WATER GLOBAL PRACTICE • WORKING PAPER

Framework for the Assessment of Benefits of Action/Cost of Inaction (BACI) for Drought Preparedness

SEPTEMBER 2019

Paul Venton, Courtenay Cabot Venton, Natalia Limones, Christopher Ward, Frederik Pischke, Nathan Engle, Marcus Wijnen, and Amal Talbi

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WORLD BANK GROUP

1818 H Street NW, Washington, DC 20433

Telephone: 202-473-1000; Internet: www.worldbank.org

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Abbreviations

AADP	Africa-Asia Drought Risk Management Peer Assistance Project
AAL	average annual loss
BACI	benefits of action and costs of inaction
BCR	benefit-to-cost ratio
CBA	cost-benefit analysis
CEA	cost-effectiveness analysis
DDC	Drylands Development Centre
DMDU	decision making under deep uncertainty
FAO	Food and Agriculture Organization of the United Nations
GC-RED	Global Policy Centre on Resilient Ecosystems and Desertification
GFDRR	Global Facility for Disaster Recovery and Response
GWP	Global Water Partnership
HFA	Hyogo Framework for Action
IDDP	Integrated Drylands Development Programme
IDMP	Integrated Drought Management Programme
MCA	multicriteria analysis
NDMC	National Drought Mitigation Center
NIDIS	National Integrated Drought Information System
NPV	net present value
PDNA	postdisaster needs assessment
PRONACOSE	National Program Against Drought (Programa Nacional Contra la Sequía)
RDM	robust decision making
SDG	Sustainable Development Goal
SEDAPAL	Servicio de Agua Potable y Alcantarillado de Lima
SPI	Standardized Precipitation Index
UN	United Nations
UNDP	United Nations Development Programme
UNISDR	United Nations Office for Disaster Risk Reduction
WEAP	water evaluation and planning system
WMO	World Meteorological Organization

Summary

This working paper brings together the work carried out to date under the joint World Bank and Integrated Drought Management Programme (IDMP) work stream on the benefits of action and costs of inaction (BACI) for drought preparedness and mitigation. The paper is intended to suggest a methodological framework for assessment of the BACI as a tool to support a shift in drought policy and programs from crisis management to a risk management approach.

The paper emphasizes that there is an initial need for a conceptual framework for analyzing the BACI and argues that the framework should be systematic enough to allow for comparability across countries and contexts, with the option of being tailored as needed.

In proposing an initial framework for the BACI assessments, the authors use the 10-step methodology for developing drought strategies that was created by Wilhite (1991) and Wilhite, Hayes, and Knutson (2005) and subsequently codified by the World Meteorological Organization (WMO) and the Global Water Partnership (GWP) (2014) to help organize the necessary stages for the assessment. In this way, the authors embed the BACI assessment in the overall development of a drought risk management strategy. The 10-step process is used as the main structure, which can be replicated or compared across contexts, even if the specifics of what is assessed within each step differs between cases. This document is a first approach designed to guide those responsible for drought management and the BACI assessments—relevant authorities, operators, institutions, and technicians—to ask the right questions at the different stages in a structured manner.

Key next steps will be to experiment with this draft approach by applying it in multiple contexts. The aim will be twofold: (a) test the guidance for its usability and clarity and use feedback to improve the approach with more concrete methodologies and technical tools within each of the steps and (b) develop more case study examples to showcase how this process can be undertaken and how it can be advantageous to stimulate positive action.

It is hoped that this approach can be improved upon and demonstrate how to do a BACI assessment for drought, and if it persuades policy makers of the value of the approach, it can support a shift away from reactive drought responses toward proactive drought risk management.

Chapter 1
Introduction

The Integrated Drought Management Programme (IDMP) and the World Bank have joined with several partners to launch a work stream on the benefits of action and costs of inaction (BACI) for drought preparedness and mitigation. Under the work stream, a number of workshops and papers on the theme have been supported by the IDMP, drawing on knowledge and best practices from a range of relevant stakeholders: researchers, technicians, authorities, operators, and institutions in charge of drought management. An expert workshop organized at the World Bank in April 2017—Drought Mitigation & Preparedness: Benefits of Action & Costs of Inaction—concluded that a systematic framework should be developed.

The objective of this working paper is to set out a framework to assess the BACI for drought mitigation and preparedness. It brings together the work accomplished to date under the IDMP and World Bank BACI work stream while also drawing on best practices from other agencies and related work streams. The paper's audience is development practitioners, including World Bank task team leaders, who are engaged with country governments and are often the ones advocating for more proactive drought preparedness measures without a more structured approach for embarking on analysis to provide this economics- and impacts-based argument.

This paper is organized as follows:

- Chapter 2 explains some of the reasons why most responses on drought have concentrated on reactive crisis management and have neglected forward-looking risk management strategies.
- Chapter 3 analyzes the phenomenon of drought and its impacts and summarizes some of the current tools and approaches to drought risk management.
- Chapter 4 makes the case for assessing the benefits of proactive drought risk management—and the costs of inaction. Some of the key issues for developing a framework for such an assessment are summarized, based on the work done in the IDMP and BACI work stream and on the discussions in the April 2017 workshop.
- Chapter 5 sets out a working framework for the BACI assessment with the intention of it being tested in real-life country situations and subsequently refined. The framework is set out within the model for the overall process of developing a national drought management policy, which was codified by the World Meteorological Organization (WMO) and the Global Water Partnership (GWP) in their 2014 National Drought Management Policy Guidelines (see box 1.1 for glossary of drought-related terms used in this paper).
- Chapter 6 proposes next steps for further development of the framework.

BOX 1.1. Glossary of Drought-Related Terms Used in This Paper

- **Adaptation:** The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects. *Source*: Intergovernmental Panel on Climate Change (IPCC) 2014.
- **Aridity:** Characteristic of a climate relating to insufficiency or inadequacy of precipitation to maintain vegetation. Aridity is measured by comparing long-term average water supply (precipitation) to long-term average water demand (evapotranspiration). If demand is greater than supply, on average, then the climate is arid. *Sources*: "Drought vs. Aridity" web National Oceanic and Atmospheric Administration (NOAA) website (accessed June 2019), https://www.ncdc.noaa.gov/monitoring-references/dyk/drought-aridity; World Meteorological Organization (WMO) 1992.
- **Drought:** (a) Prolonged absence or marked deficiency of precipitation. (b) Period of abnormally dry weather sufficiently prolonged for the lack of precipitation to cause a serious hydrological imbalance. *Source*: WMO 1992.
- **Drought impact:** A specific effect of drought on the economy, society, and/or environment, which is a symptom of vulnerability. *Source*: Global Water Partnership (GWP) Central and Eastern Europe 2015.
- **Mitigation** (of disaster risk and disaster): The lessening of the potential adverse impacts of physical hazards (including those that are human-induced) through actions that reduce hazard, exposure, and vulnerability. It is different from mitigation of climate change. *Source*: IPCC 2012.
- **Preparedness:** The knowledge and capacities developed by governments, response and recovery organizations, communities, and individuals to effectively anticipate, respond to, and recover from the impacts of likely, imminent, or current disasters. *Source*: Terminology database of the United Nations Office for Disaster Risk Reduction (UNISDR) (accessed June 2019), https://www.unisdr.org/we/inform/terminology.
- **Proactive approach to drought management:** A proactive approach to drought risk management includes appropriate measures being designed in advance, with related planning tools and stakeholder participation. The proactive approach is based on both short-term and long-term measures and includes monitoring systems for a timely warning of drought conditions, the identification of the most vulnerable part of the population, and tailored measures to mitigate drought risk and improve preparedness. The proactive approach entails the planning of necessary measures to prevent or minimize drought impacts in advance. This approach is reflected in the three pillars of integrated drought management. *Source*: Vogt et al. 2018.

box continues next page

BOX 1.1. continued

- **Reactive approach to drought management:** A reactive approach to drought management is based on crisis management: It includes measures and actions after a drought event has started and is perceived. This approach is taken in emergency situations and often results in inefficient technical and economic solutions because actions are taken with little time to evaluate best options and stakeholder participation is very limited. This approach has often been uncoordinated and untimely. In addition, crisis management places little attention on trying to reduce drought impacts caused by future drought events. *Source*: Vogt et al. 2018.
- **Vulnerability:** The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity. It is often understood as the opposite of **resilience**. *Source*: Glossary of Climate Change Acronyms and Terms, United Nations Framework Convention on Climate Change (accessed December 2018), https://unfccc.int/process-and-meetings/the-convention/glossary-of-climate-change-acronyms-and-terms.
- **Water scarcity:** An imbalance between supply and demand of freshwater in a specified domain (country, region, catchment, river basin, and so on) as a result of a high rate of demand compared with available supply under prevailing institutional arrangements (including price) and infrastructural conditions. *Source*: Term Portal, Food and Agriculture Organization of the United Nations (accessed June 2019), http://www.fao.org/faoterm/en.

Source: Integrated Drought Management Programme glossary, available at http://www.droughtmanagement.info/find/glossary/.

Chapter 2
Why Has There Been a Lack of Action on Drought Risk Management?

In 2017, the World Meteorological Organization (WMO) and the Global Water Partnership (GWP) published an Integrated Drought Management Programme (IDMP) working paper reviewing the literature on assessment of the benefits of action and costs of inaction (BACI) as part of drought mitigation and preparedness programs.[1] The paper raised a fundamental question: If proactive risk management is socially optimal compared with reactive crisis management, why is the shift from crisis management to risk management happening so slowly? Building from the specialized literature and interaction with experts, this report presents several factors that have impeded this shift.

One is the sheer complexity of the drought phenomenon, its impacts, and vulnerability to drought. It is clear from decades of experience globally that drought unfolds slowly and has a multitude of impacts, both direct and indirect. The 2016 drought in Malawi, for example, was found to have affected agriculture, food security, water, health, nutrition, energy, environment, education, transport, social protection, industry, and commerce.[2]

Drought impacts are also affected by the vulnerability of the population and their resilience, or lack of it, which are hard to gauge. The underlying causes of drought risk are multifaceted. The elusive, varied, and usually nonstructural impacts of drought are hard to predict, and they are conditioned by the complex factors that determine the vulnerability of people and natural resources to them.[3] Because of the difficulty in analyzing and dealing with the causes of vulnerability, it is easier to react to and deal with the main drought impacts when they occur rather than plan and invest to strengthen resilience. The case study in box 2.1 illustrates how drought responses in Somalia were limited to alleviating the simplest of impacts of drought—lack of water in the short term—instead of increasing the resilience of local communities through provision of stable and drought-proof water sources.

Vulnerability (and resilience) to drought can also be exacerbated by a host of other factors, including insecurity or social and political changes. As mentioned in previous paragraphs, experience of drought impacts in Malawi in 2016 were found to be significant in many sectors, which is broadly representative of many contexts. Because the impacts are so wide-ranging, the potential ways in which they can be alleviated—as well as the array of aspects that worsen or cover them, namely the embedded weaknesses of many of the economic sectors—are too. Furthermore, the Malawi experience highlights how challenging it is to disaggregate the real impact from those weaknesses.

Another example can be found in the Syrian Arab Republic. The vulnerability of the Syrian population to the protracted droughts from 2006, for example, was driven by demographic pressures, growing poverty, and changes in farming systems and natural resources, but it was made worse by state policies and the indifference of the authorities to the situation—see box 2.2. And though drought and its consequences have rarely been a cause of conflict, they may contribute to the worsening of tensions, which can lead to conflict, as in the Syrian case.

BOX 2.1. Case Study: Reactive Responses to Drought in Somalia Have Not Strengthened Resilience—and May Even Have Exacerbated the Crisis

Variability and failure of the *Gu* and *Deyr* seasonal rains in Somalia create strong risks of recurrent drought. The 2017 drought is estimated to have reduced water availability from *berkhads* (cisterns), dams, hand-dug wells, and springs by about 80 percent, with severe impacts on agriculture, livestock production, and availability of drinking water. The humanitarian response to the crisis largely involved water trucking, which saved lives but did nothing to address underlying vulnerability. Indeed, humanitarian aid may even have led to the price of vended water increasing by 50 percent. The spike in water prices is estimated to have added about US$20 million to the cost of vended water over the critical four-month drought period.

The vulnerability of the population and their agriculture was high because of their dependence on surface water resources and shallow wells. Yet there is scope to develop boreholes that tap into deeper groundwater, which is not affected by drought, and more infrastructure for rainwater harvesting and water storage. However, prior to and during the humanitarian responses, little was done to strengthen drought resilience in this way.

Source: World Bank 2017.

BOX 2.2. Case Study: Vulnerability to Drought in Syrian Arab Republic Was Amplified by Deterioration of the Economy and by Government Indifference

Drought is endemic in Syria. The droughts that persisted from 2006 to 2011 were, therefore, not out of the ordinary, other than their intensity. The 2007–08 drought was particularly devastating, with rainfall deficits as high as 60 percent and some regions receiving no rain at all. The consequences for national agricultural production were dire: The 2007–08 wheat harvest came in at 2.1 million tons, compared to the long-term average of 4.7 million tons, forcing Syria to import wheat for the first time in 15 years.

Not only were these droughts particularly intense, but their impact was also greater, in part because changes in demographics and the agricultural economy had increased vulnerability. The population was higher, there was more pressure on rangeland, and groundwater resources were depleted.

