder consultations and dialogues and incorporating feedback can enhance resilience and improve development outcomes.
- Has the project considered cross-sectoral linkages? Climate and disaster risks and vulnerabilities in other sectors may affect the project. Would enhanced coordination and information flow across relevant sector agencies be beneficial?

2) Identify if further information or follow-up locational studies/risk/technical assessments are necessary and undertake follow-up assessments. See the [Follow-Up Risk and Technical Assessments](#) section for more information.

3) Incorporate climate and disaster risk considerations into project documents. Climate risk management can contribute to the World Bank's climate-related finance targets through climate co-benefits in adaptation. See sections on [Who Does What and When During the Screening Process?](#) and [How does Risk Screening Link with Other Climate Change Commitments?](#) for further reference.





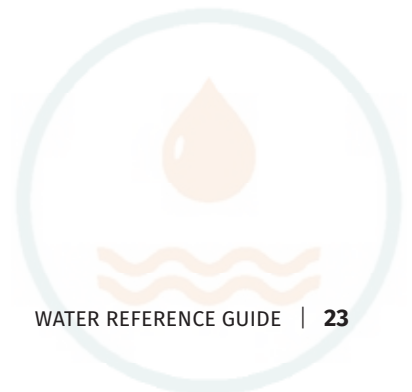
Photo: World Bank



3

WORLD BANK SCREENING SUPPORT & RESOURCES

- World Bank Screening Support
- Follow-up Risk and Technical Assessments
- Climate Change Impacts on Agriculture and Potential Adaptation Strategies



3.1 World Bank Screening Support

For risk screening support, please see:

- [Climate and Disaster Risk Screening](#) web page (FURL: RISKSCREENING/) which provides an overview of the risk screening commitment and links to the tool as well as other resources.
- [Climate and Disaster Risk Screening Tools](#) website (FURL: CCSCREEN/) for more information on the screening process and sector-specific risk screening tools.
- [Screening for Climate Change and Disaster Risks in Development Projects](#) self-paced e-course.
- [Climate Change Website](#) (FURL: CCKNOW/) provides consolidated guidance and resources to Task Teams looking to fulfill climate commitments, ensuring compliance with bank funding and corporate lending.
- [The Climate Screening Help Desk](#) which can provide support in the following areas:
 - Support with IT problems and glitches in the World Bank screening tools.
 - Assistance with the use of the tools for risk screening
 - Guidance on use of the Climate Change Knowledge Portal (CCKP)
 - Links to World Bank regional or sector experts to obtain additional information to help screen for risks to your projects.
 - Additional information and in-person trainings.

The Help Desk can be reached at climatescreeninghelpdesk@worldbankgroup.org.

3.2 Undertaking Follow-up Risk and Technical Assessments

Risk screening may help to identify areas where further information or technical assessments may be necessary. Task Teams may want to undertake a follow-up risk assessment or consult further references such as:

- An economic analysis of the project that includes climate change and natural disaster risk considerations to show the potential long-term value-added of resilience measures and help inform decision-makers.
- [Building the Resilience of WSS Utilities to Climate Change and Other Threats: A Road Map](#). World Bank Group. 2018.
To help water utilities incorporate resilience and robustness in their choices, this road map proposes a process in three phases that can inform the design of strategies necessary to water supply and sanitation (WSS) services provision. The approach reveals the strengths and vulnerabilities of investment plans concisely and helps utilities invest robustly by identifying near-term, no-regret projects that can be undertaken now, while maintaining flexibility and adaptively as future conditions evolve.
- [Confronting climate uncertainty in water resources planning and project design: the decision tree framework](#). World Bank. 2015.
The goal of this book is to outline a pragmatic process for risk assessment of Bank water resources projects. The decision tree described in the book provides project teams with a scientifically defensible, repeatable, direct, and clear method for demonstrating the robustness of a project to climate change. At the conclusion of the process, the project team will understand the vulnerabilities of the project and how any necessary adjustments improved the project's feasibility and profitability.
- [The Rural Water and Sanitation Information System \(SIASAR\) initiative: an information system for more sustainable rural water and sanitation services](#). World Bank. 2013
SIASAR provides an innovative platform designed to monitor the development and performance of rural WSS services. Through this simple tool, data collection and analysis become more accessible, more precise, and comparable across countries. The system generates performance indicators that are aggregated at several geographic levels.
- AQUASTAT, developed by the FAO Land and Water Division, is a global information system on water and agriculture. The database contains information on water resources, water uses, and agricultural water management with an emphasis on countries in Africa, Asia, Latin America and the Caribbean.

