Climate Risk Informed Decision Analysis (CRIDA)

Collaborative Water Resources Planning for an Uncertain Future

CRIDA

Climate Risk Informed Decision Analysis

1. Understanding Climate Change Impacts on Water

As most communities will experience the impact of climate change through water-related disasters or through a negative impact on their water security, bringing climate change considerations into water resources planning becomes increasingly important.

Traditionally, water management has largely been guided by the assumption that we can use the past to confidently predict and plan for the future. The changing climate requires the inclusion of climate uncertainty into water resources planning. While progressing climate science, reflected by subsequent IPCC reports, has provided a global overview of climate change and its impacts on the water cycle, it has provided limited guidance for local adaptation needs. Water managers and planners therefore struggle to make use of the valuable output of Global Circulation Models (GCMs), for local decision making, while acknowledging their associated uncertainty and limited skill due to their coarse scale, model limitations and simplifications.

In recent years, a set of complementary resilient water management tools and approaches have emerged to assess and address climate and non-climatic uncertainties that could be more easily integrated within existing planning, design, and operational decision processes. These bottom-up approaches, start from a thorough understanding of the local water resources challenges and actively engage stakeholders to define measures of success and unacceptable situations to avoid as the basis of a climate risk evaluation. In the next step, adaptation pathways are designed that systematically build resilience and maintain acceptable performance over time. Bottom-up approaches are particularly effective in building consensus between stakeholders and decision makers in the face of complex or uncertain situations.

The importance of integrating climate change considerations into water resources planning is recognized on a global scale. Various frameworks, such as the Sendai Framework for Disaster Risk Reduction, the United Nations Sustainable Development Goals, and the Paris Agreement, emphasize the need for proper planning, policy-making, and adaptation strategies. The Climate Risk Informed Decision Analysis (CRIDA) methodology was launched in 2018 as a response to these international agendas, bridging the gap between climate change uncertainty and water resource planning.

2. How does CRIDA work?

CRIDA provides a framework to identify potential water security risks in a region or watershed, caused by climate change and other drivers, by providing a step-wise planning process to identify and address the challenges for sustainable water resources management.

As indicated in **Figure 1**, the approach begins with a preparatory phase that sets the ground for a CRIDA analysis, where the stakeholder groups are identified that will be involved, as well as a rapid problem analysis to build a concept note for the CRIDA case study. It is followed in Step 1 with a collaborative understanding of the water resources system, including a shared vision on objectives and important performance metrics, summarized under the definition of a 'Decision Context'. In Step 2 the vulnerability of the system to climatic and non-climatic stressors is evaluated, using a (Climate) Stress Test. This information is then used in step 3 to provide options to address these vulnerabilities by supporting the identification of robust and flexible mitigation actions. In Step 4, a comprehensive plan is developed that evaluates the robustness of the proposed actions, to address the challenges identified and maximize co-benefits. In the final step, the proposed actions are institutionalized to ensure their implementation, considering financial and institutional constraints.

