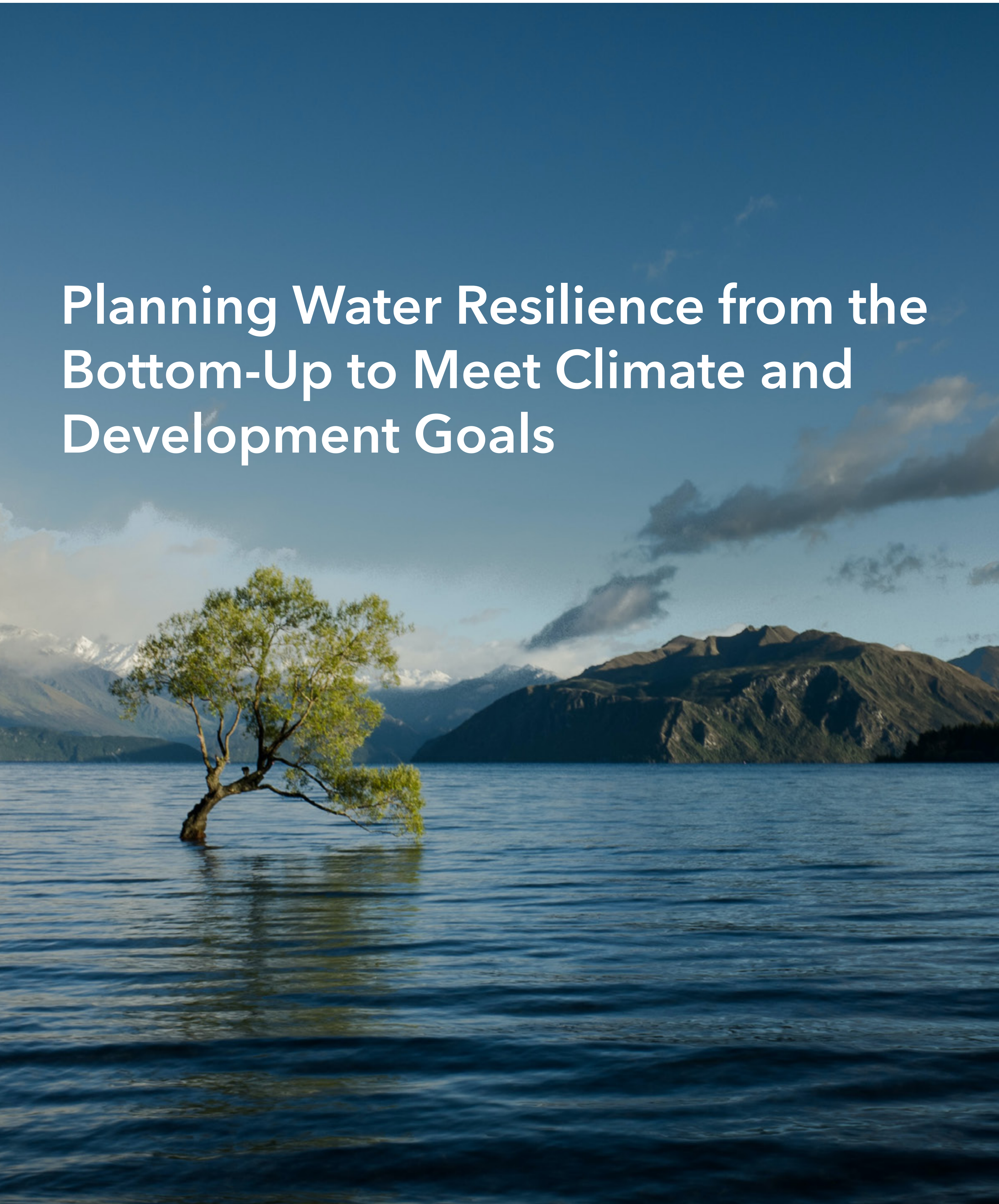
Planning Water Resilience from the Bottom-Up to Meet Climate and Development Goals



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Planning Water Resilience from the Bottom-Up to Meet Climate and Development Goals