3.3 Information on Climate Change Impacts on Agriculture and Potential Adaptation Strategies

To enhance your risk screening and explore further resilience measures in the water sector you may want to consult the following resources:

- Client country [Nationally Determined Contributions \(NDCs\)](#), [National Adaptation Programmes of Action \(NAPAs\)](#), and [National Communications](#) to the UNFCCC outline sectoral priorities, needs and knowledge gaps.
- [Climate Change Adaption and Mitigation Co-Benefits Tracking Draft Guidance Note for Water Colleagues](#). World Bank Water Global Practice. 2019.
This note is meant primarily to help Water Global Practice (GP) Task Teams (i) design projects that consider current and expected climate change impacts and (ii) maximize their projects' adaptation and mitigation co-benefits by adhering to the "Joint MDB Methodologies for Tracking Climate Finance," laid out in chapter 1 of the 2017 Joint Report on Multilateral Development Banks' Climate Finance. A "quick guide" version of this note can be found [here](#).
- [High and Dry: Climate Change, Water, and the Economy](#). World Bank Group. 2016.
This report finds that water scarcity, exacerbated by climate change, could hinder economic growth, spur migration, and spark conflict. However, most countries can neutralize the adverse impacts of water scarcity by more efficient water allocation and use of resources.
- [Guidelines for Climate Proofing Investment in the Water Sector: Water Supply and Sanitation](#). Asian Development Bank (ADB). 2016
This publication presents a step-by-step methodological approach to assist project teams in managing climate change risk in the context of water supply and sanitation investment projects.
- [Incorporating Climate Change Adaptation in Infrastructure Planning and Design](#). USAID. 2015.
This report presents an overview of potential impacts on typical infrastructure activities, adaptation responses, and strategies for a climate altered future – including resilience for [sanitation](#), [flood management](#), and [potable water](#). It includes guidance and checklists to follow in the assessment of infrastructure assets that are exposed to changing climatic conditions as well as in the selection of planning and management decisions.
- [Securing Water, Sustaining Growth](#). Organization for Economic Co-operation and Development (OECD) Task Force on Water Security and Sustainable Growth. 2015.
This report provides empirical evidence to guide investment in water security. It seeks to: analyze the dynamics of water security and growth; quantify water-related risks and opportunities and their trajectories; and assess the experience of past pathways of investment toward water security.
- [Water security for all: the next wave of tools](#). World Bank Group. 2015.
The Water Partnership Program (WPP) represents a partnership among the World Bank and the governments of the Netherlands, the United Kingdom, Denmark, and Austria. The WPP supports the Bank's poverty reduction efforts by mainstreaming climate-resilient growth and pragmatic approaches in Water Resources Management and Water Supply and Sanitation in World Bank projects and analytical work. The second phase of the program targeted specific water challenges to help countries tackle poverty through climate-resilient green growth.
- [Fifth Assessment Report of the Intergovernmental Panel on Climate Change: Global & Sectoral Aspects](#). Intergovernmental Panel on Climate Change (IPCC). 2014.
This report evaluates how patterns of risks and potential benefits are shifting due to climate change – including to water resources and services. Chapter ten on [Key Economic Sectors](#) further highlights climate risks to the water sector. For more information, see the [IPCC Technical Paper on Climate Change and Water](#) (2008) for further reference.