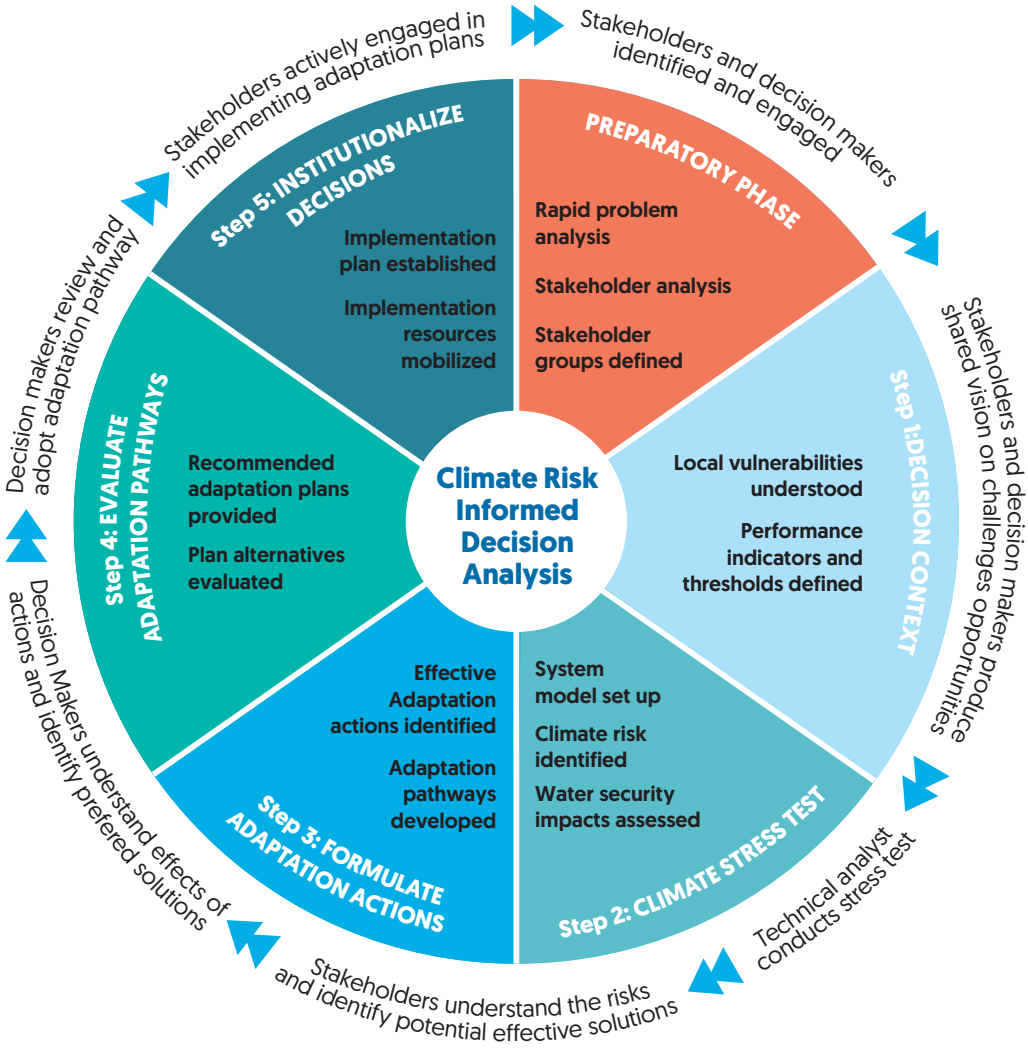


Figure 1 The different steps of the Climate Risk Informed Decision Analysis[1]

[1] Mendoza, G., A. Jeuken, J. Matthews, E. Stakhiv, J. Kucharski & K. Gilroy. 2018. Climate Risk Informed Decision Analysis (CRIDA) - Collaborative Water Resources Planning for an Uncertain Future. Paris, France and Washington, USA: UNESCO and ICIWaRM.

Where has CRIDA been used?

CRIDA has gained worldwide recognition since its publication and has been used in more than 25 case studies implemented in 22 countries from 2018 to 2022. **Figure 2** shows the currently implemented CRIDA case studies in the world. CRIDA applications have been used to address a variety of water resources challenges, with case studies focussing on urban flooding (Guayaquil, Ecuador), drought management (Limari, Chile), flood reduction (Tuolumne, California), implementation of Nature-based Solutions (Chimanimani, Zimbabwe), urban water management (Udon Thani, Thailand), among others.

Since its inception, the CRIDA methodology has received a gradually increasing recognition in international frameworks. The World Bank's "Resilience Rating System: A Methodology for Building and Tracking Resilience to Climate Change" rates CRIDA as an A+ method for developing resilience projects in the water sector as of 2021[2] . Additionally, CRIDA has been acknowledged by the Green Climate Fund (GCF) as one of the methods for addressing uncertainties and fostering adaptive planning as indicated in the GCF Water Project Design Guidelines , published in 2023.