Introduction

The COVID-19 pandemic has disrupted every facet of human life, further highlighting the importance of international cooperation and the linkages between climate, water, public health, and economics. However, 2020 still proved to be one of the three warmest years on record, with increasing levels of greenhouse gases in the atmosphere driving more extreme weather, ice melt, sea-level rise, and ocean acidification, according to recent report published by the World Meteorological Organization (WMO).[1] Furthermore, the World Health Organization (WHO) estimates that between 2030 and 2050, climate change is expected to cause approximately 250,000 additional deaths per year due to malnutrition, malaria, diarrhea, and heat stress.[2] Therefore, concerted climate action should not be underestimated amid the sharp focus on economic and industrial recovery; instead, an integrated and accessible approach to climate action based upon the best possible science and developed with active stakeholder engagement should be promoted in order to devise global strategies to mitigate both climate and pandemic impacts and to adapt to new challenges. This approach aligns with UNESCO's Open Science recommendation[3] based upon the principle that open science can accelerate the achievement of scientific solutions for global challenges, including for water-related climate uncertainty.

The effects of climate change are most acutely felt through impacts on the water cycle and water-related extreme events.[4] In order to ensure water for humans and the environment, while simultaneously meeting the world's ambitious climate and development goals, decision makers and regulators will need to adopt a new paradigm for resilient water management that embraces the uncertain future ahead.

Challenges in Meeting the Paris Agreement, SDGs, and Sendai Framework Targets

The recently published United Nations *World Water Development Report*[5] emphasizes that water is the "climate connector" that allows for greater collaboration and coordination across the majority of targets for climate change (Paris Agreement), sustainable development (2030 Agenda and its SDGs), and disaster risk reduction (Sendai Framework). These three framework agreements guide national action through 2030 and beyond. While the urgency with which these agreements demand action is laudable and certainly warranted, five years on, implementation is only just beginning to get under way and significant challenges remain. Plainly stated, the world is not on track to reach its goals.

The three agreements have overlapping targets that require coordinated planning, reporting, governance, and in many cases, funding. Developing the governance capacity and technical expertise required to advance comprehensive national plans and actions can be daunting and can inadvertently reinforce existing silos, potentially reducing the effectiveness of all three agendas. Local, regional, and national water management authorities face pressure from both the climatic impacts and intertwined human responses. A deeper understanding of hydrological responses to climate and other uncertainties is needed to better develop

1 World Meteorological Organization (WMO). 2020. *WMO Greenhouse Gas Bulletin - No. 16: The State of Greenhouse Gases in the Atmosphere Based on Global Observations through 2019*. WMO: Geneva, Switzerland.

2 World Health Organization (WHO). 2018. *Climate change and health. Fact Sheet*. WHO: Geneva, Switzerland. https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health

3 https://en.unesco.org/science-sustainable-future/open-science

4 Sadoff, C. & Muller, M., 2009. *Water management, water security and climate change adaptation: early impacts and essential responses*. Global Water Partnership: Stockholm, Sweden.

5 UNESCO & UN-Water. 2020. *United Nations World Water Development Report 2020: Water and Climate Change*. UNESCO: Paris, France.

resilient water strategies. Efforts to improve overall coherence and reduce redundancy are underway. Recently, there has been a growing push to address overall societal and ecological resilience, thereby incorporating climate adaptation, sustainable development, and disaster risk reduction and recovery.

Resilience can be defined as the ability of a system to adjust to and recover from climate impacts and, when necessary, to transform when recovery can no longer be achieved.[6] Why the emphasis on resilience? Given growing uncertainty about future conditions brought on by climate variability as well as increasingly complex and cascading hazards that undermine progress on poverty reduction and sustainable development more broadly, there is a pressing need to address these issues in concert (Figure 1). Scientific research into human interactions with nature in the context of complex water management problems provides profound feedback that can be used to improve our understanding of water resources management and the provision of services. By focusing on improving the ability of water systems and communities to dynamically adapt to, respond to, and recover from a range of shocks and stressors, rather than addressing each issue individually, societies can better prepare themselves for uncertain and shifting futures.