- [Adaptation to Climate Change in Water, Sanitation and Hygiene \(WASH\): Assessing Risks, Appraising Options in Africa](#). Overseas Development Institute (ODI). 2014
Drawing on case study reviews, this report presents the risks to delivery of WASH results posed by climate change in Africa.
- [Water and Climate Change Adaptation: Policies to Navigate Uncharted Waters](#). OECD. 2013.
This report highlights the range of expected changes in the water cycle and the challenge of making practical, on-site adaptation decisions for water. It offers policymakers an approach to better manage water risks and proposes policy guidelines to prioritize action and improve the efficiency, timeliness and equity of adaptation responses. The report also highlights the benefits of well-designed economic instruments (e.g. insurance schemes, water trading, water pricing), ecosystem-based approaches and 'real options' approaches to financing.
- [Thirsty energy](#). World Bank. 2013.
As almost all energy generation processes require significant amounts of water, and water requires energy for treatment and transport, these two resources are inextricably linked. This relationship is the energy-water nexus. Section one of this paper examines the existing models, literature, and management frameworks on the nexus. Section two describes the water demands of power generation. Finally, section three describes possible solutions that may alleviate challenges resulting from the link between energy and water by improving energy efficiency and integrating water resources management into energy planning.
- [Aqueduct Water Risk Atlas](#). World Resources Institute (WRI).
Aqueduct's global water risk mapping tool helps companies, investors, governments, and other users understand where and how water risks and opportunities are emerging worldwide. The Atlas uses a robust, peer reviewed methodology and the best-available data to create high-resolution, customizable global maps of water risk.
- [Water and Climate Change: Impacts on Groundwater Resources and Adaptation Options](#). World Bank. 2009.
This working paper addresses knowledge gaps in adaptation to climate change impacts on groundwater resources.
- [Water and Climate Change: Understanding the Risks and Making Climate-Smart Investment Decisions](#). World Bank Group. 2009.
This report and the analytical work leading to it are focused on key topics related to the impact of climate change on the water cycle and water investments. This report contributes to the World Bank agenda on climate change and more specifically, informs the water sector investments on climate issues and climate-smart adaptation options.



Photo: World Bank



ANNEX 1

CLIMATE IMPACTS AND RISK MANAGEMENT MEASURES FOR WATER SUBSECTORS

- Potential Impacts of Climate and Geophysical Hazards on Water Subsectors
- Examples of Measures to Enhance a Project's Adaptive Capacity through Non-Physical Components
- Examples of Climate Risk Management Measures for Water Sub-Sectors



Table A.1 | Potential Impacts of Climate and Geophysical Hazards on Water Subsectors¹⁹

| Subsectors | Potential Impacts of Climate and Geophysical Hazards on Water Subsectors |
|--------------------------------------|--|
| Land Use/ Watershed Management | <ul style="list-style-type: none"> • Water flows can be altered by changing temperature/precipitation patterns and shifts in the amount and timing of snow-fed stream flow. For example, earlier and shorter runoff seasons caused by smaller snowpack levels formed later in the winter may cause more frequent summer droughts (with implications for hydropower generation and urban water supply among others). • Watershed erosion control measures may be less effective due to heavy rainfall events. • Increased and potentially new contaminants may result from greater precipitation, runoff, and extreme weather events. • Lower dissolved oxygen levels in lakes and streams due to increasing water temperatures may threaten aquatic species. • Recharge rates of aquifers and changes in river flow volume and timing may be affected by shifts in seasonal precipitation patterns. |
| Dams and Reservoirs | <ul style="list-style-type: none"> • Reservoir capacity may be reduced by erosion and sedimentation due to heavy precipitation/storms. • Reservoir water levels may be reduced by drought and higher evapotranspiration due to warming temperatures. • Overtopping of dams and reservoirs may occur due to high winds or other extreme weather events. |
| Water Supply | <ul style="list-style-type: none"> • Water demand for irrigation and cooling in energy generation may increase due to high temperatures. • The ability of water resources to serve as coolants for certain activities, for instance, electricity generation, may be less effective with rising temperatures. • Water supplies may be reduced due to drought/higher temperatures and a corresponding increase in the evaporation rate. • Increased and potentially new contaminants may result from greater precipitation, runoff, and extreme weather events. • Higher concentrations of water contaminants may also be caused by lower water levels due to reduced precipitation/drought. • Recharge to surface and ground water supplies may be impacted by lower precipitation levels and extreme heat or may become salinated due to saltwater intrusion from sea level rise. |
| Wastewater | <ul style="list-style-type: none"> • Algal blooms and pathogens may increase, necessitating enhanced wastewater treatment, due to higher temperatures. • Sewers may overflow due to extreme precipitation and storm surges. • Wastewater pumping and treatment systems may be impacted if strong winds or extreme weather events disrupt electricity supply or cause flooding, leading to the release of untreated sewage into lakes, rivers and coastal waters. |
| Sanitation | <ul style="list-style-type: none"> • Latrines may become inundated and overflow due to heavy precipitation/storms, leading to downstream pollution and possible health/sanitation problems. |
| Riverine Flood Protection | <ul style="list-style-type: none"> • The structural integrity of embankments, levees, and dikes may be impacted by extreme weather events and geophysical hazards such as earthquakes. • Saltwater intrusion can reduce both the quality and volume of freshwater and groundwater in coastal areas. |

¹⁹ Climate Change Adaption and Mitigation Co-Benefits Tracking Draft Guidance Note for Water Colleagues. World Bank Water Global Practice. 2019.