But public policies also heightened vulnerability. The northeast part of the country, traditionally the nation's breadbasket, had actually grown poorer as state projects strained land and water resources. The gap between urban and rural living standards had widened, and unemployment was rising fast. The political system was closed and oppressive, and corruption was rampant.

box continues next page

BOX 2.2. continued

Vulnerability translated into growing food insecurity. The United Nations (UN) estimated that between 2008 and 2011, 1.3 million people were affected by the drought, with 800,000 people "severely affected." As the drought extended into the second and third years, the population in the northeast was less and less able to cope. With no crops for two consecutive years, farmers no longer had seeds, and herders were forced to sell or slaughter their flocks as a result of the lack of pasture and fodder.

Malnutrition, which was already widespread in the area, rapidly increased, with "up to 80 percent of those severely affected surviving on a diet of bread and sugared tea." The incidence of nutrition-related diseases soared between 2006 and 2010, with 42 percent of infants suffering from anemia in Raqqa governorate.

The lamentable failure of the government to respond with adequate humanitarian assistance or to help farmers ride out the drought and restore their productive capability only worsened the situation. By 2010, the UN estimated that 3.7 million people, or 17 percent of the Syrian population, were food-insecure and that 300,000 people had migrated because of the drought, leaving more than two-thirds of villages in two governorates (Hassakeh and Deir ez-Zor) deserted.

Some 65,000 families migrated from the northeast to the tent camps that lie around Damascus and Aleppo. The families that settled in a tent camp in Mzeirieb near Dara'a from 2008 onward found relatives and friends there who had been subsisting in these conditions for a decade or more. Not only do these events show the complexity of vulnerability, but they also form an important part of the background to the subsequent uprising in Syria.

Sources: De Chatel 2014; Ward and Ruckstuhl 2017.

Understanding drought impacts is an entry point for planning drought risk management, yet this approach too often focuses on direct and immediate impacts rather than longer-term impacts on society and natural resources. Drought impacts are the realization of preexisting risks. In theory, impacts can be examined as a means of providing a window into the conditions of vulnerability that lead to social, economic, and environmental losses. In practice, most of the quantification of drought impacts concentrates on the *direct* and *immediate* impacts, failing to capture the *indirect social, environmental, and political impacts* that have mid- to long-term implications (Logar and ven den Bergh 2013; UNDP 2011). Longer-term social impacts may include food insecurity and famine, migration, gender disparities, negative short- and long-term health effects, and reduced access to education. Impacts on the environment and natural resources may include rivers, streams, and springs drying up; aquifer depletion; reduced hydroenergy generation; and loss of ecosystem services. Political impacts may include conflict and civil unrest.[4]

Although there has been great improvement in the understanding and measurement of drought, most countries lack the institutional capacity to plan for drought risk management and preparedness.

Along the same lines, there is a lack of appreciation for the nonclimatic drivers of drought risk. Experience demonstrates that there is no direct relationship between a country's ability to provide timely and accurate drought forecasts and its political and institutional readiness to take a risk management approach, mobilize resources to strengthen resilience, and prepare for effective responses to the onset of drought. Progress has been made with investments in monitoring networks that improve knowledge on the status of precipitation, temperature, surface water supplies (stream flow, soil moisture, reservoir levels, snow pack, and water use), groundwater, and remote sensing. There have also been improvements made in the sophistication, accuracy, and user-friendliness of drought early warning. However, though these investments help indicate the onset, severity, and spatial coverage of drought and what its impacts may be, they have not always led to greater preparedness (see Drechsler and Soer 2016; IAWG 2011; Pulwarty and Sivakumar 2014). In many cases, this is the direct result of the lack of institutional capacity in the form of drought preparedness plans and policies at the national and subnational levels.

The causes of vulnerability at the household and local level are poorly understood, which obstructs the means and the environment for a risk management approach and exacerbates impacts. It is vital to understand the underlying causes of drought impacts, especially from the perspective of the most vulnerable, and to find ways that these risk drivers can be reduced. But just as drought impacts are extremely diverse, so too are the causes of risk and vulnerability to drought (see table 2.1).

Many weaknesses in knowledge, institutions, and capacity—and in political will—typically impede a risk management approach and so exacerbate impacts. At a country or regional level, there are often weaknesses that undermine ability to adopt a risk management approach. There may be shortcomings in knowledge and planning, such as limited drought monitoring networks; ineffective or absent early warning systems; poor quantity, quality, and accessibility of data; or poor-quality preparedness plans. Weakness may also lie in the lack of risk management instruments, such as crop insurance, or in poor targeting and limited effectiveness of drought mitigation measures. There may be capacity gaps such as insufficient human resources or insufficient funding. One area of typical weakness is in water resources management. This is a critical mechanism for drought risk management, and there are often

TABLE 2.1. Household-Level Vulnerability to Drought

The components of vulnerability	Examples of vulnerability
Exposure: The degree to which people are subject to droughts, which depends mainly on where they live	Dryland farmers in semiarid areas and a history of rainfall variability
Sensitivity: The degree to which people are affected by droughts, which is determined by the nature and composition of their income sources and assets	Dryland farmers with insecure land tenure, no access to perennial water sources, few productive assets or working capital, scant options to diversify their production systems or to diversify into off-farm activities or downstream value added, and limited access to input and output markets
Coping capacity: The ability of people to manage risks or mitigate the impact of droughts after they occur, through their own resources or with support from friends, relatives, or the government	Poor, drought-affected households with insufficient knowledge to improve productivity, practice conservation agriculture techniques, or strengthen risk management and with limited savings or salable assets.

Source: Authors.

deficiencies here—inadequate water infrastructure, lack of interregional water transfers, lack of demand management and efficiency, absence of collaboration over transboundary resources, and so on. And one vital underlying factor is whether decision makers are convinced and prepared to apply their political will to invest in these aspects, even if there are evident cobenefits.

Overall, political economy conditions often give governments weak incentives to adopt a risk management approach. It can be hard to gain traction for several reasons. One is that acting on drought impacts is highly visible and has immediate effects, whereas investing in risk management brings diffuse, often unseen benefits. Another is the need for a holistic approach, integrating analysis and action across sectors and agencies, each of which have their own mandates and priorities and each of which will wish to badge their own achievements. A third reason lies in the political economy of aid: It is easy to get aid for emergencies and harder to get resources for long-term investment in marginal areas. There is also a perverse incentive at play: National actors may not invest in mitigation if external donors cover the costs of drought impacts. Finally, there is a distortion that may arise from factors that lie largely beyond the control of governments, such as climate change or population pressure. This combination may lead to a sort of fatalism, or even a tendency, for politicians to wash their hands of responsibility and blame factors beyond their control.[5]

What is needed is a coordinated national drought policy implemented through effective institutional capacity. To move from a reactive, crisis management mode to a risk management approach, clear policy and institutional capacity are needed. Institutional capacity should be able to provide: (a) effective monitoring and early warning systems to deliver timely information to decision makers; (b) effective impact assessment procedures; (c) proactive risk management measures; (d) preparedness plans aimed at increasing coping capacity; and (e) effective emergency response programs directed at reducing the impacts of drought (Wilhite and Pulwarty 2017).

More and better economic analysis could be a decisive factor in moving countries from crisis management to risk management. A key factor in persuading governments and societies to make this move is clear knowledge of the benefits of action versus the costs of inaction.

Avoiding losses in the long term through preparedness and mitigation should not be the only emphasis. It is relevant to also highlight the immediate benefits for liquidity that proactive actions can bring so key players are more inclined to shift from emergency and recovery.

These deficiencies in the capacity to make preventive decisions identified at higher administrative levels are applicable also at the household level. A relevant example is engagement in drought insurance. Drought risk transfer solutions and insurance programs are aimed at offering sustainable risk mitigation options, often at the individual scale. However, the benefits are not always evident, and clients are sometimes hesitant to pay premiums beforehand and get the product, especially because the process of claiming the insurance once a drought hit was traditionally slow and inefficient. Index-based insurance has become prominent in order to make timely payouts to farmers and livestock producers—instead of claiming, they receive compensation when the selected drought index oversteps a specific threshold.

In spite of this change, potential clients are not always convinced of the profit, and they remain skeptical about making a significant investment in advance. A thorough quantification of the benefits that could be obtained in case of a drought and of the potential damages in case of not contracting any insurance could create awareness at the household and community levels and make the case for expanding these types of solutions.

Unfortunately, despite new effort in this field, economic analysis has often been insufficient to drive progress toward adoption of a risk management approach and greater investment in preventive actions. Part of the explanation can be found in economic theory, which shows that under conditions of uncertainty, actors will delay irreversible investments until their net benefits exceed a positive critical value. The secondary and indirect benefits of the risk management approach are often not well-factored into economic analyses, thus undervaluing the economic benefits of risk management—and leaving decision makers unconvinced (McDonald and Siegel, 1986; Wilhite and Pulwarty, 2017; WMO and GWP 2017).

Notes

1. World Health Organization. 2017. *Benefits of Action and Costs of Inaction: Drought Mitigation and Preparedness—A Literature Review*, by N. Gerber and A. Mirzabaev. Integrated Drought Management Programme (IDMP) Working Paper 1. WMO, Geneva, Switzerland; GWP, Stockholm, Sweden.
2. Veronique Morin and Francis Samson, World Bank senior disaster risk management specialists, BACI workshop, April 2017.
3. *Vulnerability* to drought shocks is determined by: (a) exposure, the degree to which people are subject to droughts, which depends mainly on where they live; (b) sensitivity, the degree to which people are affected by droughts, which is determined by the nature and composition of their income sources and assets; and (c) coping capacity, the ability of people to mitigate the impact of droughts after they occur, through their own resources or with support from friends, relatives, or the government. *Resilience* is the ability of people to withstand and respond to droughts.
4. For references on these impacts, see the following, for example: on conflict and civil unrest, Johnstone and Mazo (2011); Linke et al. (2015); von Uexkull (2014). On migration, Gray and Mueller (2012). On gender disparities, Fisher and Carr (2015). On reduced hydroenergy generation, Shadman et al. (2016). On food insecurity and famine, IFRC (2006). On poverty, Pandey, Bhandari, and Hardy (2007). On negative short- and long-term health effects, Ebi and Bowen (2015); Hoddinot and Kinsey (2001); and Lohmann and Lechtenfeld (2015). On reduced access to education and loss of ecosystem services, WMO and GWP (2017).
5. On this reflection about the lack of action and motivation when large external influences must be managed, see IPCC (2012) and UNDP (2012).

Chapter 3
What Tools and Approaches Are Being Used to Initiate Drought Risk Management?

This chapter describes some of the frameworks and approaches that have been used to define and describe drought risk management. It is not a comprehensive overview; it simply aims at giving a sense of the wide variety of approaches, which reflects the multifaceted nature of drought risk and its management.

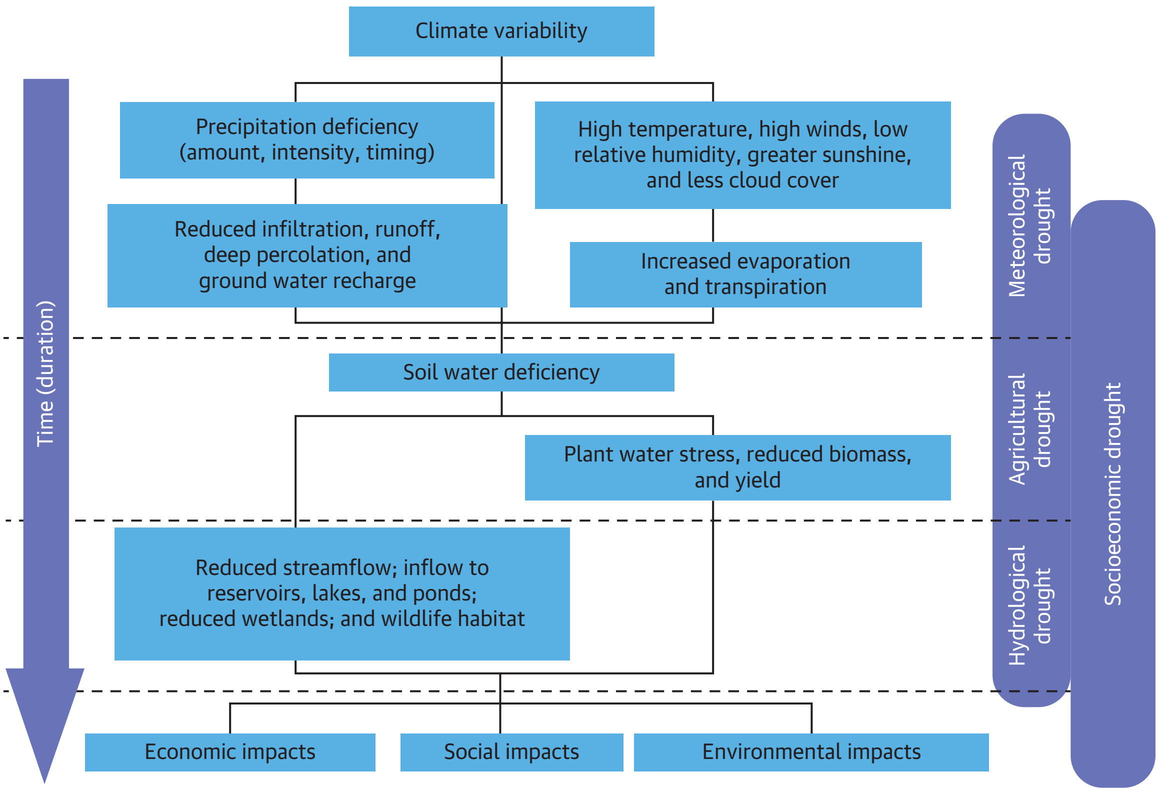
Understanding Drought and Its Impacts

Drought typically follows a sequence—from changes in meteorology to impacts first on agriculture and then on water. Figure 3.1 presents a commonly used framework for understanding drought. It demonstrates the deepening progression of drought severity from a meteorological phenomenon to one with increasing impacts on people and the environment as it advances from meteorological drought to agricultural drought and then to hydrological drought. The impacts themselves are broadly categorized as either social, economic, or environmental. Sequentially, because meteorological drought can lead to stress on plants, agricultural-related drought impacts are an early sign of a deepening problem. Likewise, because the dominant paradigm is for crisis management and agricultural drought to be the first to impact people's livelihoods, the tools and approaches focused on agricultural drought impact are commonly the first to be mobilized and often the largest part of crisis responses.