As a result, CRIDA has become more frequently used in capacity building programmes, such as in the CASTT Adaptation Academy, in collaboration with the UNFCCC, where national climate adaptation focal points from 75 countries have been trained on the fundamentals of water-centric adaptation and resilience since 2021.

1. THE US AND CANADA
LAKE ONTARIO–ST. LAWRENCE
The creation of the Great Lakes Adaptive Management (GLAM)

2. THE US CALIFORNIA
A CRIDA study of Tuolumne River Basin and New Don Pedro Dam

3. MEXICO
Examining Mexico's Water Reserves Program as an Ecosystem-Based Adaptation Instrument

4. DOMINICAN REPUBLIC
GUAYUBIN CATCHMENT
Leveraging collaborative modeling to build a more equitable and resilient future

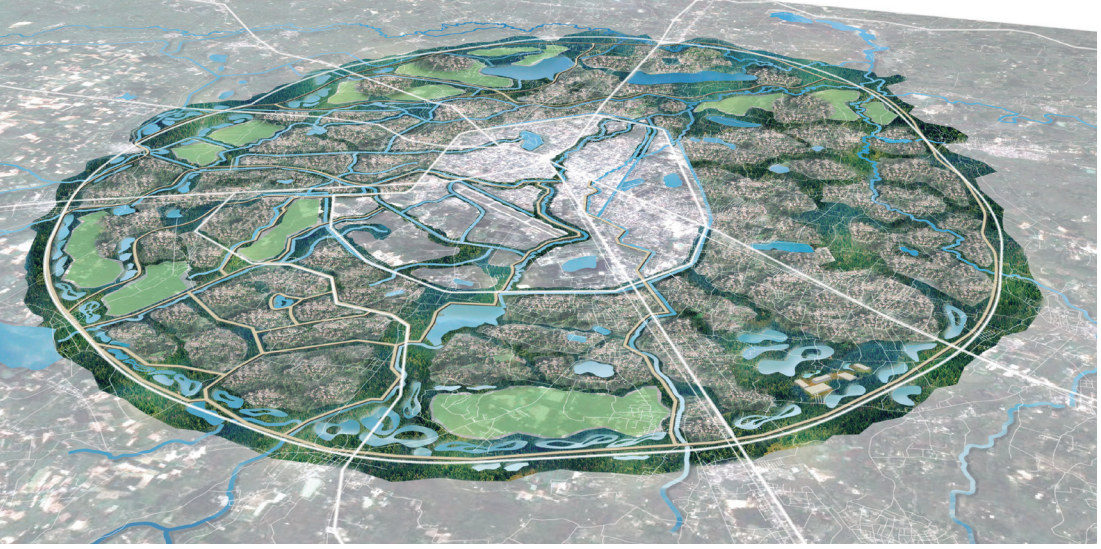
5. COLOMBIA
THE MAGDALENA RIVER BASIN
Future Climate Uncertainty: Analysis of the Hydropower Sector

6. ECUADOR GUAYAQUIL
An adaptation strategy for future climate change and improve the city's resilience to urban flooding

7. PERU CHANCAY LAMBAYEQUE
Assess the performance of the Chancay-Lambayeque to future climatic and demographic changes

8. CHILE LIMARI CATCHMENT
Climate change impacts on Water security in Chile's drylands

Figure 2 Global map of implemented CRIDA case studies



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Case study 1

Implementing nature-based solutions in Udon Thani, Thailand to adapt to climate change and rapid urbanization

Udon Thani, Thailand is a South-East Asian city that is expected to double in both physical size and population by 2030. The city is also experiencing increased frequencies of droughts and floods that are attributed to climate change, leading to concerns about stressing the water supply, particularly in the dry season, and increased flood impacts during the rainy season. These conditions place Udon Thani's vision to be an economic hub for the region and as a liveable urban centre at risk. To address these issues, the U.S. Agency for International Development implemented the "Building Resilient Asian Cities in the Mekong Region" project. This project utilized the CRIDA approach, focusing on addressing current failures rather than uncertain future projections. By using evidence-based strategies and integrating green infrastructure with existing grey infrastructure through advanced hydrological modelling, the project aimed to mitigate the impacts of extreme climate events.