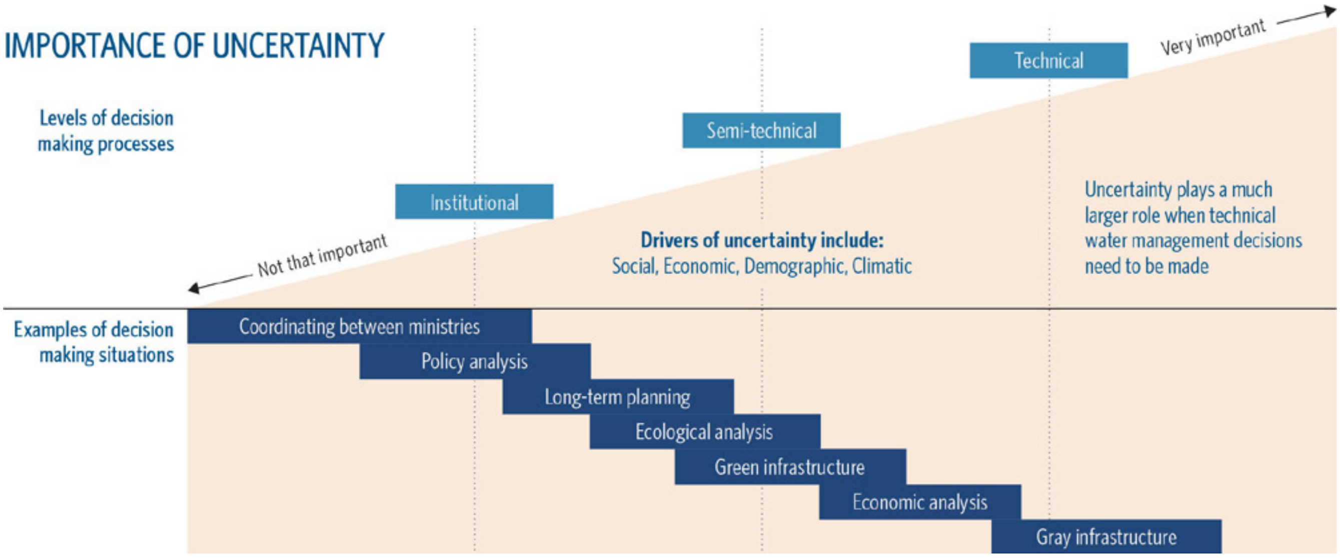

Figure 1: The importance of uncertainty will have different impacts depending on the decision making context. Bottom-up approaches help to navigate tradeoffs between risk tolerance, potential consequences, and amounts of analytical uncertainty in order to guide users towards appropriate solutions. Source: Adapted from Matthews et al.[7]

Approaches for Addressing Uncertainty: Moving from Theory to Practice

As 2020 has demonstrated, societies are constantly facing new uncertainties and mounting threats to essential systems such as human health, water resources, and disaster preparedness. How problems are diagnosed directly impacts the types of solutions presented; therefore, the approaches used in risk assessment and decision making for water resources will have implications for design, allocation, governance, and operations for decades to come. Although climate change is not a new risk for water managers, there is significant disagreement on how to address climate as a risk (or opportunity) and appropriately assess the complex interactions between human and water systems.

6 Smith, D.M., Matthews, J.H., Bharati, L., Borgomeo, E., McCartney, M., Mauroner, A., Nicol, A., Rodriguez, D., Sadoff, C., Suhardiman, D., Timboe, I., Amarnath, G., & Anisha, N. 2019. *Adaptation's Thirst: Accelerating the convergence of water and climate action*. Background Paper prepared for the 2019 report of the Global Commission on Adaptation. GCA: Rotterdam, the Netherlands and Washington, DC, USA.

7 Matthews, J., Matthews, N., Simmons, E., & Vigerstol, K. 2019. *Wellspring: Source Water Resilience and Climate Adaptation*. The Nature Conservancy: Arlington, USA.

Case study - Managing the Energy-Water Nexus in Zambia's Capital

In brief: Stress testing allowed the planner to establish a nexus between energy limitation and water-supply shortage. It further helped to determine that the key to resilient water supply was robust energy production.