Based on this general conceptualization of drought, different actors have developed approaches appropriate to their specific fields of expertise and interest. For example, the Food and Agriculture Organization of the United Nations (FAO) has concentrated on agricultural drought, with a methodology to measure impacts of agricultural drought (figure 3.2).[1]

However, though agriculture-related impacts account for a significant proportion of drought impacts, there are many others—for example, the case analyzed in the Malawi postdisaster needs assessment (PDNA)[2] (figure 3.3). Some impacts are first-round impacts—on crop production and on water resources. Others are follow-up impacts on the population immediately affected by drought, such as farmer incomes and the health, nutrition, and education status of drought-affected populations. A third level is on downstream activities, such as industries reliant on agriculture and water. Finally, there are the diffuse and longer-term impacts on growth, trade, foreign exchange, fiscal balance, and so on. Clearly, this diversity of impacts calls for more than an agriculture-based recovery strategy and a greater focus on a risk management approach and multisectoral recovery strategy.

FIGURE 3.1. **Defining the Three Stages of Drought and Typically Observed Impacts**



Source: WMO 2006.

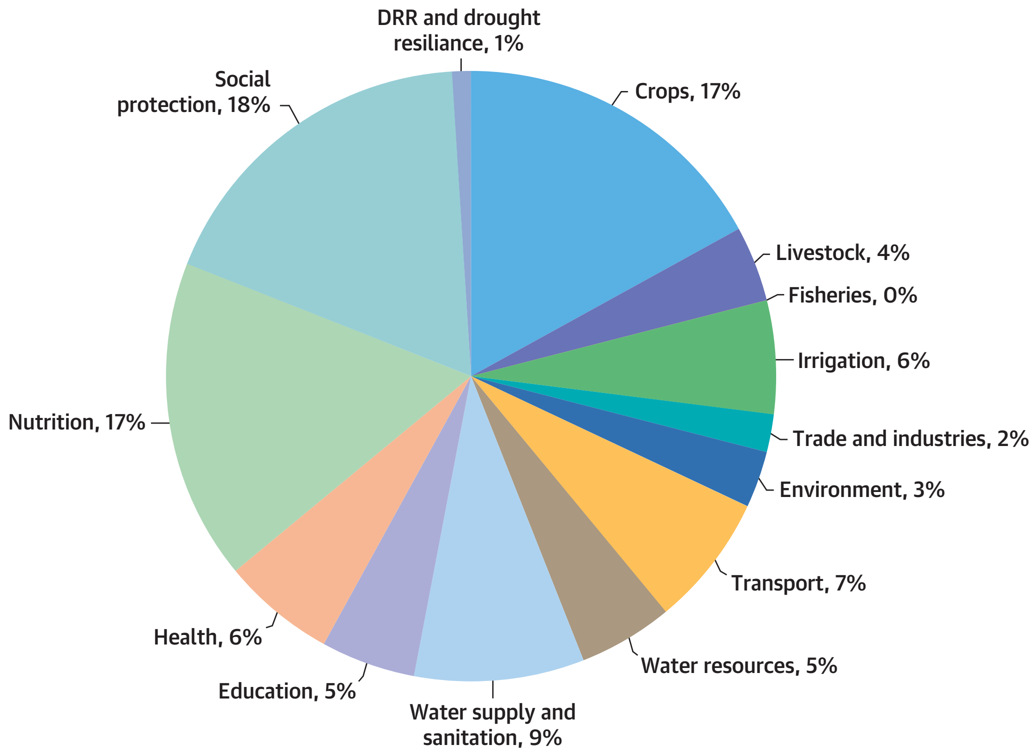
FIGURE 3.2. **FAO's Methodology to Measure Disaster Impact: Components**

		Damage	Losses
Crops Livestock Fisheries Forestry	Production	Predisaster value of destroyed stored production and inputs	Value of lost crop production (disrupted economic flows)
	Assets	Replacement or repair value of destroyed assets—machinery, equipment, tools	

Source: Mira Markova, FAO, BACI workshop, April 2017.

Note: According to the FAO, *damage* refers to the total or partial destruction of physical assets and infrastructure in disaster-affected areas, expressed as replacement or repair costs. *Losses* refers to the changes in economic flows arising from the disaster. These need to be measured separately and added up together to cost the impacts.

FIGURE 3.3. Malawi PDNA, Sectors Affected



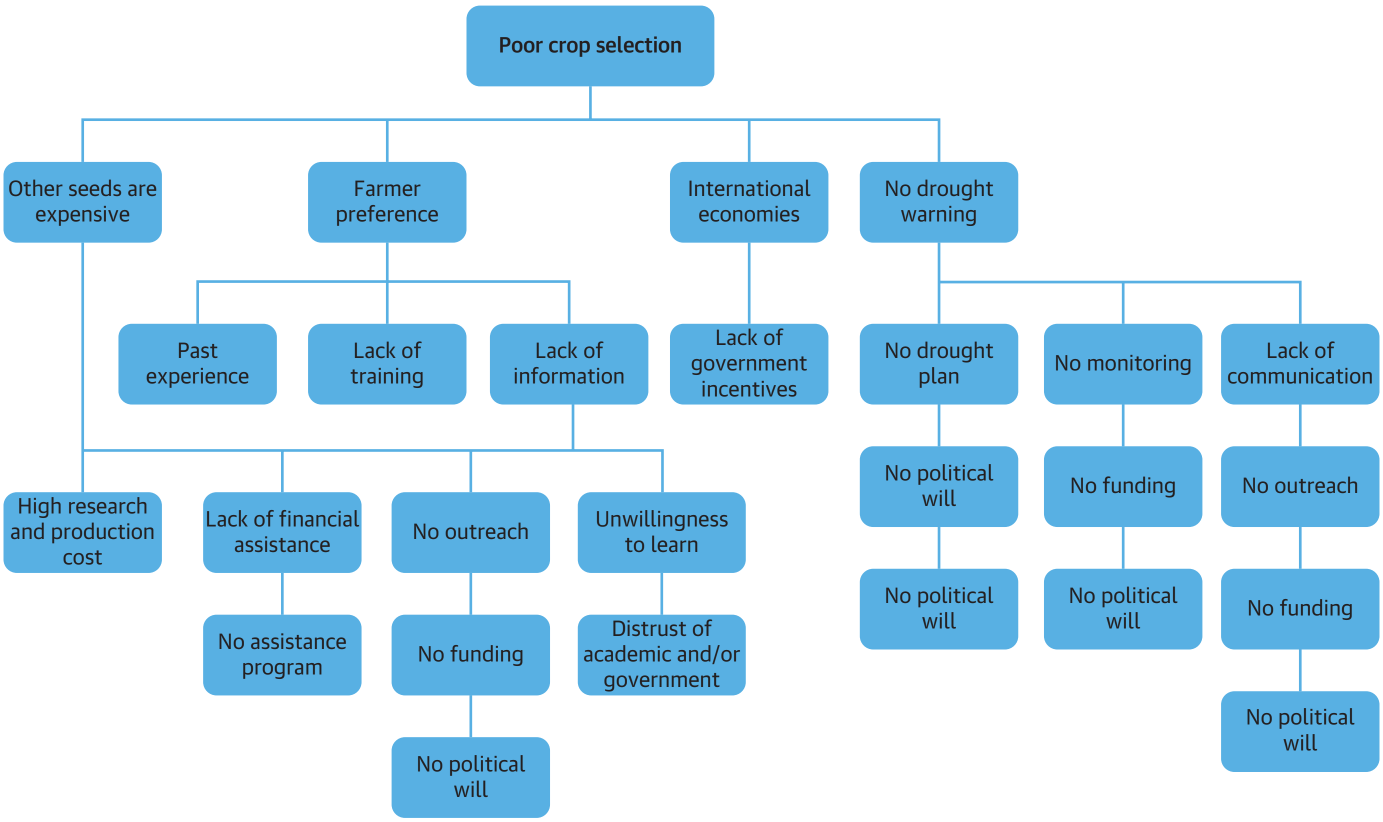
Source: Veronique Morin and Francis Samson. World Bank, BACI workshop, April 2017.
Note: DRR = disaster recovery and response; PDNA = post disaster needs assessment.

Understanding Why Drought Impacts Occur

Methodological work on drought has focused on impacts and responses rather than on *why* the impacts occur. There is a large array of tools and approaches used to measure drought impact and design response and recovery measures. Much less has been done on determining what it would take to prevent or reduce them in the future. Considerable work has been done on these questions of vulnerability for other disaster risks,[3] but this type of approach has rarely been applied to drought risk.

The deep-rooted causes of drought risk at the household level are the underlying structural issues of vulnerability and low resilience. These core causes are complex and encompass a wide range of issues across sectors. Figure 3.4 gives one example: The vulnerability and low resilience to drought of a farming household may be partly determined by the crops and varieties they choose to grow and by their production techniques. These choices may result in crop failure in the case of drought—but why do they make these choices in the first place? And what can be done to improve them? The figure shows the many drivers behind this single choice—and a household may be making a hundred choices, similarly reflecting the household's knowledge, assets, capacities, constraints, and risk management strategies. Each one may affect the vulnerability of the household to drought.

FIGURE 3.4. Mapping the Underlying Causes Why a Household Vulnerable to Drought Might Choose the "Wrong" Crop



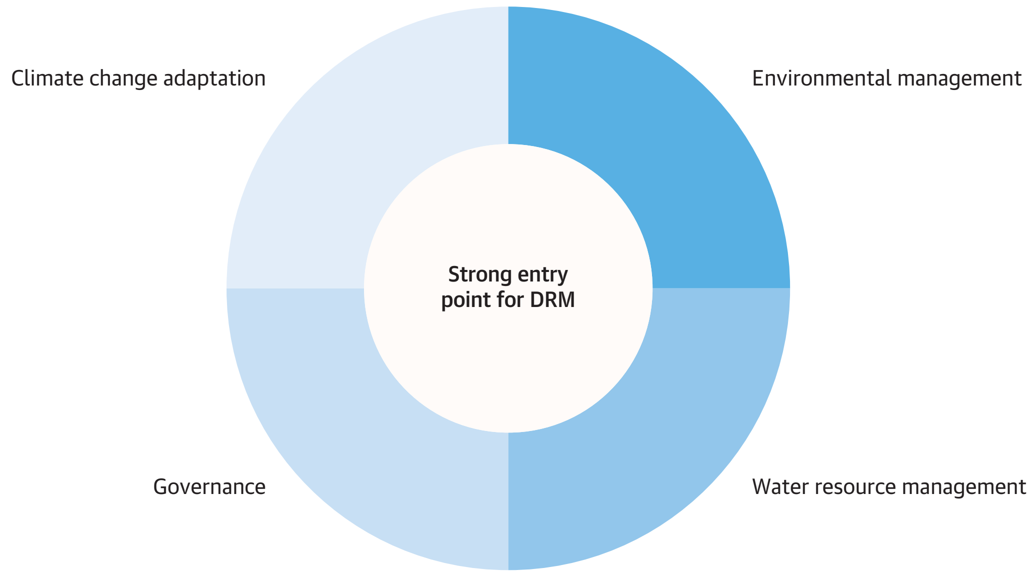
Source: Adapted from Preparedness and Mitigation Working Group, Western Drought Coordination Council 1998.

At the national or regional levels, there have been a number of approaches to identifying the macro drivers of drought risk and to proposing entry points to drought risk management. As a complex issue with several sizable barriers to progress, some useful ways in which drought risk management is approached conceptually are presented.

An Approach to Identifying Macro Drivers of Drought Risk

A 2012 collaborative project that brought together professionals from Africa and Asia identified a number of macro-level "causes," "drivers" and "amplifying factors" of drought risk. The many participants in the Africa-Asia Drought Risk Management Peer Assistance Project (AADP) overwhelmingly considered environmental degradation, poor water resource management, and poor governance to be the main causes of drought impact (UNDP 2012). Poverty is understood to be both an underlying driver of risk and an amplifying factor with respect to other drivers of risk. In addition, experts recognize that climate change and population pressures (that put additional pressure on water resources, particularly groundwater) also play increasingly significant roles in the formation of drought risk (UNDP 2012).[4]

FIGURE 3.5. Some Macro-Level Entry Points to Drought Risk Management



Source: UNDP 2012.
Note: DRM = drought risk management.