Table A.2| Examples of Measures to Enhance a Project’s Adaptive Capacity through Non-Physical Components²⁰

| Non-Physical Components | Possible Actions |
|--|--|
| Policy Development/ Long-Term Strategic Planning | <ul style="list-style-type: none"> • Develop water resource policies and strategic planning that consider future climate impacts on water quality and quantity at the national, state, and sectoral levels. • Develop guidelines for water infrastructure investments and watershed management that incorporate integrated water resources management (IWRM) to build resilience by incorporating flexibility into water systems to manage uncertainty, facilitating basin-wide planning, and improving understanding of available water resources. • Prepare and implement water resource management plans that incorporate climate change and disaster risks. For example, accommodating for lower river water flows due to higher evapotranspiration and less snow. • Create city regulations that requires grey water reuse on all large new developments – particularly in drought prone areas – and creates incentives for rainwater harvesting on newly built structures. • Develop and enforce urban planning and zoning for informal settlements and refugee camps that can facilitate local governments to provide water, wastewater, and sewage services in the future • Monitor water use and regulate use through associated fees (this may help increase revenues for maintenance and upgrades to water infrastructure). • Consider the establishment of stormwater utilities that promote environmental protection, enhance water resources and flood control. • Promote an integrated, cross-sectoral approach to water infrastructure and watershed management that considers a landscape approach, urban planning, health, and community engagement. • Provide flexibility in project management protocols that allow them to be adapted to changing hazards. • Establish water users’ associations to govern local water systems. • Incorporate climate and disaster risk screening as part of coastal risk assessments. • Establish plans to deal with potential conflicts that may arise with lower water levels in transboundary rivers. • Provide financial incentives to customers to use less water – especially in drought-prone locations. |
| Capacity Building, Training and Outreach | <ul style="list-style-type: none"> • Raise awareness in Ministries, Departments, Agencies, Local Governments, as well as Civil Society Organizations (CSOs) and the private sector on climate change impacts on water infrastructure and supply. • Provide education and training for staff to effectively respond to system disruptions or emergency events caused by climate change/disasters. • Build capacity on hydromet monitoring systems to prepare for climate related disasters. • Support customer water saving awareness campaigns. |
| Emergency Planning | <ul style="list-style-type: none"> • Strengthen disaster planning and response for water infrastructure and services such as a flood risk-management plan. • Develop early warning systems and establish emergency protocols to respond and prepare for climate-related disasters (for example, establish communication procedures between relevant municipal and private sector operators to reduce water levels in the system in advance of storm events). • Ensure backup power supply for key water sanitation service assets. <p>Identify critical customers such as hospitals and develop emergency supply plans.</p> <ul style="list-style-type: none"> • Establish or expand a contingency budget reserve to address unexpected disruptions and fund investments to restore water services. • Integrate disaster risk management criteria into codes and regulations to increase the resilience of water supply infrastructure, dams, levees etc. |

²⁰ Climate Change Adaption and Mitigation Co-Benefits Tracking Draft Guidance Note for Water Colleagues. World Bank Water Global Practice. 2019; Gender in Water: Brief for Task Teams. World Bank Water Global Practice. 2017.

| | |
|--|--|
| Data Gathering, Monitoring and Information Management System | <ul style="list-style-type: none"> • Establish information systems that can combine climate and hydrological data with spatial data sets from multiple agencies including for land-use, soils, topography, river networks, and other environmental assets to monitor future climate and disaster risks. • Incorporate GIS/remote sensing/climate risk assessment technologies to identify climate/disaster risks in project locations and integrate risk mitigation measures into project design. • Improve aquifer modeling and increase the monitoring of water quality. |
| Maintenance and Operations | <ul style="list-style-type: none"> • Account for maintenance activities that ensure preparedness for climate-related risks during budget preparation. • Reduce leakage through metering/leakage detection and reduction programs. • Develop contingency plans in the event of disruption and install redundant systems to back up a primary system. |
| Support to Vulnerable Populations | <ul style="list-style-type: none"> • Include capacity building activities that enable women to serve as effective agents for community preparedness for flooding and other extreme events. • Incorporate changing climate and migration patterns in population projections when estimating the population to be served by a water supply and sewage system. • Improve access to information and communication technologies (ICT) including radio, TV, and mobile devices to increase access to weather forecasts and reduce the impacts of extreme events on vulnerable populations. • For dams and reservoirs, ensure that benefit sharing schemes and resettlement policies do not disadvantage women or other vulnerable populations; for example, if 'head of household' signature is required, informal land rights are neglected, or information is not accessible. • Ensure women's access to and decision-making power over competing water resources (e.g. women's participation in water user associations). • Support equal access to information and resources. For example, while agriculture is the largest employer of women in developing countries, female farmers are often excluded from information and decision making around irrigation. |