A summary of institutional context: Zambia's principal water treatment facility, the Iolanda Water Treatment Plant, is dependent on hydropower from the Kafue Gorge dam to operate. However, the facility often experiences power shortages. During the dry season, low levels of water in the Kafue Gorge reservoir affect both water availability and power availability, making Zambia's capital of Lusaka especially vulnerable to climate-related risks. This case study explores the approaches that would increase the Iolanda Water Treatment Plant's ability to deliver acceptable levels of water supply to the utility that serves Lusaka, while incorporating plausible climate change risks into decision making. Application of the Climate Risk Informed Decision Analysis (CRIDA) approach at the Iolanda Water Treatment Plant helped to identify three solutions to the shortage of power and water: (1) buying and installing back-up generators, (2) creating a power agreement that would favor the plant during power shortages, and (3) building large transfer tanks to store water for the city. These alternatives were evaluated for effectiveness, feasibility, and cost. The final strategy, selected via incremental cost analysis and considering political will, recommended the option of buying and installing back-up generators — building robustness for the present and leaving options open for flexibility as conditions change.

Contributors: USACE-IWR; Millennium Challenge Corporation, Zambia; Lusaka Water and Sewerage Company

Over the past half-century, water management has largely been guided by the assumption that we can use the past to confidently predict (and plan for) the future, and that we prioritize investments based primarily on financial and/or economic objectives — ideas embedded within what are known as "top-down" approaches, which rely upon the accuracy of climate predictions from large-scale models (in the case of climate sciences, general circulation models or GCMs) as the basis for decision making. These approaches often neglect to incorporate the local context and constraints while minimizing stakeholder engagement. They are also subject to the various physical and modelling limitations inherent to large scale models, thus constraining their applicability to decision making.

More recently, a new set of complementary resilient water management tools and approaches have emerged that work to assess and address climate and non-climatic uncertainties in a manner that can be integrated within existing planning, design, and operational decision processes. "Bottom-up" approaches have been developed to confront these uncertainties through a process that involves stakeholder engagement from the outset, where stakeholder-defined measures of success form the basis of risk evaluation. Emphasis is placed on gaining a more complete understanding of the local water system context, the project's vulnerabilities, the level of analytical uncertainty, and the decision maker's tolerance for risk. This localized, context-specific philosophy is essential for finding more comprehensive policy responses and ensuring long-term community support.[5,8]

A key concept in a bottom-up vulnerability assessment is identifying the specific plausible futures that may result in a failure to accomplish the desired system outcomes. System performance is "stress-tested" against climate data and other variables to define "breaking points" (i.e., conditions under which satisfactory performance is not met), which can then be compared with the tolerance for risk and failure held by decision makers. Bottom-up

8 OECD. 2015. *OECD Principles on Water Governance*. Adopted by the OECD Regional Development Policy Committee on 11 May 2015. Welcomed by Ministers at the OECD Ministerial Council Meeting on 4 June 2015. https://www.oecd.org/cfe/regionaldevelopment/OECD-Principles-on-Water-Governance-en.pdf.

approaches align with traditional engineering planning processes and offer the potential for the incorporation of social, financial, or ecosystem considerations as part of climate-robust or flexible solutions to local water management challenges. They also represent useful tools in meeting the ambitious climate and development goals that countries have set for 2030 and beyond.

Case study - Designing for Resilience in the Greater Mexico City Region

In Brief: A novel approach joining human-hydrologic modeling and stakeholder engagement for freshwater resilience planning under uncertainty across scales is applied to solve for the water supply sustainability objectives of local residents and decision makers in the Greater Metropolitan Supply System of Mexico City.[9]

A summary of institutional context: Freshwater provisioning and regulating service play major roles in shaping urban vulnerabilities to the stresses and shocks of global change in the modern era. This case study illustrates an example of the freshwater resilience planning and investment prioritization process — or Resilience by Design — for the water supply of Mexico City and the surrounding supply systems. It highlights the need to consider urban areas as nested systems within the broader freshwater systems that supply them, and promotes the importance of participatory, performance-based approaches for resilience planning of water resources systems under uncertainty. The use of bottom-up approaches served as a tool for integrated, cooperative analysis of systems and the discovery of potential solutions across a range of uncertainties.

Contributors: World Bank; University of Cincinnati; University of Massachusetts-Amherst; Agua Capital

What Do Bottom-up Approaches Look Like?