Thus, drought risk management has to take into account both drivers of household vulnerability and macro drivers of vulnerability. The approach needs to be based on practical understanding of vulnerability and resilience at the household and local levels, and it must integrate this with understanding of the macro-level causes.

Coherence between these main drivers should be maximized. The findings of the AADP survey call for synergy between environmental management, water resource management, adaptation to climate change, and efforts to strengthen good governance (see figure 3.5). The inclusion of governance is an especially important aspect to note because a lack of "political will" and suitable governance are repeatedly mentioned as significant blockages to effective action (WMO and GWP 2014).

Indeed, though root causes of disasters have been identified for several decades, actions are sometimes not commensurate with that knowledge. One approach to understand why some events lead to sustained actions while others of the same magnitude might not has been to link the political ecology of disasters with the event ecology (see Wilhite and Pulwarty 2017).

An Approach to Drought Risk Reduction for Drylands as Specific Vulnerable Agro-Climatic Zones

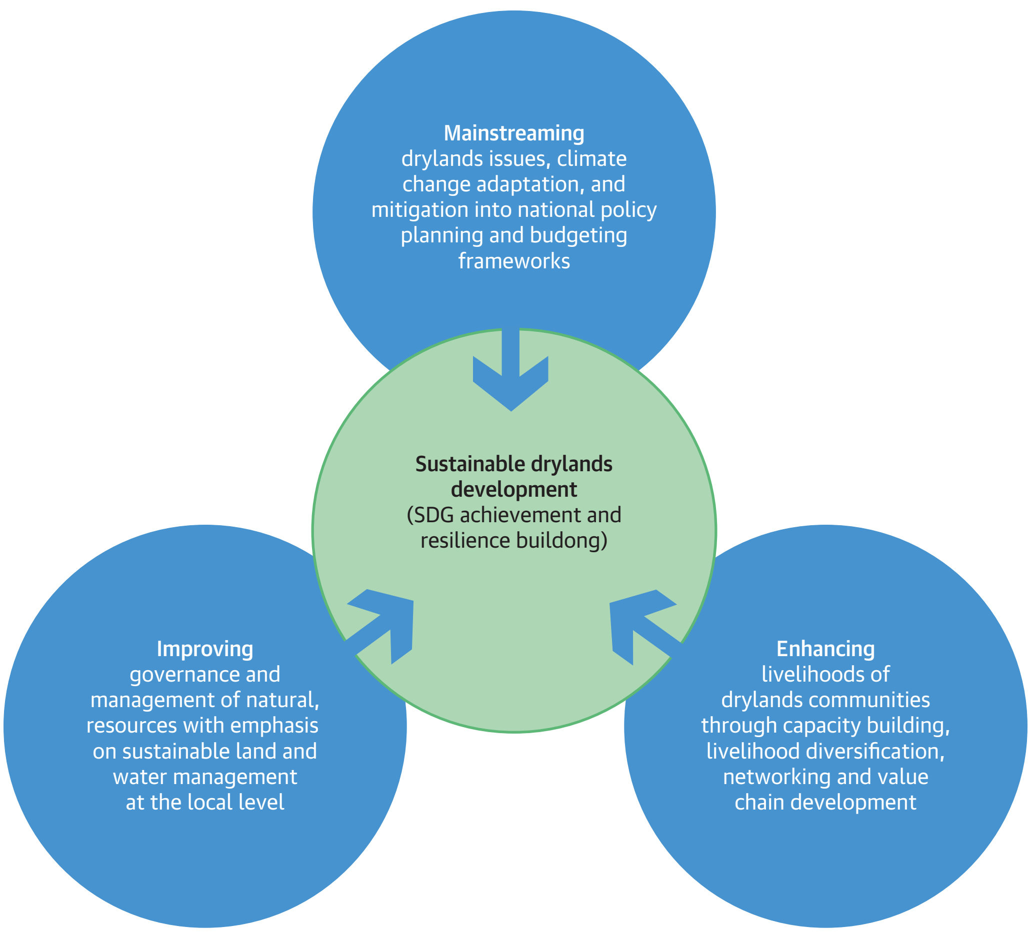
Drylands, by definition, are vulnerable to drought, and considerable work has been done to identify the drivers of that vulnerability and how resilience could be strengthened. Rural development and poverty alleviation in drylands require action on several fronts: legislation, capacity strengthening, water management, gender equity, health, and education, among others. The United Nations

Development Programme (UNDP) has long worked to identify both challenges and responses, launching the Integrated Drylands Development Programme (IDDP)[5] with the overall goal to strengthen resilience by working on the twin vulnerabilities of poverty and unsustainable land management in the drylands.

The IDDP developed a framework to build the resilience of populations that are vulnerable to the impacts of drought with three key components, all of which are relevant to drought risk management. (see figure 3.6):

- Mainstreaming drylands issues, climate change adaptation, and mitigation into the national policy, planning, and budgeting framework
- Enhancing livelihoods of drylands communities through capacity building, livelihood diversification, networking, and value chain development
- Improving governance and management of natural resources with emphasis on sustainable land and water management at the local level

FIGURE 3.6. IDDP Integrated Approach to Building Resilience in the Drylands



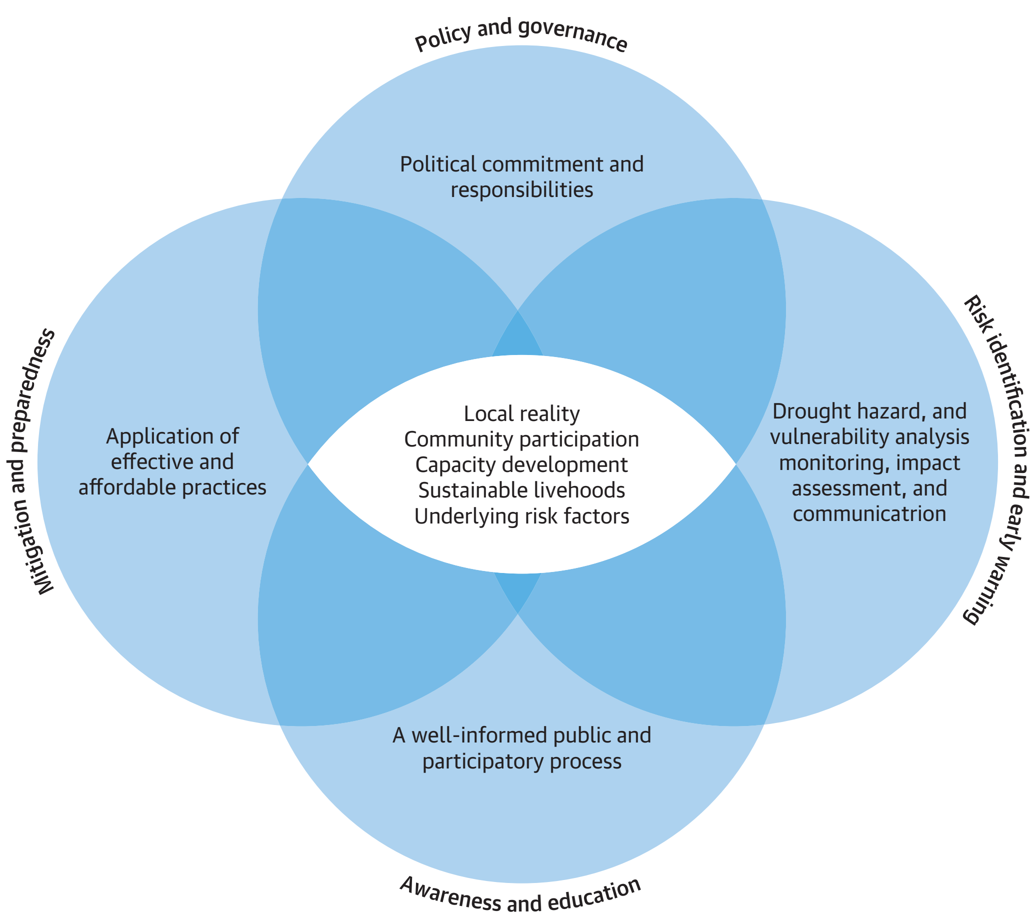
Source: UNDP 2012.
Note: SDG = Sustainable Development Goal.

A Comprehensive Framework for Both Higher-Level and Local Action

In 2011, the United Nations Office for Disaster Risk Reduction (UNISDR) developed a conceptual framework (figure 3.7) for drought risk reduction[6] that takes an integrated development approach, covering:

- Policy and governance: political commitment and responsibilities
- Risk identification and early warning: drought hazard and vulnerability analysis, monitoring, impact assessment, and communication
- Awareness and education: a well-informed public and participatory processes
- Action at the local level on the underlying risk factors (that is, on vulnerability): community participation, capacity development, and sustainable livelihoods
- Mitigation and preparedness: application of effective and affordable practices

FIGURE 3.7. The UNISDR Drought Risk Reduction Framework



Source: UNISDR and National Drought Mitigation Center, University of Nebraska-Lincoln (in UNISDR 2009).
Note: UNISDR = United Nations Office for Disaster Risk Reduction.

The framework emphasizes political will and governance for disaster reduction, as well as the need for institutional capacity at both the central and local levels. At the central level, the framework seeks to place policy responsibility with platforms with political authority over national development planning and investment such as a national council so that policies and programs can be agreed and resources allocated. The framework then provides for implementation to be largely decentralized to the local level, based on local initiatives and ways of acting and with the involvement of local government and civil society.

There have been practical applications of this framework. In practice, these have often highlighted reasons for the slow progress toward proactive drought risk management. The least progress on any of the five components has been with action on the underlying risk factors. And though some progress has been made on policy and governance, this has largely been confined to outputs, such as the establishment of institutions like national platforms, rather than outcomes on the ground that result from real shifts in governance structures.

Drought Risk Management Policy Tools

Developing a Drought Risk Management Policy: A Widely Used Methodology

The overriding principle of drought policy should be an emphasis on risk management through the application of preparedness and mitigation measures (Sivakumar et al., 2014). This policy should be directed toward reducing risk by developing preparedness plans based on understanding the drought hazard and of the *underlying causes* of societal and environmental vulnerability (WMO and GWP, 2014).

A methodology developed by the IDMP and the National Drought Migration Center (NDMC) in Nebraska, based on the work of Wilhite,[7] is used worldwide by all type of organizations and has become a common framework for developing drought risk management policy. The methodology, which was codified as the National Drought Management Policy Guidelines by the WMO and GWP (2014), provides a set of generic steps that can be adapted to any level of government, from national to subnational to local, and to any geographical setting for the development of a drought risk management policy and preparedness plans. The methodology has been widely used and adapted by many countries and regions. The steps in the methodology are illustrated in figure 3.8 (WMO and GWP 2014).[8]

This methodology is used to provide a framework for the discussion of benefits of action and costs of inaction (BACI) assessments in chapter 5. The methodology specifically targets some of the main barriers to action on drought risk management that are highly relevant to the IDMP and BACI work stream, suggesting the following questions to help promote action:[9]

- What are the cost-benefit ratios for the actions identified?
- Which actions are considered to be feasible and appropriate by the general public?
- How are the public and leadership to be effectively engaged? (See Wilhite and Pulwarty 2017.)

FIGURE 3.8. **A 10-Step Methodology for Developing a Drought Risk Management Policy**

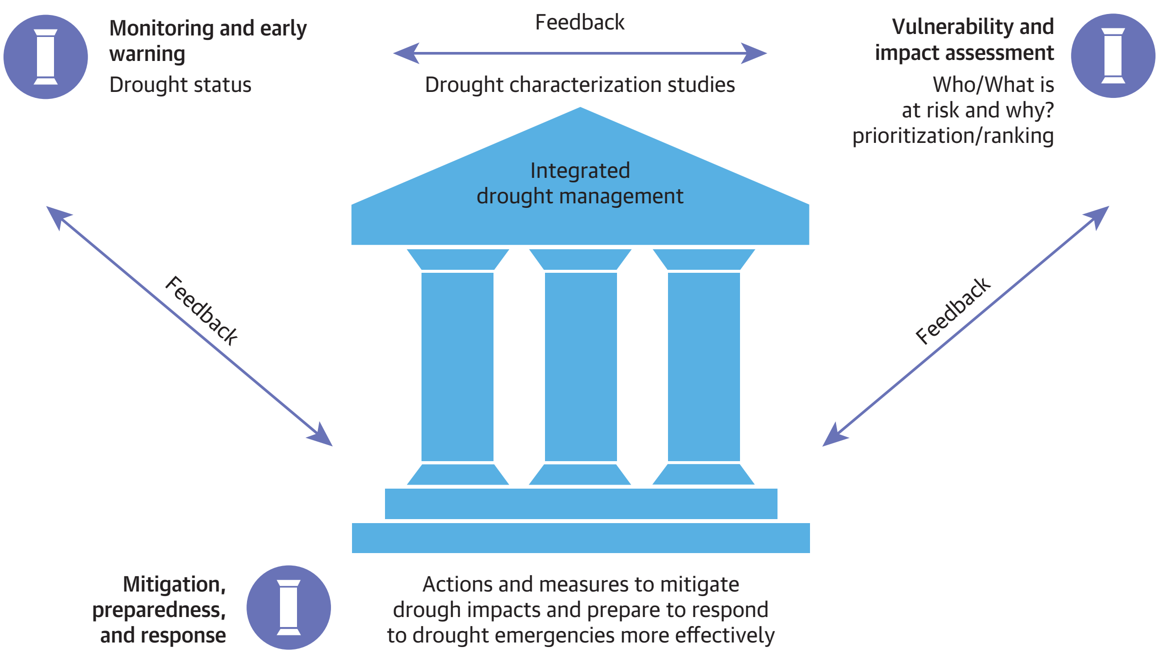
Source: Adapted from WMO and GWP 2014.

