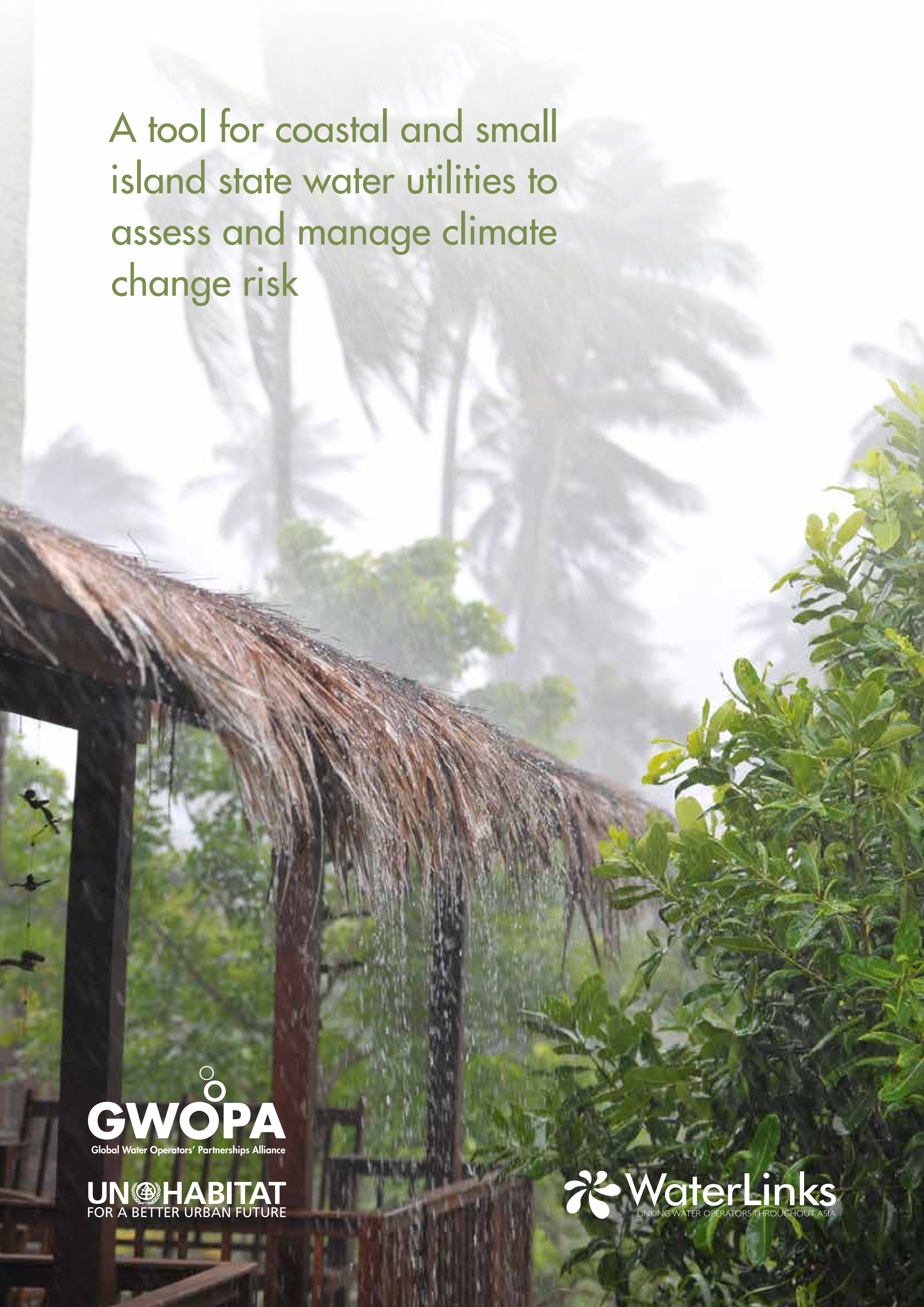
A tool for coastal and small island state water utilities to assess and manage climate change risk



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WaterLinks
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CONTENTS

PREFACE

Climate Change[1] iis big news all over the world. Ironically, water usually finds mention in the footnotes even though it is arguably the principal adverse fall-out of changing climate patterns and extreme weather events.