Table A.3 | Examples of Climate Risk Management Measures for Water Sub-Sectors²¹

| Sub-Sector | Adaptive Measures |
|---------------------------------|---|
| Land Use & Watershed Management | <ul style="list-style-type: none"> • Support local ecosystems through watershed conservation and restoration measures to leverage natural provisioning and regulating services. For example, swamps/wetlands/forested areas help purify water supplies and can shield human communities from storm surge. • Limit or regulate development around critical ecosystems (oases, mountains, water towers etc.) • Reduce the risk of flooding in a nearby urban area through improved IWRM such as through managing sediment deposits. • Improve operations and maintenance practices at reservoirs to foster resilience against climate-induced water scarcity. • Plan for flood management in urban and rural contexts. • Manage stormwater runoff through grey infrastructure (increased drainage, sewage, and wastewater treatment capacity) and green infrastructure (bioswales, rooftop gardens, vegetated permeable space, improved ecosystems, etc.) |

²¹ Building the Resilience of WSS Utilities to Climate Change and Other Threats: A Road Map. World Bank Group. 2018. Confronting climate uncertainty in water resources planning and project design: the decision tree framework. World Bank. 2015. Climate Change Adaption and Mitigation Co-Benefits Tracking Draft Guidance Note for Water Colleagues. World Bank Water Global Practice. 2019.

| | |
|----------------------|---|
| Irrigation | <ul style="list-style-type: none"> • Improve water use efficiency in rainfed and irrigated agriculture such as through rehabilitating irrigation infrastructure to reduce leakages. • Explore water re-use techniques, rainwater harvesting and sustainable drainage. • Improve water supplies for agriculture through landscape management. • Identify farming populations that will be vulnerable to extreme weather, water shortages, or flooding and: <ul style="list-style-type: none"> • Prioritize drought-sensitive or rainfed areas for irrigation investments. • Develop early warning systems; for example, automated text messages. • Launch crop insurance schemes or other measures to help agricultural beneficiaries weather climate-induced economic losses. |
| Water Supply | <ul style="list-style-type: none"> • Identify areas prone to extreme heat, drought, or variable rainfall and reduce water stress. For example: <ul style="list-style-type: none"> • Rehabilitate or upgrade water systems to reduce losses through waste and leakage (i.e., non-revenue water reduction) to improve supply-side efficiency. • Invest in water recycling and desalination systems where appropriate. • Deploy high-efficiency water cooling systems at thermal power plants or migrate these generation facilities to dry cooling systems. • Diversify local water sources. • Identify areas exposed to extreme precipitation and other climate/disaster risks and protect water quality by: <ul style="list-style-type: none"> • Promoting safe sanitation and washing practices to prevent water contamination. • Investing in water treatment facilities and water quality monitoring systems. • Increase the structural integrity of embankments, levees, dikes, and other riverine/coastal flood protection defenses so they can withstand hazards. • Prepare emergency (drinking) water supply plans in areas prone to climate-induced droughts, extreme heat, flooding etc. • Relocate or elevate water system assets that frequently flood or that will be inundated by sea level rise. • Promote water demand management through tariff adjustments, awareness campaigns, and regulations that boost consumer-end efficiency. |
| Sanitation & Hygiene | <ul style="list-style-type: none"> • Improve drainage and erosion control around high-use, public bathrooms and latrines. • Promote sanitation and hygiene practices that reduce climate-induced public health risks by minimizing the probability of cholera, diarrhea, other vector-borne diseases outbreaks. • Invest in public awareness campaigns, education initiatives, and local capacity-building to support proper waste disposal to limit water contamination in the event of climate-related flooding. |
| Wastewater | <ul style="list-style-type: none"> • Rehabilitate, redesign, or expand sewage and wastewater treatment infrastructure to decrease water stress through water reuse and cope with extreme weather impacts. • Require more efficient use of local water resources in drought-prone areas; for example, removing solid waste before wastewater reaches the treatment facility. • Develop wastewater management strategies and guidelines that incorporate climate and disaster risks. • Develop emergency management plans in the event of extreme weather events. |