- Which actions are sensitive to the local environment and are sustainable practices?
- Are actions addressing the right combination of causes to adequately reduce the relevant impact?
- Are actions addressing short-term and long-term solutions?
- Which actions would equitably represent the needs of affected individuals and groups?

Structuring a Drought Risk Management Policy

How should a drought risk management policy be structured? The IDMP and its partners have adopted three pillars of drought management (figure 3.9): (a) drought monitoring and early warning systems to determine drought status; (b) vulnerability and impact assessment to determine who and what are at risk and why; and (c) mitigation, drought preparedness, and response to set out actions and measures to mitigate drought impacts and to prepare to respond to drought emergencies.[10] The pillars represent a common way of structuring drought risk management policies and programs and have been used in many initiatives, like in the examples presented in box 3.1.

FIGURE 3.9. **The Three Pillars of Integrated Drought Management**



Source: Pischke and Stefanski 2018.

BOX 3.1. **Case Studies: What Conditions Lead to Success in Proactive Drought Risk Management?**

Mexico

In Mexico, the frequency and high impact of drought stimulated action at the national and basin levels. Recurrent drought in most parts of the country from 2010 to 2013 led to the formation of the National Program Against Drought (Programa Nacional Contra la Sequía [PRONACOSE]) with the objective to develop tools with a new proactive and preventive approach for integrated drought management at the level of basin councils.

Knowledge management, training, and outreach were key elements of the program. Since the beginning of the program, a broad outreach campaign focusing on communication and education has proved fundamental. Even though drought is a recurrent phenomenon in Mexico, there is a lack of documentation regarding its drivers as well as its economic and social impacts. Organizing and disseminating historical information is part of the strategy to raise awareness among water users and society in general. Training on drought evolution and mitigation for all stakeholders and officials in the basin councils has proved crucial (WMO and GWP 2014).

box continues next page

BOX 3.1. continued

U.S.

In the United States, a growing drought problem has led to stronger emphasis on drought risk management. This change can be attributed largely to four key factors. First, a series of significant droughts has affected many parts of the country since 1996, in many cases for five to seven consecutive years. Second, the spiraling impacts of drought and the increasing number of key sectors affected, as well as the conflicts among sectors, have elevated the importance of drought preparedness within the policy community at all levels.

Changes in national policy and the strengthening of institutions for developing knowledge, methodologies, and information have contributed to more proactive risk management. A third factor, the creation of the National Drought Mitigation Center (NDMC) at the University of Nebraska in 1995, has resulted in increased attention on issues of drought monitoring, impact assessment, mitigation, and preparedness. Many states have benefited from the existence of this expertise (WMO and GWP 2014). The final factor has been the creation of the U.S. National Integrated Drought Information System (NIDIS). NIDIS is mandated under its own public laws (National Integrated Drought Information System Act of 2006, P.L. 109-430; Public Law reauthorizing NIDIS in 2014, P.L. 113-86) which explicitly call for "enabling the Nation to move from a reactive to a more proactive approach to managing drought risks and impacts."
Source: Pulwarty and Verdin 2013.

Brazil

Since the 1990s, Brazil has been taking progressive action to reform drought management and planning to move from reactive crisis management to proactive risk-based management of droughts (De Nys et al. 2017; WMO and GWP 2014). For example, in 1995, the Aridas Project (Projeto Áridas 1995) already suggested a long-term planning methodology for the development of the northeast region that put drought preparedness at the front, embracing an integrated approach and focusing on economic, social, and environmental sustainability. It was perhaps the first endeavor in the country to act on drought before it hit rather than under a crisis management perspective.

Work at the regional level on the benefits of action strengthened the risk management approach. This included the evaluation of the costs of droughts and of the benefits of preparedness actions in the Brazilian Nordeste (see summary in Bastos 2017).

Thus, when posterior protracted droughts hit, Brazil had experience with a proactive management approach. The severe and multiyear drought starting in 2012 caused significant crop and cattle losses and reduced many reservoirs to critically low levels, but Brazil's decades of experience helped trigger, inform, and shape the most recent action at several administrative levels.

Notes

1. FAO has applied this methodology for many years, not only to drought-related disasters but to all. A review of 78 FAO postdisaster needs assessments (PDNAs) in 48 countries between 2003 and 2013 found that about one quarter (22 percent) of damage and loss impacts from the whole range of disasters occurs in the agriculture sector.
2. Veronique Morin and Francis Samson. World Bank, BACI workshop, April 2017.
3. For example, see the framework developed by Professor Ian Davis described in Blaikie et al. (1994).
4. Similar perspectives are captured in WMO and GWP 2014.
5. The UNDP Global Policy Centre on Resilient Ecosystems and Desertification (GC-RED) builds on the work of the UNDP Drylands Development Centre (DDC). One area of GC-RED engagement is the IDDP, UNDP's integrated approach to drylands.
6. This framework corresponds broadly to the Hyogo Framework for Action (HFA), developed at the 2005 World Conference on Disaster Risk Reduction, which calls for: (a) policies and governance for drought risk reduction; (b) drought risk identification, impact assessment, and early warning; (c) drought awareness and knowledge management; (d) reducing underlying factors of drought risk; and (e) effective drought mitigation and preparedness measures.
7. The methodology was first presented in Wilhite 1991 and later revised to incorporate greater emphasis on risk management (Wilhite et al. 2000; Wilhite, Hayes, and Knutson 2005).
8. The fact that the steps are numbered does not imply that they need to be undertaken in the presented order.
9. Under step 5, task 6 of the WMO and GWP Drought Management Policy Guidelines on developing a to-do list.
10. The three pillars were set out in the High-Level Meeting on National Drought Policies (UNCCD, FAO, and WMO 2013) and have been further developed by WMO and GWP (2014).

Chapter 4
Toward a Framework for Action

This chapter discusses how information on the benefits of action can be used strategically and pragmatically to help promote the adoption of a proactive risk management approach. The points raised here bring together evidence from the previous work already undertaken in the Integrated Drought Management Programme (IDMP) work stream regarding benefits of action and costs of inaction (BACI), best practices from the various approaches and frameworks presented in chapter 3 as well as stakeholder feedback from the most recent BACI workshop.[1]

An assessment of the benefits of action needs to be prepared proactively so that it can be used to propose solutions at the right moment. When communities of scientists agree on guidelines and methodologies for assessments of the benefits of action, this not only provides a scientific basis for proactive risk management, but it also facilitates acceptance by policy makers of the extent of the problem and the need for a new proactive approach (see Nkonya et al. 2011).

Crises can present opportunities to push for reform and create change. If assessments of the benefits of action are already available, this will encourage acceptance of proactive risk management approaches at times when decision makers are alarmed by critical events.

The points raised in this chapter show how frameworks and mechanisms for proactive management can best be prepared so that they are ready for the decision makers when the time for change is propitious.

The economic argument for drought mitigation and preparedness must sit within a wider disaster risk management framework to be successful. Although the economic case for a more proactive response is a powerful tool for early action, economic numbers alone are unlikely to catalyze change. Assessments of the benefits of action need to sit within an integrated framework for drought mitigation and preparedness—see the three pillars in figure 3.9.

The technical work needs to be complemented by an understanding of how change happens—and can be encouraged—in a particular political economy. It is essential to recognize the political and governance context, how this influences the creation of risk, why there may be a lack of political will or public interest, and how that might change.

Understanding the political economy is essential for creating change in both the political and social spheres. This understanding can also lead to an active promotion through a targeted dissemination and communication plan that includes not only the government and donors but also the public via advocacy and an informed media. Strategies to encourage change in fragile states and areas of conflict need to be carefully adapted to the context and its likely evolution.

The analysis has to include not only the impacts of drought but also the causes of vulnerability. As drought impacts have been the dominant driver for action on drought, presenting an assessment of the economic BACI has considerable persuasive power. However, this assessment also has to show the underlying vulnerabilities, which are the main causes of drought risk, and how a coherent and coordinated long-term approach across sectors is required to strengthen resilience.

The analysis needs to be set within the local governance and social context. The assessment—and monitoring and early warning systems—need to reflect not just the progress of drought through the stages shown in figure 3.1. They also need to reflect possible local responses when drought hits. Nonclimatic indexes and indicators of drought (for example, local political cycles and agendas) should be tracked and integrated into monitoring systems because it conditions the response and early action and can be as important as the severity of the natural phenomenon.

What are local institutions and households capable of doing in drought circumstances, and what are they likely to do? Aligning the impacts of emerging conditions on the ground with decisions likely to be taken by different individuals, groups, and organizations will help shape preparedness plans.[2]

Similar to the wider disaster risk reduction agenda, it is essential that drought risk reduction be embedded within existing development processes at local and national scales and not treated as a stand-alone issue of concern. Just as vulnerability has multiple causes, drought risk management requires multiple responses across sectors. Improved water management is clearly key, and this in itself is a complex set of tasks that cuts across sectors and institutions (see box 4.1). But responses will also be needed -as in the Malawi case discussed in previous chapters- in agriculture, food security, health, nutrition, energy, environment, education, transport, social protection, industry, and commerce. This multisectoral response presents a challenge but also an opportunity because drought risk management can be mainstreamed into larger programs, attracting extra resources and strengthening activities and outcomes.

Better recognition of the benefits of drought risk management by different actors encourages more widespread uptake, especially if investments are "no or low regrets." BACI assessments need to demonstrate the cobenefits of drought risk management, including improved livelihoods resulting from increased resilience, such as those from agriculture, food security, health and nutrition, and education; greater sustainability of natural resources; and protection of the environment. Ideally, assessments

BOX 4.1. Case Study: The Drought Risk Management Benefits of Action and Costs of Inaction through Improving Access to Water in Honduras

Improving access to water for year-round agricultural production in Azacualpa, a small village in Honduras, was understood to be critical to reducing drought risk. This led to the construction of 27 reservoirs. The outcome was not only improved drought risk management but also significant improvements in employment (from 30 percent to 70 percent); better organizational capacity; more productivity, social cohesion, and well-being; increased income levels (rising from US$1.60 to $3.84 per day); higher profitability (36 percent return on investment); diversification of crops; increase in cropping intensity, with as many as four crops a year on the same piece of land; food security (increase of 26 percent in maize production and 23 percent in beans production); better market access; increased access to financial services; increased land value (by 47 percent); and a decrease in migration.

Source: GWP Central America 2017.

would quantify the contributions of these factors to reducing drought costs (see WMO and GWP 2017, 14). This analysis can help derisk the idea of investing in drought mitigation and highlight the substantial opportunities for growth that can result. The attraction of acting on drought risk management would increase if most of the measures were no or low regrets.

Practical examples can demonstrate where early action results in benefits. Case studies can play a key role in communicating the benefits of action and ensuring that it results in greater preparedness. They can show how a step-by-step plan will progressively build resilience. They can also illustrate options for proactive drought management based on lessons learned, documenting which actions were taken over time and in different sectors. There may even be value in negative examples—cases where a proactive risk management approach was tried and either it failed or it succeeded but did not lead to a more general adoption of a proactive approach. The lessons on *why* would be rich in learning.

Inevitably, there are challenges on data and on existing knowledge that need to be resolved by improved information systems, preferably using methodologies that allow comparisons over time and among countries. Many available estimates of drought costs are partial and difficult to compare. The problem is compounded by a general lack of data on droughts and their impacts and also, too often, by problems of ownership of data and of access to them. Moreover, there is relatively little knowledge available on the costs of indirect and longer-term drought impacts (WMO and GWP 2017). There is a need to strengthen the evidence base, develop practical examples, and develop mutually compatible methodologies to comprehensively assess drought costs and impacts, including indirect impacts of droughts—and how these can be mitigated—as well as achieved cobenefits. Furthermore, it is imperative that any assessment take a multidisciplinary approach because drought is affected by, and affects, many sectors.

Notes

1. The outcomes of this workshop are described in greater detail in the workshop summary available at http://www.droughtmanagement.info/idmp-activities/benefits-of-action-and-costs-of-inaction/.

2. See WMO and GWP (2016). The NIDIS is an example of advance monitoring in these aspects.

Chapter 5
Draft Framework for the Benefits of Action/Costs of Inaction Assessments

There is a need for a more organized and common conceptual framework for assessing drought risk and for analyzing the benefits of action and costs of inaction (BACI). The framework should be systematic enough to allow for comparability across countries and contexts. However, it should also be modular and provide options so that it can be tailored as needed. Essentially, the framework should help actors ask the right questions to establish the case for more proactive responses.

The 2017 workshop (see chapter 1) proposed key elements of this framework:

- **An integrated approach:** The framework needs to be relevant to multiple disciplines and sectors; hence, flexibility will be important. It should be able to take account of issues such as conflict that intersect with drought.
- **A learning tool:** The conceptual framework needs to include a communications plan to ensure that assessments not only inform decisions but also contribute to capacity building and planning for action.
- **Grounding in experience:** It needs to include examples and case studies of where frameworks/assessments have resulted in positive action.