Since 2008, more than half of the world's population already lived in cities. This figure continues to grow, particularly in Africa and Asia, and coastal urban centres receive a disproporionate share of this growth. Urbanization can be a positive force, however safe, adequate, and predictable water supplies are a necessary feature of sustainable urban development.

Coastal water utilities and those of small island states, especially in the developing world, already bear the brunt of climate change, often to much higher degrees than their inland counterparts. Sharper, more concentrated rainfall or drier and longer periods without it; salt water intrusion; floods; and droughts, all take a heavy toll on the utilities' ability to fulfil their objectives.

This guidebook is designed to help utilities identify and assess climate change manifestations that impact adversely on their operations and formulate a credible response. It draws principles from the Water Operators' Partnership (WOP) between Yarra Valley Water, Melbourne, and the National Water Supply and Drainage Board, Sri Lanka and is targeted towards coastal and small island states. However the tool has universal application, especially in a developing economy environment such as those obtaining in Asia, Pacific, Latin America or Africa, which have limited capacities to conduct local vulnerability assessments, and where data availability and quality are often poor.

In light of the fact that many utilities have deficits in data and technical capacities, the guide offers two approaches. The first, a 'top-down' approach is recommended where the needed data is readily available. The second, a 'bottom-up approach' can serve utiliites that cannot easily aquire such data for decision making. Before undertaking the assessment process described in the guide, the utility should take time to review its contents and requirements, and based on an internal review of financial resources and technical capacities, the technical operations management can determine which approach is best for them.

Cognizant of the technical demands of the exercises that follow, the guide also endeavors to help utilities build their own understanding and capacities in dealing with climate change. Those utilities that mainstream long-term climate change monitoring and impact resolution into their operations will clearly benefit the most.

Utilities may want to pursue the excercises herein with the help of an external expert or partner utility that has extensive experience in conducting their vulnerability assessments. WOPs can also be helpful in implementing broader changes and improvements that may be identified through the exercises in the tool. It would be useful to identify utilities that are more prone than others to climate change impacts and assist them to prepare adaptation plans on the basis of this tool using a Water Operators' Partnerships (WOP) approach. This would ensure early testing of the tool and provide immediate benefit to affected utilities.

The authors received valuable technical insights from Yarra Valley Water, Melbourne; Palm Beach County Water Utility, Florida; National Water Supply and Drainage Board (NWSDB), Sri Lanka; and Seattle Public Utilities, Seattle. They peer-reviewed the tool; nonetheless, we remain responsible for all errors or omissions. We also consulted with Manila Water and Maynilad, the two concessionaires in Metro Manila, as also the National Water Resources Board of the Philippines, as well as the Metropolitan Water and Sewerage System. Their suggestions are gratefully acknowledged. Finally, we wish to thank the the authors Arjun Thapan, Chairman of WaterLinks, and Claudius Gabinete, United States Agency for International Development through the WaterLinks Alliance Project, without whose sustained support, insights, and technical contributions, this tool would not have seen the light of day.

This tool was prepared with support from the Cities and Climate Change Initiative and Global Water Operators' Partnerships Alliance of UN-Habitat. We hope that this tool will stimulate interest in utilities building greater resilience to climate change and adapting intelligently to a new environment. Comments, questions, and suggestions will always be welcome.

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1. Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use (IPCC, 2013).

EXPLANATORY NOTE

What to expect from the Tool

Climate change manifests itself through variable precipitation, saline ingress, and extreme weather events such as floods and droughts. This tool will enable coastal water and wastewater utilities to assess their water resources for climate-related risks. It will help utilities to (i) understand the issues, (ii) assess the range and scale of climate change impacts to their water availability, (iii) identify a set of options, and (iv) identify an implementable program of response to ready themselves.