The case study in Udon Thani exemplified the collaborative approach of CRIDA. It identified areas where the conventional system would fail under

[2] Hallegatte S, Clement VWC, Siddiqi SN, Winglee MA. Resilience Rating System : A Methodology for Building and Tracking Resilience to Climate Change (Vol. 1) : Summary (English). In. Washington, D.C: World Bank Group; 2021.

[3] GCF. Technical Annex-Part 1: Water project design guidelines. In: Sectoral Guide Series. Yeonsu: Green Climate Fund; 2023.

extreme weather conditions and developed specific green infrastructure strategies such as canal restoration, green streets, retention parks, and wetland conservation areas. A comprehensive cost-benefit analysis ensured the feasibility of these strategies and secured funding from the Thailand government. These experiences not only serve as a model for other cities worldwide, but also emphasize the urgency of addressing climate risks, particularly in rapidly growing urban areas of low-income countries. Collaborative and evidence-based approaches are crucial for a sustainable and secure future.

Case study 2

Addressing a climate change induced megadrought in the Limarí Basin in Chile

The Limarí River Basin in Chile is confronted with water challenges due to competing demands for limited resources. The region depends on stored water in the Andes Mountains, but it suffered from a prolonged megadrought from 2010 to 2019, leading to depletion of reservoir levels. Concerns have been raised regarding the sustainability of current water allocation, considering population growth and climate change projections that indicate reduced precipitation and higher temperatures.

The Limarí River Basin CRIDA study assessed the impact of climatic and non-climatic drivers on the water security by using a climate stress test on a vulnerable mountain catchment in Chile, to identify water security hazards under climate change projections. By engaging local stakeholders early in the process through a collaborative, bottom-up approach, the performance indicators and the critical thresholds were identified beyond which significant economic impacts occur.

A climate stress test also revealed a limited set of adaptation actions that can be implemented in the basin to address the dwindling water resources. Adaptation pathways were evaluated, and recommendations were made to explore desalinization and climate smart-agriculture options to address the unsustainable water resources exploitation in this semi-arid region of Chile.

Case study 3

Resilient water and energy supply for zambia's capital in the face of drought

The city of Lusaka in Zambia faces vulnerability due to water shortages worsened by droughts and its dependency on the Kafue River, which supplies 40% of its water. To address this issue and improve resilience, a USD $354 million water infrastructure improvement program was implemented from 2016 to 2018. However, concerns arose about the impact of worsening climatic

conditions on the project. To enhance its resilience, the CRIDA approach was chosen due to its ability to handle situations with limited historical data, engage stakeholders effectively, and provide practical decision-making choices.

Using the CRIDA approach, the team analysed factors affecting plant performance during droughts, with a focus on identifying energy availability as the limiting factor. This led them to explore energy solutions. In the next stages, CRIDA was used to conduct a risk analysis, considering analytical uncertainty and impact severity. Given the project's limited data availability and significant community impact, CRIDA recommended flexible and robust solutions that could be adjusted as conditions change. Three solutions were modelled: expanding the city's storage capacity, providing generators for high lift pump sets, and entering into a dedicated power agreement with the utility company. By evaluating these solutions against various future climate scenarios, the team linked costs to the plant's future resilience.

The analysis revealed that implementing generators and a dedicated power agreement would be sufficient to mitigate water shortages. As a result, the construction contract was amended to include generator pads and connections, ensuring the project's resilience without an immediate need for installation. Through the use of CRIDA, the project achieved a cost-effective and adaptable solution to enhance the urban water infrastructure resilience of Lusaka in the face of climate challenges.