This chapter outlines the key steps that are required to undertake an assessment of the BACI, set within the process of overall development of drought risk management policy. The 10-step methodology that was codified by the World Meteorological Organization (WMO) and Global Water Partnership (GWP) (2014) in their Drought Management Policy Guidelines (see figure 3.8) provides clear entry points for embedding systematic assessment of the BACI within a structured process. The guidelines explicitly state the need for the BACI assessment: "the costs and benefits of [a proactive drought risk management policy] must be weighed against the losses that are likely to result if no plan is in place (i.e., the cost of inaction)."

The presentation of the draft framework for the BACI assessment in this chapter is, therefore, set out within those 10 steps as illustrated in figure 3.8. Although the steps are numbered, and despite the fact that some might be more logical in the beginning of the process, the 10-step methodology needs to be presented and understood as a cycle: All the steps are important, and they are not necessarily consecutive, unrepeatable, or part of a linear logic.

The 10-step process is thus used as the main structure, which can be replicated or compared across contexts, even if the specifics of what is assessed within each step differs between cases.

Factoring the BACI Assessment Expertise into the Oversight Body for Policy Development

Step 1: Appoint a national drought management policy commission. The first of the 10 steps in the WMO and GWP Drought Management Policy Guidelines proposes the establishment of a national commission to guide and oversee the development and implementation of a national drought management policy. It is essential to check whether there is already an existing commission or work group that can have this task added; it is not rare to find commissions under the areas of finance or planning that are already looking at multisector development and could have a complementary mandate on drought management.

This commission should reflect the multidisciplinary nature of drought and its impacts. An advisory team to support the policy commission should be assembled, taking care to include specific BACI skills, particularly economic knowledge, together with expertise from each of the key impact sectors. Wherever possible, existing expertise from mandated agencies, such as line ministries, should be assigned so as to maximize ownership and minimize the creation of new roles.

Integrating the BACI Considerations into the Initial Goals and Objectives of a Risk-Based National Drought Management Policy

Step 2: State or define the goals and objectives of a risk-based national drought management policy. The second of the 10 steps in the WMO and GWP guidelines is to set the goals and objectives for a risk-based national drought management policy. This step will define the scope and general goals of the policy; determine the role of the government and other actors at each political or administrative level; highlight the most vulnerable areas, populations, and economic sectors; and so on. This step will also establish a timeline for development of the policy and, in broad terms, for the implementation and achievement of the likely goals as well.

This is a critical stage for the BACI assessment. A thorough review of existing evidence on the costs of inaction, as well as the costs of past droughts and any benefits from earlier action, should be undertaken and incorporated to help justify the goals and objectives of the plan. This review should be based on the best available information and best practices with regard to vulnerability and impact assessment. The value for money argument for proactive risk management should be stated as part of the policy objectives, and any cobenefits that go beyond drought risk management should be highlighted.

Embedded within this should be initial consideration of the benefits and costs of inaction. For example:

- Historically, what have been the most notable impacts of drought, including any measures of the economic impact of drought on various sectors?
- What are the country's most vulnerable economic and social sectors and regions, and how have they been impacted economically by drought? What current trends may increase, and how will these affect the BACI?
- If actions are deferred, how will this decision affect a country's overall development, its ability to recover from future droughts, and the costs associated with that recovery process? If action is taken now, how might that protect the country's overall development? What are the cobenefits of early action on drought risk management?
- How should we calculate aggregated losses or benefits in terms of administrative levels (local, regional, national, and so on) in the studied areas, and how does this affect the identification of winners and losers?

Getting Stakeholder Participation to Obtain their Knowledge and Views Relevant to the BACI and to Build their Ownership of the Policy and the BACI Approach

Step 3: Seek stakeholder participation; **define** and **resolve** conflicts between key water use sectors. In the third step, the WMO and GWP guidelines call for stakeholder participation as an integral part of the policy development process. Many stakeholders who are not in government, including the private sector, have interests in drought risk management. These groups must be involved early and continuously at both national and subnational levels.

This step creates a valuable asset for the BACI assessment because stakeholders are a key source of information. For example, local communities can provide important data on the impact of drought on their livelihoods, including tolerance for supply disruptions and effects on local communities. They can also provide cost-effective ideas and solutions and highlight the aspects for which they expect more transparency and traceable accounts on costs and benefits.

Stakeholder participation can take place in a variety of ways, and its form will depend somewhat on the local context. In all cases, participation should always specifically seek and incorporate a wide range of views across ages, genders, wealth groups, and so on. It is important that everyone have a chance to voice their thoughts. Engaging stakeholders is often done via a range of participatory techniques that can include focus groups with different affected groups, key informant interviews, and surveys. The conversations are typically semistructured and may also include techniques to rank potential mitigation activities. It is important to ensure that the dialogue is truly interactive and that findings from these discussions—and elements of policy as they are developed—are fed back to the communities as a means to continue to engage them and give them ownership both of the policy and of subsequent implementation.

Taking Inventory of Assets and Resources and Identifying Groups at Risk to Build Vulnerability Profiles

Step 4: Inventory data and financial resources available and broadly **identify** groups at risk. The fourth step in the WMO and GWP guidelines is to conduct an inventory of natural, biological, human, and financial resources together with a preliminary identification of key vulnerabilities, vulnerable groups, and factors that may impede the risk management. At this stage, the BACI assessment can carry out a broad-brush identification of groups, areas, and activities at risk and sketch out their main vulnerabilities. This summary analysis will be deepened in the more elaborate procedures for the BACI assessment embedded within step 5.

Drafting the Key Tenets of Policy That Will Guide Long-Term Preparedness Planning, Based on the BACI Assessment Tools of Hazard and Impact Assessment and Vulnerability Assessment

Step 5: Prepare/write the key tenets of the national drought management policy and preparedness plans, following the three-pillar approach. This fifth step in the WMO and GWP guidelines is the most important, and it is also the step in which the BACI approach has the most to contribute.[1] The step essentially defines the policy and the environment for long-term preparedness planning, specifically emphasizing identification of vulnerabilities, impacts, and potential actions that can reduce drought risk rather than simply react to its occurrence.[2]

BOX 5.1. Six Tasks to Develop a Risk Analysis and Drought Risk Management Plan According to WMO and GWP Guidelines

1. **Assemble the team.** The development of a drought risk management plan begins with the establishment of a series of committees or task forces to oversee the development of the institutional capacity necessary for the plan as well as its implementation and application during times of drought when the various elements of the plan are activated. In each case, it will be necessary to decide if both a technical advisory and a policy committee are needed or just one multidisciplinary team in closer collaboration.

2. **Drought hazard and impact assessments.** Drought impact assessments begin by identifying direct consequences of the drought, such as reduced crop yields, livestock losses, and reduced reservoir levels. These direct outcomes can then be traced to secondary consequences (often social effects), such as the forced sale of household assets, food security, reduced energy production, dislocation, or physical and emotional stress, that happen even after climatological conditions have returned to normal, complicating the assessments even more.

3. **Ranking impacts.** The relevant drought impacts identified in the previous task should be ranked, taking into consideration concerns such as the cost of mitigation actions, the area or extent of the impact, trends over time, public opinion, and fairness.

4. **Vulnerability assessment.** There are many widely known frameworks for vulnerability assessment that provide a common understanding on how to identify the social, economic, and environmental causes of drought impacts. For each of the identified impacts prioritized in the previous assessment, the members of the working group should ask why these impacts occurred.

5. **Action identification.** Once drought impact priorities have been set and the corresponding underlying causes of vulnerability have been exposed, actions can be identified that are appropriate for reducing drought risk. It is important to take care when analyzing the impacts and the potential winners and losers resulting from the planned actions.

6. **Developing the to-do list.** After the impacts, causes, and relevant potential actions have been identified, the next step is to determine the sequence of actions to take as part of the risk reduction planning exercise.

It is within this step that the core of the BACI assessment would take place, quantifying the impacts and benefits simultaneously with the impact and vulnerability assessment, as well as ranking potential response options. The description of the process for preparing the BACI assessment follows the tasks set out in the WMO and GWP guidelines, which break this step down into six discrete tasks, as described in box 5.1.

Assembling the Team (Task 1)

A working structure will need to be set up for the BACI assessment, recognizing the need to work in an integrated way across sectors and between political and administrative levels. A collaborative approach among the various ministries is necessary to enhance data and information sharing, apply cross-fertilization of best management practices to address key vulnerabilities, and so on.

The working structure will probably include one or more advisory committees—possibly a technical advisory committee and a policy committee together with interinstitutional teams or task forces—to carry out the risk analysis and develop the drought risk management plan.

Much of the work will need to be delegated to the level of vulnerable regions or localities. At this subnational level, drought task forces can be set up to work out specific objectives that support the goals of the national plan and to develop a drought risk management program for the area.

Drought Hazard and Drought Impact Assessment (Task 2)

The BACI assessment starts with two key inputs to the overall risk assessment. First, an understanding through a drought hazard assessment of the probability of different types of drought occurring is necessary, and then combining that with a drought impact assessment that will provide information on how these events impact the natural and human environments.[3] These analyses should also be informed by the robustness of water resources in a region or country. Future droughts may be more severe or prolonged than historical events; therefore, understanding the ability of key water resources to withstand these events needs to be part of the analysis.

The Drought Hazard Assessment

The objective of the hazard assessment is to understand the likelihood of drought happening in any given year. This requires a review of historic data on drought magnitude and recurrence, as well as any data on spatial distribution and regions most at risk.

Table 5.1 provides a sample hazard assessment framework for drought. It considers low-, medium, and high-magnitude events, though clearly there could be many more levels of magnitude—the level of detail will depend on the data available. The data required to complete this table will need to include the frequency and intensity of drought, both historic and projected, downscaled and localized to the extent possible. The exceedance probability translates the recurrence to the probability that an event will happen in any given year.

This simple framework is well-adapted to discrete and short events such as floods, hurricanes, or tornadoes. However, the characteristics of drought differ from other hazards in two ways: Droughts often appear as multiyear events, and they may have long-term effects—changes in water resources, for example, may be continuous over a period of time, often several years. The likelihood of a multiyear event, the duration of the drought, and the longer-term hydrological effects are all parameters to consider in the hazard assessment, in addition to frequency and intensity.

TABLE 5.1. Sample Drought Hazard Assessment Framework

Magnitude	Hazard recurrence (years)	Exceedance probability (%)
Low	1 in 3 years	33
Medium	1 in 5 years	20
High	1 in 10 years	10

Source: Authors.

If the framework considers only a measure of deviation from normal intensity and frequency and does not take into account the previous situation of moisture or dryness, the picture of how significantly anomalous the phenomenon is remains incomplete.

Normally, different methodologies for accumulation of anomalies in precipitation (and variables) in a time series exist for different drought indexes. For example, the Standardized Precipitation Index (SPI; McKee, Doesken, and Kleist 1993) is a widely used tool that incorporates the accumulation of the phenomenon in every time step calculation. At the same time, each value can be expressed in terms of probability of occurrence or exceedance, so it will be useful for preparing a table like the example in table 5.1.

Further, the potential for drought to have a significant impact on human populations often results from a combination of climate, economic, and social factors, which need to be incorporated into any hazard assessment.

Determining the methodology to identify the number of sequences and the scales of drought intensity to use is fundamental because the types of interventions used to mitigate impacts will differ depending on the likely magnitude of a drought. The effectiveness of the indicators used in capturing these particularities is fundamental for the BACI assessment because more expensive measures may be justified only in higher-magnitude events where the potential losses are greater, or under changes in frequency or sequencing of several small events, which can have as great as, if not greater, impacts than a single large event.

At the same time, determining the different magnitudes and recurrences of various events will depend on the amount and quality of data available on past events. It may not be possible to construct more than a few data points.

It is essential to assume that drought features are not necessarily stationary. For that reason, the team performing the analysis will also need to review any projections for how magnitude and recurrence vary with climate change. With a long-term time horizon for the analysis, the initially considered exceedance probability can change. Given the large uncertainty, more robust solutions can be found in applying sensitivity analyses—that is, what happens if exceedance probability varies by a certain percentage and what impacts are expected to the system or community.

In addition, the hazard assessment needs to take place at multiple levels. Transboundary water use necessitates that any assessment include an analysis of potential water impacts at a regional level. A national-level assessment will need to be complemented by regional assessments that allow sufficient understanding at a more localized scale. Regional assessments may also drill down into even more localized assessments that look specifically at hot spot areas that suffer from regular hazards related to drought. Because of the close relation of drought risk with water resources, the hydrological basin (both surface and groundwater) may be one level of assessment, as it has been in Mexico (see "Drought Risk Management Policy Tools" section).

It is important to note that a multihazard risk assessment may be required. Although drought is the main hazard being evaluated here, it rarely occurs in isolation—it is often followed by floods, for example, and is often intertwined with conflict, migration, economic stress, health crises, and so on.

There are plenty of resources to learn more on how to perform these assessments. The Global Facility for Disaster Recovery and Response (GFDRR) has released the report *Assessing Drought Hazard and Risk: Principles and Implementation Guidance* (World Bank 2019), in which further references can be found. This document provides direction on effective drought hazard and risk assessments and is based on a new extensive inventory and technical evaluation of drought models and tools, made available through https://www.droughtcatalogue.com. Also important to note: The WMO, GWP, and several other institutions collaborated in 2016 to release a *Handbook of Drought Indicators and Indices* (WMO and GWP, 2016, edited by Svoboda and Fuchs).