The current edition of the tool, by its intent and design, focuses on climate vulnerability and risk assessment of the utility's water resources. Although it offers guidance on the initial steps in identifying the potential range of adaptation options that utilities can take, it does not delve extensively into how these options can be implemented. There is an abundance of literature available to address water resource availability and quality problems, flooding and other water and sanitation problems that are anticipated to arise more frequently under climate change. The tool will be updated to address any novel impacts that may be identified later on.

The tool offers two approaches to assessing climate vulnerability and risk. The Top-down[2] approach incorporates a scientific outlook to identifying and assessing climate change impacts that will enable the design of a credible adaptation program. This approach is highly technical in nature and requires significant financial and time inputs, lasting for more than a year. The Bottom-up approach offers a more intuitive but evidence-based path to understanding climate change scenarios, impacts on operations, and options for mitigation. It is less technical, requires fewer resources and needs less time to resolve.

The two approaches are not mutually exclusive. In fact, these two can be complementary. The tool offers the two as separate approaches to highlight their distinct techniques and perspectives. There are cases where both approaches were combined – top down analyses utilizing downscaled projections and impact scenarios, and bottom-up practices involving multi-stakeholder forums to identify and build a range of adaptation responses based on the climatic (identified in top-down) and non-climatic (driven by economic, social, political vulnerabilities and capacities) scenarios (identified during stakeholder consultations). The blend of what elements from each approach or assessment model that can be included in a combined approach depends on the capacities and institutional willingness of the utility or participating utilities, in case of water operator partnerships or WOPs.

Choosing the best approach to take is not straightforward, and can be uncertain at times. This is a decision that rests on an internal review of the utility's financial and technical resources, and the political support and willingness of the regulator (s) and local government(s) in the area(s) the utility operates. Moreover, if the utility opts for a WOP, the selection would also be contingent on the mentor's capacities and limitations.

The 12 exercises under Top-down approach in the tool will allow you to produce the following outputs:

- Range and scale of exposure and sensitivity of your assets including water and wastewater facilities, machines and equipment, to extreme weather events such as storms, floods and droughts;
- Indicative trends and likely amounts of water lost (or gained) due to variability in precipitation, both current and projected, from surface and ground water resources;
- Indicative trends in concentration of salinity in your existing ground water resources, both current and projected;
- Range of adaptation options and technologies that you can deploy;
- A communications strategy that will enable you to pursue a continuous dialogue with your principal stakeholders; and
- A final implementation plan that you will need to action.

The Bottom-up approach endeavors to elicit similar outcomes through the outputs below:

- Critical climate variables and the water utility's sensitivity to these;
- Water system responses to a range of potential climate changes;
- Vulnerability of the water utility to climate change impacts;
- System performance according to the uncertainty associated with climate change factors driving the water utility's vulnerability; and
- Overall system risk analysis and areas in need of further analysis.

2. The Top-down approach is so called because of the use of the downscaled general circulation climate models to commence the study of impacts and design adaptation solutions. For a more detailed definition of the top-down and bottom-up methodologies see 'Climate Change and Urban Water Utilities – Challenges and Opportunities' published by the World Bank in April 2010.

FIGURE 1: Climate change risk management cycle

TOP-DOWN APPROACH	RISK MANAGEMENT CYCLE	BOTTOM-UP APPROACH
Exercise 1: Identifying Historical Operational Disruptions **Exercise 2:** Assessing Historical Rainfall and Temperature Variations **Exercise 7:** Establishing Salinity Baselines	Establish baseline conditions	Setup a technical working group and apprise the group of the best and most locally relevant climate information and projections. Identify vulnerabilities in the water systems based on current climate conditions.
Exercise 3: Projecting Rainfall and Temperature Scenarios	Forecast trends	Conduct sensitivity analysis of vulnerable components of the water system under different climate scenarios, including baseline.
Exercise 4: Estimating Climate Change Impacts **Exercise 5:** Assessing Flood Impacts **Exercise 6:** Assessing Drought **Exercise 8:** Forecasting Sea Level Rise and Changes in Salinity **Exercise 9:** Identifying Water Supplies Shortfall	Assess changes from baseline	
Exercise 10: Evaluating Adaptation Options **Exercise 12:** Final Implementation Actions	Select and implement appropriate adaptation action(s)	Develop a decision model based on the result of the sensitivity and scenario analysis.
Exercise 11: Communications Strategy	Monitor and evaluate	