A number of complementary yet distinct bottom-up approaches are available for decision makers. Choosing among them will require an understanding of the specific decision context. In practice, coping with uncertainty in decision making requires identifying likely threats and opportunities in order to develop robust solutions, and then considering how to retain flexibility across multiple potential futures. The combination of robustness to extreme events and flexibility to dynamic conditions can be applied to all aspects of water resources management decision making, including infrastructure design, institutional analyses, and policy formation. In general, some bottom-up approaches emphasize one or several issues such as the robustness of solutions, the flexibility of decisions, and/or the assessment of tradeoffs in an integrated manner. Below are several of the prominent bottom-up approaches being used today.

Developed through the Upper Great Lakes International Joint Commission in North America, **Decision Scaling** is a bottom-up, robustness-based approach to water system planning that uses a "stress test" for the identification of system vulnerabilities and simple, direct techniques for the iterative reduction of these vulnerabilities through targeted design modifications.[10] A variant known as **Eco-Engineering Decision Scaling** (EEDS) has broadened the approach to include applicability for green infrastructure and nature-based solutions (NBS).[11]

9 Freeman, S. S. G., Brown, C., Cañada, H., Martinez, V., Nava, A. P., Ray, P., ... & Wi, S. 2020. Resilience by design in Mexico City: A participatory human-hydrologic systems approach. *Water Security, 9*, 100053.

10 Brown, C., Ghile, Y., Laverty, M., & Li, K. 2012. Decision scaling: Linking bottom-up vulnerability analysis with climate projections in the water sector. *Water Resources Research, 48*(9).

11 Poff, N. L., Brown, C. M., Grantham, T. E., Matthews, J. H., Palmer, M. A., Spence, C. M., Wilby, R.L., Haasnoot, M., Mendoza, G.F., Domnique, K.C., & Baeza, A. 2016. Sustainable water management under future uncertainty with eco-engineering decision scaling. *Nature Climate Change, 6*(1), 25-34.

Launched in 2015 by the World Bank, ***Confronting Climate Uncertainty in Water Resources Planning and Project Design: The Decision Tree Framework***[12] is a step-by-step decision making approach which, given the perceived vulnerability of a water resource project, investment, system, and/or plan, deepens the level of analysis. Building upon the principles of Decision Scaling, the Decision Tree Framework places an emphasis on the analysis of tradeoffs between the various aspects of water resources management in a climate change and uncertainties context. The approach can be applied to stress test a plan, a water system, a discrete investment, or an operations plan.

With an emphasis on flexibility and risk minimization, **Adaptation Pathways** (or Dynamic Adaptive Policy Pathways; DAPP) is a structured and dynamic approach to planning that allows for policies to change over the course of a project's lifetime, taking into account changes in the system, new vulnerabilities, and new opportunities in order to avoid being "locked in" to a singular approach.[13] The approach has been pioneered by in the Netherlands by Deltares, TU Delft, and the Netherlands Ministry of Infrastructure and Water Management.

Building upon all of the above approaches, UNESCO and the International Center for Integrated Water Resources Management (ICIWaRM; a Category II center under the auspices of UNESCO) published **Climate Risk Informed Decision Analysis** (CRIDA),[14] which presents a decision support system to help water resources planners to navigate through uncertainties on planning, design, and operations with robust and socially acceptable solutions. CRIDA incorporates aspects of governance and finance as well.

Case study - Understanding Climate Change Impacts on Water Security in Chile's Limarí River Watershed

In Brief: The climate stress test provides a relevant assessment tool for potential climate change impacts on critical components of the water system vulnerabilities at a watershed scale.

A summary of institutional context: The Limarí River Watershed is located in Chile and hosts a wide range of economic activities reliant upon water usage (e.g., agriculture, mining). The watershed has a high interannual variability in its hydrology. In recent years, an unusually long drought (2009-2015) has changed expectations with regard to climate variability in the region and led to dramatically lower reservoir levels and new water supply challenges. Local stakeholder input was gathered to help identify critical water management performance needs and to define water security vulnerability in the regional context. Based on this input, a climate stress test as part of a CRIDA analysis has been performed to identify specific water security hazards, plausibility, and suggested adaptation strategies to address insufficient reservoir volumes for the Paloma Reservoir.[15]

Contributors: UNESCO IHP; CAZALAC; La Sarena, Chile; Deltares; local stakeholders

Who Is Using the Approaches?