3. How to get involved?

CRIDA Website

The CRIDA Hub can be accessed from www.unesco.org/crida, providing a more detailed overview of the current developments, case studies, publications, news, and training opportunities.

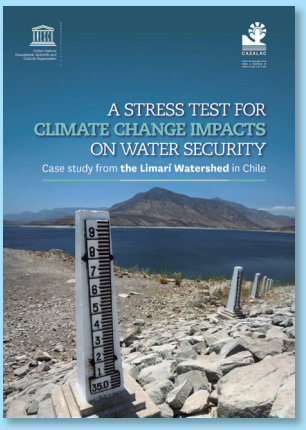
Scan the QR code for more information, explore the current CRIDA case studies and access the available reading materials online.

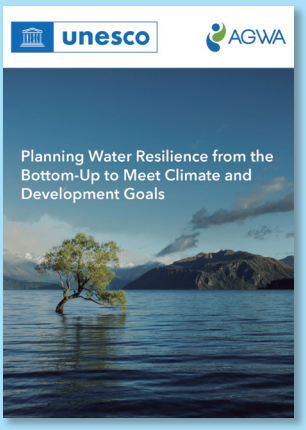
Manuals and publications

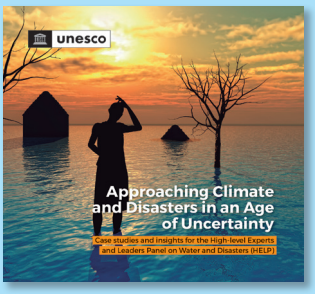
The CRIDA manual provides a detailed overview of the CRIDA methodology and elaborates on each of the five steps through a number of hands-on examples to illustrate the concepts. The manual is available in five languages (English, French, Spanish, Portuguese and Arabic) and can be downloaded from the CRIDA Hub.

Complimentary to the manual, a set of CRIDA-inspired case studies are presented in the publication on 'Approaching climate and disasters in an age of uncertainty: case studies and insights for the High-level Experts and Leaders Panel on Water and Disasters (HELP)' .

Publications







A policy brief was also developed, providing an overview on the different available approaches on 'Planning water resilience from the bottom-up to meet climate and development goals', that includes CRIDA as one of the recommended approaches.

Capacity Building

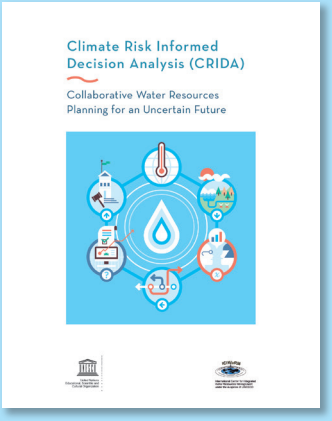
Training courses on the concepts of CRIDA are organized regularly in different parts of the world and are announced on the CRIDA Hub.

Online training is accessible on a permanent bases and is currently available in five languages (English, Spanish, French, Portuguese and Arabic) on the UNESCO Open Learning Platform (https://openlearning.unesco.org/). The online courses are self-paced and learners will receive a certificate after finalizing all assignments.

Community of Practice

A Community of Practice for CRIDA is being established to foster partnerships and share the best practices with various entities and can be accessed from the CRIDA Hub.

If you are interested in setting up a CRIDA case study in your region and join the CRIDA Community of Practice, you can express an interest for implementation of a CRIDA case study via the website.



4. CRIDA Contacts

The CRIDA community is comprised of a variety of stakeholders in all regions that have been involved in the development of the CRIDA methodology or have been engaged in CRIDA case studies. If you would like to get in contact with the CRIDA community, you can contact the UNESCO Intergovernmental Hydrological Programme (IHP), the International Center for Integrated Water Resources Management (ICIWaRM), the Alliance for Global Water Adaptation (AGWA) or Deltares.

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SC-2024/HYD/PI/5

[4] UNESCO, 2023, Approaching climate and disasters in an age of uncertainty: case studies and insights for the High-level Experts and Leaders Panel on Water and Disasters (HELP).

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