The Drought Impact Assessment

As shown in figure 3.1, drought impacts are typically classified as economic, environmental, or social. These are summarized in brief here:

- **Economic** impacts include categories such as production losses from crops, dairy and livestock, and timber and fisheries; income loss for farmers; unemployment; loss to tourism; increased energy demand and loss of supply; substitution of more expensive fuels; disrupted food supply; disrupted water supply; revenue losses to government; cost of water transport; reduced economic development; decreased land prices; and so on. They typically start to occur when the meteorological phenomenon has lasted so long that the subsequent stages of drought are felt, jeopardizing the normal conditions of water supply—and sometimes triggering an increase in the water demand—for the economic activities.
- **Environmental** impacts include categories such as damage to plant species, increased number and severity of fires, loss of wetlands, estuarine impacts, increased groundwater depletion and land subsidence, loss of biodiversity, animal distress and migration, wind and water erosion of soils, reduced levels in water bodies, reduced flow from springs, water and air quality effects, and visual landscape quality. These impacts are often overlooked but can occur as soon as an anomaly in precipitation occurs, depending on how sensitive an ecosystem is to droughts.
- **Social** impacts include categories such as mental and physical stress; problems caused by water shortages; deterioration in health and nutrition; loss of human life; public safety issues; increased health issues; increased disease caused by wildlife concentration; increased conflict; disruption of cultural belief systems; modification of recreational activities; public dissatisfaction; inequity in drought impacts across socioeconomic groups, such as age, disability, and gender; loss of cultural sites; loss of aesthetic value; reduced quality of life; and so on. These impacts are normally the last to appear, and they occur when drought has continued long enough and has been intense enough to transcend the basic hydrometeorological anomaly and permeate throughout a socioeconomic system.

Monetizing Drought Impacts

To complete the BACI assessment, each of the elements of risk that are identified as part of the policy process need to be quantified to the extent possible. The costs of inaction are calculated by estimating the damages or losses that occur as a result of different magnitudes of drought. The intention is to define the costs of potential impacts in financial or economic terms based on the impact assessment and with reference to different magnitudes of drought. However, in practice, data rarely exist for a complete costing of impacts, and some—often social or human impacts such as stress or violence—cannot be monetized using traditional techniques and must be considered qualitatively.

For those impacts that can be monetized:

- The first step is to describe the potential impact in quantitative terms. For example, in a high-magnitude drought, 20 percent of crops is lost.
- The next step is to find the data to allow a costing of this loss. In the example in table 5.1, this would require an assessment of the value of crops. If average crop production is valued at US$1.0 million per year, it can be estimated that 20 percent of that, or US$200,000, is lost in a high-magnitude drought. Other costs that can usually be monetized include interruption to business activities and interruption to services (for example, water or sewage services or hydropower generation). Loss of water services could be monetized by looking at the cost of providing substitute services (for example, through water trucking or distribution of bottled water).
- Environmental and social impacts can be harder to quantify. However, it can be possible to find proxy indicators for quantification. For example, a loss of biodiversity/landscapes can be quantified by looking at the loss of tourism revenue that results from this. Water quality effects can be quantified either by looking at the cost of health services to deal with those effects or by estimating the cost to clean the water or to provide substitute water services such as tanker or bottled water.
- Indirect costs should also be accounted for in the analysis. Indirect costs are typically secondary costs that occur as a result of the primary impacts. For example, a lack of access to clean drinking water can result in health problems such as diarrhea. The costs of treating such health problems, as well as the economic impact on days lost for work or school, should also be included.

For those impacts that cannot be monetized:

- The impacts of drought that are harder to monetize can also be some of the most important impacts. There is a risk that the costs of inaction are underestimated because not all of the impacts can be monetized for inclusion in the quantitative analysis. This is particularly true for indirect or secondary impacts. It is, therefore, important that the quantitative analysis sit within a wider qualitative framework that accounts for both the qualitative and quantified impacts.
- Logically, nonmonetizable effects, such as health, environmental, and social impacts, should be taken into account. For this, a cost-effectiveness analysis (CEA)[4] is a helpful approach that can eventually allow for the ranking of potential mitigation activities.

Where possible, it is useful to draw on existing evidence from available and published research on droughts, at least to obtain proxy methodologies or references. For example, *Uncharted Waters* (Damania et al. 2017) quantified how dry shocks impact both global agricultural productivity and food calories and looked at longer-term health impacts in Africa and other regions, as well as impacts on the economic activity of firms, for which there is not still enough practice to measure systematically.

Table 5.2 provides a list of the types of data that might be required to complete this assessment.[5]

TABLE 5.2. Data Requirements

Elements at risk	Data requirements
Economic	The value of losses associated with economic sectors (crop, dairy and livestock, timber and fishery production, and tourism). The assessment should consider not only the direct economic losses but also any indirect impacts such as the inability to plant the following year, loss of milk production for food consumption, or recovery time for fisheries to return to their predrought state. The cost of a reduction in energy supply from hydropower. This can be valued by considering data on the lost revenues to electricity supply companies, as well as the economic impact to businesses and households of lost production or education time, impact on hospitals, and so on. The cost of increased food prices can be measured by the increased cost and the number of people affected or by valuing the cost of providing a substitute source of food. If no substitute is available, and those affected have less food as a result, data will be required on the decrease in food supply, as well as resulting malnutrition rates and costs. Lost revenue to water supply firms can be quantified by estimating the number of days that service is interrupted and the average revenue per day.
Environmental	Data will be required to quantify the extent of the damage—for example, number of plant species damaged, hectares of wetlands lost, quantity of water bodies affected, and so on. Monetizing environmental losses requires the use of willingness to pay or other contingent valuation techniques. It may be possible to monetize some of these losses by tracing the environmental impact to its outcomes—for example, by determining the lost revenue to tourism as a result of environmental impacts, loss in crops as a result of water or wind erosion of soil, or increased flooding damage to houses as a result of loss of wetlands.
Social	Data will be required to quantify the number of people affected by social impacts for each different type of impact. Monetizing social impacts can be difficult; therefore, it may be helpful to give the impacts a qualitative ranking—for example, from minimal to severe damage. It may be possible to monetize some of these losses by tracing the social impact to its outcomes. For example, where stress leads to health outcomes, it may be possible to gather data on the number of people affected and the cost of treating those health outcomes. Increased conflict may incur a cost through loss of life and property and through the deployment of peacekeeping forces. Monetizing losses such as damage to cultural sites, loss of aesthetic value, or reduced quality of life requires the use of willingness to pay or other contingent valuation techniques.

Source: Authors.

A Worked Example of Quantifying and Monitoring Drought Impacts

The impact assessment should describe and define all of the elements at risk as a result of drought. As an example, for impacts related to crop damages and losses, it might include the following:

- **Economic:** Loss of crops—number of hectares lost and the value of that loss; percentage of loss of total value of crops
- **Environmental:** Hectares of land with degraded soil
- **Social:** Number of people with compromised food consumption; number of people with reduction in number of meals per day; cases of malnutrition

It is likely that the economic elements at risk will be the most readily quantifiable. Table 5.3 provides an example of how crop loss as a result of drought can be quantified for different levels of drought severity. Clearly, crop loss is only one possible impact and it is easier to identify and evaluate than many others.

TABLE 5.3. Crop Losses Due to Drought—Without Mitigation

Drought severity	Exceedance probability (%)	Crop loss (%)	Value of crop loss due to drought ($)
Low	33	20	3.0 million
Medium	20	50	7.5 million
High	10	100	15 million
Average annual loss			4.0 million

Source: Authors.

Nonetheless, estimates should be made and aggregated for all potential areas of loss subject to direct or indirect impacts.

The estimate of the costs of inaction can either be presented as in table 5.3, quantifying the impact of droughts of different magnitudes, or using the average annual loss (AAL) estimate. This estimate weighs the cost of damages or losses according to the probability of that loss happening in any given year. In the example above, the AAL is nearly $4 million[6], meaning that in any given year, those would be the losses.

Ranking Impacts (Task 3)

As highlighted in the overall policy guidance, the ranking of impacts should take into consideration a number of criteria, including the cost of mitigation actions.

Vulnerability Assessment (Task 4)

The vulnerability assessment considers the root causes of the impacts identified. Again, these have to be sought in all the sectors potentially affected by drought. This can be important for the BACI assessment because they may indicate systemic or complex issues that drive vulnerability, which in turn will increase the cost of potential mitigation measures identified to address those impacts.

The vulnerability assessment provides an opportunity to show how those potential mitigation measures are able to address the core vulnerabilities—for example, by incorporating tools that assess the changes in robustness and vulnerabilities of a sector generated by the plan or strategy for drought mitigation, such as decision making under deep uncertainty (DMDU) or robust decision making (RDM) and similar techniques.[7]

RDM has been used to elaborate long-term water management strategies. In particular, applications have been used to stress water systems, both as they are and with potential improvements, set against scenarios of hydrological drought, as in the case of the Lima water utility (see the case study in box 5.2). This is done to identify key vulnerabilities and pinpoint the combination of options that work well under many different futures and that guarantees more met demand (less impact because of reduced vulnerability).

Similar approaches can be applied to most of the sectors affected by drought and the potential improvements in them: hydropower generation, agriculture, and so on.

It is important to note that the outputs of many of these types of tools are the prioritization of the available set of alternatives, so their usefulness is not constrained to the vulnerability assessment step.

BOX 5.2. Case Study: Enhancing Lima's Drought Management Plan to Meet Future Challenges

Lima's water utility, Servicio de Agua Potable y Alcantarillado de Lima (SEDAPAL), provides water to most of the metropolitan region. Although SEDAPAL is generally able to meet the current needs of its customers and respond effectively to most drought conditions experienced in the past, it faces a number of challenges in doing so in the future, namely an increase in demand as a result of a rapidly growing population and expanding city. Currently available surface and groundwater supplies on which SEDAPAL relies are only adequate to meet current needs. Changes in these supplies—either long-lasting reductions in supply as a result of climate change, long-term variability, or more acute or frequent droughts—would challenge SEDAPAL's ability to maintain supplies.

Recognizing the urgency of Lima's water situation, SEDAPAL developed a US$2.3 billion master plan. Although the investments identified in the plan will help preserve SEDAPAL's capability for addressing drought conditions in the near and long-term future, the plan did not specifically consider its ability to successfully manage future droughts. Therefore, a robust decision making (RDM) study was carried out. Building on a previous World Bank study that tested the robustness of SEDAPAL's master plan, the new study evaluated SEDAPAL's current drought management plan and proposed improvements.

SEDAPAL's existing drought management plan included a set of potential actions to be triggered during hydrologically dry periods. The study team used a water evaluation and planning system (WEAP) model of SEDAPAL's management system to estimate how well the plan would perform across a wide range of plausible drought hydrologic conditions of intensity and frequency and against current and increasing demands.

The technique defined vulnerability by comparing the average projected unmet demand during dry years of all the options and their combination to a set of thresholds: 1 to 5 cubic meters per second. The team was able to recognize the measures of the drought management plan that truly played an important role in increasing SEDAPAL's ability to manage droughts across the wide range of futures.

Additionally, the technique helped investigate what would happen during droughts if, in addition to the current drought management plan, emergency conservation measures were added, reservoir operations were modified, and new drought storage was made available. The study demonstrated that there was significant room for improvement in those aspects. As a result, a set of proposals was made around these recognized vulnerabilities to increase the robustness of the water system.

The study thus provided a first look at how SEDAPAL's drought management plan could be strengthened over time to accommodate changes in demand and drought conditions.

Source: Groves et al. 2019.

Even if these tools are focused on appraising the root causes of problems, they usually go beyond that because they help identify the most convenient actions to minimize them, which could be considered part of the following tasks. Therefore, in cases of applying RDM or similar, it is possible that, for tasks 5 and 6, the teams would need to monetize only the different alternatives and their possible benefits.

Action Identification (Task 5) and Developing the To-Do List (Task 6)

Prioritizing potential drought mitigation actions should include an assessment of the relative costs and benefits of the possible options. Although the core of a BACI assessment requires such quantification, it should be only one measure used in a multicriteria analysis (MCA) to determine the most effective package of response options. There are many benefits that cannot be quantified—for example, social impacts—that are as valid as the monetized impacts. Equally, other factors such as political or cultural aspects will be important decision-making criteria.

For each mitigation measure being considered, the following steps need to be undertaken to complete a BACI assessment:

- **Identify the costs of the drought risk mitigation measure.** These should include both upfront capital costs required to implement the measure, as well as ongoing maintenance costs over the lifetime of the intervention. This may require making some assumptions about the annual repair costs that will be required to maintain any interventions and should also include costs incurred by the community (not just the implementing organization).
- **Identify the benefits of the drought risk mitigation measure.** Benefits will most likely be represented as avoided losses—both direct (for example, avoided loss of crops) and indirect (for example, effects on health, economic growth, and development gains). Each of the economic, environmental, and social impacts of drought identified in task 2 should be reviewed in light of the proposed adaptation measures, and a determination should be made for how much those impacts will decrease as a result of the mitigation measure. For example, if drought destroys 90 percent of crops, and irrigation is estimated to reduce those damages to 50 percent, the benefit of the irrigation is the avoided loss (the 40 percent of crops that is no longer destroyed). In addition, mitigation measures may bring additional benefits—for example, increasing production in nondrought years. Measures may also result in wider social or economic cobenefits, each of which should be identified and quantified. Data on the benefits of mitigation will be gathered from a wide variety of sources, including consultation with local stakeholders, relevant documentation on similar projects or in technical/design specifications, and evidence from research projects.