Note: The climate change risk management cycle is an iterative process. Blue colored groups of exercises denote the focus areas of the tool, while the green colored group receives less attention. Monitoring and evaluation are critical in a sound risk management process but outside the current scope of the tool.

How to use the Tool

The tool has 3 main parts: an introduction that discusses the background, the manifestations of climate change, and its principal impacts; the Top-down Approach that incorporates 12 exercises by identifying historical operational disruptions through to final implementation plans, and; the Bottom-up Approach that describes what the 5-week program of action should typically encompass. Impact assessments are made for each variable that affects supply and demand.

Following the principles of climate risk management cycle, this tool is structured to comprise the above five sequential main groups of exercises for each climate change impact area. These exercises are essential elements in getting your water utility ready for climate change. Specific data requirements and activities in each impact area are highlighted in each section.

Water Operators' Partnerships are a potential source of support for acquiring the knowledge, technical and technological required to assess climate change problems in a utility's water resources. They can also help utilities establish a credible adaptation response mechanism in countries with a deficit of data and technical skill or which have less experience in directly addressing water resource related climate change impacts. Utilities looking to engage in a WOP should involve the mentor even before the process starts. This provides the opportunity for both parties to settle on the assessment model(s) or approach(es) they are comfortable with and able to use. Establishing baseline conditions is not a technically intensive activity. However, forecasting future trends and impacts (changes from baseline) would often require external expert assistance apart from a mentor utility.

Chronology and Time Requirements

Note that the assessments described in the exercises under the Top-down Approach vary greatly in terms of preparation and implementation time required. In order to maximize resources, the tool recommends that utilities begin with the exercises related to stocktaking of historical and baseline information first, starting with Exercises 1 and 2. Analyses required for Exercises 3, 5 and 6, and elsewhere in tool should not take more

outputs from these two exercises are required for Exercises 8 and 9. Adaptation options can only be evaluated after the first 9 exercises have been completed. Ideally, a utility should be able assess the potential impacts of climate change to its operations and determine its adaptation action(s) within 20 months.

The communications strategy (Exercise 12) should be completed within the first two months of the program. It is crucial that the utility's initial effort towards climate-proofing water and wastewater systems be effectively communicated to all staff and management levels within the organization. Table 1 provides a sample work plan on the period of time within which all 12 exercises can be completed.

Progress and results of the assessment, as well as the potential adaptation options, should be disseminated to all identified stakeholders throughout the program period. A sample template outlining the salient results of tool exercises is given in Appendix A.

Scope and Limitations

The tool is essentially a climate change vulnerability and risk assessment guide for water utility operators. It addresses the following water and wastewater issues that may be exacerbated by climate change (i) water availability from surface and groundwater resources; (ii) extremes in the form of flood and drought; and (iii) saline intrusion. It also attempts to address differences in the capacities of utilities in terms of financial and technical capabilities by offering top-down and bottom-up approaches.

Due to limitations in current literature, the tool does not address the impact of potential increase in contamination of water supply due to anticipated higher temperatures. It is also, by design, limited in addressing the impacts of storm, floods, and droughts for which a wide range of literature and guidelines from well-established sources already exists. The tool also does not venture into areas such as protection of infrastructure or preparing of emergency response plans.

Managing Uncertainty

While the tool provides steps for discrete calculations, we recommend that the results be considered as indicative and not definitive. The results of climate models and equations