While bottom-up approaches have only been in use for around a decade, there are already a number of early adopters institutionalizing these methods within their operational policies

12 Ray, P.A. & Brown, C.M. 2015. *Confronting Climate Uncertainty in Water Resources Planning and Project Design: The Decision Tree Framework*. World Bank: Washington, DC, USA.

13 Haasnoot, M., Kwakkel, J. H., Walker, W. E., & ter Maat, J. 2013. Dynamic adaptive policy pathways: A method for crafting robust decisions for a deeply uncertain world. *Global environmental change, 23*(2), 485-498.

14 Mendoza, G., Jeuken, A., Matthews, J.H., Stakhiv, E., Kucharski, J., & Gilroy, K. 2018. *Climate Risk Informed Decision Analysis: Collaborative water resources planning for an uncertain future*. UNESCO and ICIWaRM: Paris, France and Alexandria, USA.

15 Verbist, K., Rojas, P. and H. Maureira. 2020. *A Stress Test for Climate Change Impacts on Water Security - Case study from the Limarí Watershed in Chile*. UNESCO: Paris, France.

and frameworks. The U.S. state of California has included CRIDA as a key part of its Climate Change Adaptation Plan for prioritizing state resiliency efforts around hydrological risks and water resources infrastructure improvements.[16] The Global Commission on Adaptation (GCA) will use bottom-up approaches to achieve the goals of its Water Action Track through 2030. Similarly, the UNFCCC's Marrakech Partnership for Global Climate Action (MPGCA) has highlighted the utility of these approaches in its 2019 *Yearbook of Global Climate Action*, while another UN agency has included CRIDA as part of its mandate to build capacity to increase resilience to climate change in its 2020–2022 workplan.[17]

Policy support at regional, national, and transboundary levels will be integral to achieving meaningful change on a global scale. A recent crowd-sourced publication involving national, sectoral, and civil society partners from more than 100 countries was launched in the lead up to COP25. Led by the Alliance for Global Water Adaptation (AGWA), the *Watering the NDCs*[18] report provides guiding principles and recommendations for national climate planners and decision makers to help them ensure that they meet their goals within their National Adaptation Plans (NAPs) and Nationally Determined Contributions (NDCs), including through the use of bottom-up approaches.

Dozens of case studies have already demonstrated the efficacy of bottom-up approaches in assessing and addressing risk across a range of scales and contexts. A multi-year project has utilized bottom-up approaches to improve transboundary water management and build resilience to climate change within the Dniester River Basin in Europe. These approaches work at the city level, too. For example, CRIDA has been applied to address water security issues in Central Cebu, the Philippines.

Impacting Project and Development Finance

The development finance community is interested in these approaches as ways to increase resilience across their project portfolios by incorporating the concepts into their procurement and screening processes. The World Bank has already institutionalized the principles within its Decision Tree Framework. The Asian Development Bank (ADB) is in the early days of using a variant of bottom-up approaches, while the European Bank for Reconstruction and Development (EBRD) is already using bottom-up principles for some of its water programs.[18]

Next Steps: Expanding Implementation

To further scale up implementation of bottom-up approaches, new support tools as well as broader awareness and capacity will be required. In the past several years, the practitioners behind the development of these approaches have emphasized training and outreach. They are also currently working on tools to simplify aspects of application of the frameworks in order to shorten implementation periods and broaden their potential for use.

A number of training events across varying formats have already taken place. In 2018 through a program led by the UNFCCC Consultative Group of Experts (CGE), over 100 national adaptation focal points participated in three regional multi-day workshops featuring training on bottom-up approaches. In 2019 UNESCO's Intergovernmental Hydrological Programme (IHP) and partners organized a five-day workshop in South Africa to train

16 California Department of Water Resources Climate Change Program. 2020. *Climate Action Plan Phase III: Climate Change Adaptation Plan*. CA DWR: Sacramento, USA.

17 UN Economic Commission for Europe Working Group on Water and Health. 2019. *Draft programme of work for 2020-2022*. UNECE and World Health Organization: Geneva, Switzerland. https://www.unece.org/fileadmin/DAM/env/documents/2019/WAT/04Apr_03-04_11thWGWH/Official_docs/ECE_MP.WH_WG.1_2019_3_ENG.pdf

18 Timboe, I., Pharr, K., & Matthews, J.H. 2020. *Watering the NDCs: National Climate Planning for 2020—How water-aware climate policies can strengthen climate change mitigation & adaptation goals*. Alliance for Global Water Adaptation (AGWA): Corvallis, USA.

19 International Hydropower Association (IHA). 2019. *Hydropower Sector Climate Resilience Guide*. IHA: London, UK.

various stakeholder groups in implementing CRIDA and other bottom-up approaches. That same year, ICIWaRM led similar courses for Eastern African water resources professionals in Uganda. In 2020 the first open online training on CRIDA was developed through UNESCO's Online Learning Platform,[20] featuring 11 modules that include readings, video lectures, knowledge checks, and assignments.

Training has made its way into classrooms and local governments as well. In the past several years, graduate students have participated in full courses and one-day workshops at several universities (e.g., University of Stellenbosch, Oregon State University, University of Idaho, University of Oxford). Mayors and city planners in the Baltic Sea region took part in three separate one-day workshops specifically focused on urban climate adaptation aspects of bottom-up approaches. Additionally, the World Bank has hosted training courses in South Korea (for clients from several governments in Asia), Nepal, Morocco, Peru, Tanzania, the U.S., and elsewhere.

Case study - Master Plan Devised: Implementing Green Infrastructure in Udon Thani, Thailand

In Brief: Multi-purpose green infrastructure projects to mitigate uncertain increases in floods and droughts in Udon Thani, Thailand.

A summary of institutional context: Udon Thani is a city in northeast Thailand with a population of over 500,000 for the greater metro area. According to UN statistics, Udon Thani is projected to grow 20% by 2030, becoming an important economic and strategic gateway to Indochina. The projected growth in population has led to increasing concerns about stressing the water supply, particularly in the dry season, and increased flood impacts during the rainy season. Currently, the city relies on a single source of water — the Huay Luang Reservoir. In close collaboration with local stakeholders, a CRIDA analysis was used to discover the potential vulnerabilities and effectiveness of proposed development and investment plans. Based on the analysis, the city is currently in the design and construction (USD $25 million) of the first phase of development of green infrastructure solutions that integrate urban storm water storage and diversion with recreation in the downtown area. The application of nature-based solutions has demonstrated how land use planning can balance future growth and urbanization against flood risks and water security challenges.

Contributors: USACE-IWR; Mayor of Udon Thani; Department of Public Works; Chamber of Commerce; Chamber of Industry; the Royal Irrigation Department; estudio OCA

Furthermore, this policy brief is also expected to contribute to the Adaptation Academy[21] being launched by the UNFCCC, which is planning to train national climate decision makers in aspects of bottom-up approaches specifically related to national climate plans (e.g., NDCs) as well as measurement, reporting, and verification (MRV) processes.

UNESCO IHP and partners are organizing a multi-day conference on bottom-up approaches for high-level decision and policy makers, planned to coincide with the rescheduled COP26 currently set for November 2021. In order to share insights and relevant case studies, UNESCO, AGWA, and ICIWaRM have begun a monthly webinar series on climate-resilient water management approaches. The series began in July 2020 and features international experts experienced in addressing a number of climate and development challenges, with content specifically designed to address the policy and decision making elements of bottom-up approaches.

20 https://openlearning.unesco.org/courses/course-v1:CRIDA+CRIDA0001+Run1_2020/about

21 https://unfccc.int/process-and-meetings/transparency-and-reporting/support-for-developing-countries/unfccc-castt-climate-action-and-support-transparency-training/climate-action-and-support-transparency-training-castt-adaptation-academy

An outcome of UNESCO's 2021 conference will be a set of recommendations on the use of climate-resilient water management approaches and a compilation of global case studies featuring bottom-up approaches. The case study collection is intended to be shared widely among IHP networks and the broader water community, ultimately leading to recommendations for resilient water resources management approaches across different scales in order to improve national risk management strategies and to lower the impact of water-related hazards on local communities vulnerable to exacerbated climate variability and change. The conference and its outcomes will also help guide in the preparation and implementation of the 9th phase of IHP (2022-2029), which will emphasize the interaction between human needs and water systems.

These approaches can also be applied outside of the global and national policy processes governing climate action, sustainable development, and disaster risk reduction. The private sector faces tremendous risks from climate change and other uncertainties. Preliminary guidance is being drafted to help support industries in the practice of reducing climate risk and negotiating tradeoffs around climate change. Guidance is being crowdsourced by adaptation specialists and business representatives such as CDP, AGWA, Pacific Institute, and the Resilience Shift, drawing heavily upon the principles behind bottom-up approaches.

Case study - Planning for 2050 in California's Central Valley Water System

In Brief: System-wide stress test allowed California water managers to examine how existing policies affect future robustness and point toward solutions to meet future water needs.

A summary of institutional context: As variability and extremes in temperature and precipitation are projected to increase over the coming century, agricultural and municipal water managers could face serious challenges in maintaining reliable service. In the U.S. state of California, the Central Valley Water System is made of a series of natural river channels and human-made facilities that function to store and manage water supplies for approximately 25 million users across the state. The California Department of Water Resources used a bottom-up decision scaling approach to stress test water resources system performance to changes in temperature and precipitation. Results of the study provide a summary of the sensitivity of the State Water Project (SWP) to climate change and contribute to more informed decision making around climate adaptation planning and investments.

Contributors: California Department of Water Resources

A Community of Practice

Beginning in 2017, AGWA launched an online Knowledge Platform to serve as a hub for capacity building resources and information on bottom-up approaches (https://AGWAguide.org). Peer-reviewed scientific articles and other reports explain the intricacies and steps required to implement each approach. A library of case studies, publications, and other training resources are available on the Knowledge Platform, with significant expansions expected into 2021.

As the community of practice grows, more updates and opportunities for engagement will arise. AGWA and partners are listening to the demands of policy makers and practitioners for more regional or thematic guidance around bottom-up approaches. New networks focused on crowdsourcing expertise are beginning to form, with the first focused on the adaptation needs of small island developing states (SIDS). To stay up to date on the latest developments and join the community of practice, individuals are encouraged to join a topical mailing list on bottom-up approaches at https://AGWAguide.org/get-involved/.

Case study - Ecosystems for Adaptation with Mexico's Water Reserves Program

In Brief: Mexico's Water Reserves Program is an Ecosystem-Based Adaptation instrument demonstrating that it is possible to strike a sustainable balance between water use and environmental conservation of flows.

A summary of institutional context: Overexploitation of water resources in Mexico's major economic productivity areas has led to loss of biodiversity and limited economic development, while making communities more vulnerable to the uncertainty of climate change. This case study explores how the National Water Reserves Program allowed the government to allocate water for environmental needs while meeting the present and future needs of its citizens. The Eco-Engineering Decision Scaling (EEDS) methodology was used to quantify and demonstrate the adaptation benefits of the program by examining water reserves scenarios, as well as floods and droughts, for their impact on environmental flows.

Contributors: WWF-Mexico; Mexican National Water Commission (CONAGUA); Inter-American Development Bank (IDB); AGWA; UNESCO

Solution-Oriented Tools for the Paris Agreement, SDGs, and Sendai Framework

Bottom-up approaches provide policy makers with the means to achieve cross-cutting commitments for climate-resilient societies and ecosystems. The tools outlined in this policy brief are already being implemented across the globe for various water management projects. Policy makers should identify opportunities to use the tools in the development of proactive water management strategies as part of their NDCs and NAPs, in addition to their SDG and Sendai Framework commitments. Even (and especially) amid increasing climatic and hydrological variability, bottom-up approaches represent an opportunity for inclusive, flexible, and robust cross-sectoral solutions to meet today's and future challenges. Adoption of these approaches will provide for coherence across climate, sustainable development, and disaster risk reduction goals, bringing local-level knowledge into the national and global policy arenas.

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