Table 5.4 expands upon the impact assessment and documents the benefits of drought risk mitigation measures. This table should be completed for each measure and each sector and not only for "direct avoided losses and benefits" (as table 5.4 shows). There should also be an attempt to capture the elements that are at risk of suffering indirect impacts and to capture the cobenefits.

The data gathered in the previous steps should be combined into a model that calculates the benefit-to-cost ratio (BCR) and net present value (NPV) (see box 5.3 for explanations of terminology) of each measure being considered. The cost-benefit analysis will combine the costs and benefits, over the project lifetime, and discounted over time, to calculate the BCR and the NPV.

- The *project lifetime* is the number of years that the project intervention is expected to bring benefits to the community. This is likely a longer time period than the number of years that the project is running and is normally taken as the lifetime of the longest-lived asset.

TABLE 5.4. An Example of Monetizing Direct Avoided Losses and Benefits

Elements at risk	Description of elements at risk—without mitigation scenario	Description of elements at risk—with mitigation scenario	Monetize avoided losses and benefits
Economic	In a high-magnitude drought, 100 percent of crops is lost; in a medium magnitude drought, 50 percent of crops is lost; in a low-magnitude drought, 20 percent of crops is lost.	In a high-magnitude drought, irrigation would reduce losses from 100 percent to 50 percent; in a medium magnitude drought, irrigation would reduce losses from 50 percent to 25 percent; in a low-magnitude drought, irrigation would reduce damages from 20 percent of crops to 0.	The cost of mitigation is US$5.0 million. See "A Worked Example of a BACI Analysis."
Environmental	In a high-magnitude drought, 50 percent of tourism revenues is lost for approximately three months as a result of depletion of recreational water bodies.	In this example, it is not possible to prevent depletion of water bodies; therefore, no change.	For example, damages are estimated at 50 percent of tourism revenues lost for three months.
Social	In a high-magnitude drought, families have to migrate for water, causing psychosocial stress, especially for women and children.	Rehabilitation of water points allows families to stay where they are, eliminating migration entirely.	This can be assessed only qualitatively.

Source: Authors.

BOX 5.3. Definition of Terms

The *benefit-to-cost ratio* (BCR) indicates the level of economic benefit that will be accrued for every $1 of cost. A ratio greater than 1, therefore, indicates that the intervention is worth investing in from an economic perspective, whereas anything less than 1 indicates a negative economic return.

The *net present value* (NPV) takes the net benefit (benefits minus costs) each year and discounts these to their present-day value. If the result is greater than 0, this indicates that the economic benefits outweigh the costs. The higher the value, the greater the economic argument for initiating the project.

- The *discount rate* is used to discount costs and benefits occurring in the future because people place a higher value on assets provided in the present and a lower value on benefits that may accrue further into the future. The discount rate is normally equivalent to the average return one might expect if the same money was invested in an alternative project and can be derived by looking at the rates used for similar projects within the country (the discount rate used by development banks can be a good source).

As highlighted in the WMO and GWO guidelines, a variety of factors should then be considered to prioritize measures, including but not limited to the BCR. The BACI assessment should be weighed against other criteria such as feasibility, sustainability, and political issues.

A Worked Example of a BACI Analysis

Using the data presented for crop losses, we present a short worked example of what the full analysis might look like. The numbers are purely indicative, used only to provide an example of how the analysis can be conducted with actual data. Further, this example focuses on only one impact for the sake of clarity—it is highly likely that most assessments will need to aggregate multiple impacts.

Table 5.3 articulated the crop losses without any mitigation intervention. Table 5.5 presents the same analysis but with mitigation.

In this example, the cost of the irrigation required to obtain this level of crop loss is US$5.0 million. It is assumed that this investment in year one will require ongoing maintenance costs of US$250,000 per year and that the systems will need to be replaced at the end of 10 years.

Table 5.6 presents a simple cost-benefit analysis, conducted over 10 years and discounted at 10 percent. The without mitigation scenario is estimated in columns (a) and (b), and estimates the net present cost of crop losses (column [b]) occurring over the 10 years analyzed, based on the AALs (column [a]) calculated in table 5.3.

Columns (c) through (e) combine the average annualized losses after mitigation from table 5.5 (column [c]), with the cost of investing in mitigation (column [d]), to calculate the total net present cost with mitigation (column [e]).

TABLE 5.5. Crop Losses Due to Drought—With Mitigation

Drought severity	Exceedance probability (%)	Crop loss (%)	Value of crop loss due to drought ($)
Low	33	0	0
Medium	20	25	3.8 million
High	10	50	7.5 million
Average annual loss			1.5 million

Source: Authors.

TABLE 5.6. Cost-Benefit Analysis: Irrigation

Year	Crop AAL—without (a)	Net present cost—without (b)	Crop losses—with irrigation (c)	Cost of irrigation (d)	Net present cost—with (e)
0	4.0	4.0	1.5	5.0	5.6
1	4.0	3.6	1.5	0.25	1.5
2	4.0	3.3	1.5	0.25	1.5
3	4.0	3.0	1.5	0.25	1.5
4	4.0	2.7	1.5	0.25	1.5
5	4.0	2.5	1.5	0.25	1.5
6	4.0	2.3	1.5	0.25	1.5
7	4.0	2.0	1.5	0.25	1.5
8	4.0	1.9	1.5	0.25	1.5
9	4.0	1.7	1.5	0.25	1.5
Total	**39.9**	**27.0**	**15.0**	**7.3**	**19.3**

Source: Authors.
Note: AAL = average annual loss.

The cost without mitigation is US$27.0 million, and the cost with mitigation is US$19.3 million, indicating that the investment in mitigation is outweighed by the avoided crop losses and should be prioritized as an investment.

Importantly, even if the result was reversed, and the cost with mitigation was more expensive than the cost without mitigation, the decision for investment should be weighed in the context of other qualitative factors—for example, environmental or social benefits that were not monetized but could nonetheless be important and affect the decision-making criteria.

We can use this case to explain additional aspects that need to be measured when performing the costings and inherent assumptions assumed in the model. For instance, if the considered context is benefitting from a groundwater-driven irrigation system, with more groundwater depletion, the marginal and fixed costs to draw water would increase over time; therefore, the cost of irrigation in column (d) would also change if that were to be assumed. This is only an example to illustrate how the team in charge of performing the analyses needs to be familiar with the economic dynamics of the elements to be managed to define the costs appropriately—in this case, conditioned by the hydrology of the sources of water used, which must be fully understood and the changes in demand.

The findings from these steps should be used to draft the drought risk management policy and to align drought risk management with broader development planning (see step 2). The BACI assessment can be used to identify low-hanging fruits where progress and positive outcomes can be achieved swiftly and in a cost-effective manner, as well as to highlight actions that may require more funding, political will, or institutional change. Further, policies, actions, and recommendations based on the BACI assessment need to be aligned with national development planning. These linkages should be defined in the policy document.

Identifying Research Needs and Filling Institutional Gaps, Including for BACI Assessments

Step 6: Identify research needs and fill institutional gaps. The principal tasks for a BACI assessment were described in step 5. The results can contribute to the drafting of a proactive drought risk management policy based on the BACI tools of hazard and impact assessment and vulnerability assessment. The remainder of the 10 steps in the WMO and GWP guidelines deal with ways to complete the development of the drought management policy and how to build ownership of the policy and prepare for its implementation. These steps are also key to strengthening and completing the BACI assessment and to integrating the methodology and results into national policy and programs.

The sixth of the 10 steps in the WMO and GWP guidelines is to identify specific research needs that would contribute to a better understanding of drought, its impacts, mitigation alternatives, and needed policy instruments, leading to a reduction of risk.

For the BACI assessment, this step should identify data gaps to strengthen the quantification of the impacts of drought and of actions to strengthen resilience and mitigate impacts. Research plans that would fill those gaps should be developed. The data required to undertake a comprehensive BACI assessment can be extensive. Wherever there were gaps in the information and data needed for the

BACI assessments already carried out, they should be identified and further research commissioned. Key areas for this research are likely to include:

- the frequency and intensity of drought, both historic and projected, downscaled and localized;
- the impact of different magnitudes of events on human and natural systems, including both direct and indirect impacts;
- the cost of those impacts, to the extent that they can be monetized;
- the cost of a range of drought risk mitigation measures; and
- the (co)benefits (or avoided losses) associated with different types of adaptation measures.

Integrating Science and Policy Aspects in Drought Management, and the Key Role of BACI Assessment

Step 7: Integrate science and policy aspects of drought management. Policy makers' understanding of the scientific issues and technical constraints involved in addressing problems associated with drought is often limited. Likewise, scientists and managers may have a poor understanding of existing policy constraints for responding to the impacts of drought. Communication and understanding between the science and policy communities is vital to the success of the planning process. Thus, the seventh of the 10 steps in the WMO and GWP guidelines—integrating science and policy within drought management—is a critical step in the development of a national drought policy.

A BACI assessment can play a key role in this integration of science and policy aspects of drought management by translating data on the impacts of drought into an analysis that helps put numbers to those impacts. Here, the BACI assessment can be particularly powerful for making the case for investment in more proactive approaches and for helping identify activities that will allow this to happen cost-effectively.

The Role of the BACI Assessment Process in Publicizing and Building Public Awareness and Consensus

Step 8: Publicize the policy and preparedness plans; **build** public awareness and consensus. The eighth step of the WMO and GWP guidelines provides for a communications program about the risk-based drought management policies, publicizing principles and drafts and progressively building public awareness and consensus. Throughout the policy and planning development process, local and national media can be used to spread information about the process, the principles, and the evolving policies, as well as their rationale. Typically, public information specialists will be engaged in this process, both at central and subnational levels, and they will play a key role in this step.

The BACI assessment can play a vital role in this. The economic argument for action should be used as part of a communications plan to guide public awareness and advocate for the importance of early action. If properly disseminated, the knowledge developed by the BACI analysis will create further engagement.

Developing Educational Programs Reflecting the BACI Assessments

Step 9: Develop education programs for all age and stakeholder groups. As a complement to the communications program, the ninth step of the WMO and GWP guidelines provides for a broad-based education program directed at all age groups. This systematic and structured approach will go beyond awareness of the new strategy to educate both key stakeholders and the public at large about the importance of preparedness and risk reduction and how it can be accomplished. The program can deal with issues of vital importance to people but are little understood such as short- and long-term water supply issues.

This education program will help strengthen public acceptance and increase general knowledge about drought management, how to be prepared for it, and how to deal with it when it occurs. The program can also be the first step in strengthening national expertise in drought management. One key outcome is likely to be that the need for action on drought preparedness will not be forgotten during nondrought years.

The BACI assessment clearly has a key role to play in this. The economic argument for action can be a powerful educational tool. Beyond giving people a better grasp of the risk-based approach, education will be important to help people understand the pros and cons of different pathways of investment and why their taxes are being put into projects that, at first sight, might appear to have little to do with drought.

Evaluating and Revising Policies and Plans and Revisiting BACI Assessments

Step 10: Evaluate and **revise** policy and supporting plans. The final step in the policy development and preparedness process in the WMO and GWP guidelines is to create a detailed set of procedures for monitoring and evaluation of the successes and failures of the policy and of the preparedness plans at all levels. This process must be dynamic and iterative; otherwise, the policies and plans will quickly become outdated. Periodic testing, evaluation, and updating are needed to keep the plan responsive to the needs of the country and of vulnerable regions and sectors.

Updating the BACI assessment based on new research and empirical evidence on the impact of drought risk mitigation and preparedness action should be carried out on a regular basis to help evaluate and revise planned actions based on their proven cost-effectiveness over time.

Notes

1. For that reason, most of the substance for structuring the BACI assessment is contained in this step and the tasks it contains. The explanation and examples provided by the authors are much more extensive than in other parts of the text.

2. In the text of the guidelines, this step does not give guidance on how to actually produce preparedness plans or drought contingency plans in terms of contents, but it defines how to create the capacity and the environment to develop these contents as they fit in each context.

3. Risk is a function of hazard and vulnerability. Task 2 explains how drought hazard and potential impacts are assessed. Task 4 discusses the assessment of vulnerability.

4. According to a World Health Organization report (2003), the estimated cost-effectiveness of a single proposed new intervention is compared either with the cost-effectiveness of a set of existing interventions reported in the literature or with an assigned fixed price cut-off point representing the assumed social willingness to pay for an additional unit of health, environment, ecological, or nonmonetizable aspect to improve or achieve.

   CEA is different from cost-benefit analysis (CBA), which allocates a monetary value to the measure of the impact. Typically, the CEA is a proportion where the denominator is a noneconomic parameter compared with the cost associated to the measure that triggers the increase or decrease in that parameter. Extensive literature is available to learn about CEA and CBA.

5. The range of impacts that can occur is broad; therefore, it is important to refer to the full list of potential impacts in the WMO and GWP guidelines when looking at quantifying impacts.

6. (0.33*3.0) + (0.2*7.5) + (0.1*15) = 4.0

7. For more information on DMDU and RDM, see http://www.deepuncertainty.org/.

Chapter 6
The Way Forward

This document brings together the work carried out to date under the work stream on the benefits of action and costs of inaction (BACI) for drought preparedness and mitigation and paves the way toward a methodological framework for assessment of the BACI as a tool to shift from crisis management to risk management.

The paper emphasized that there is an initial need for a conceptual framework for analyzing the BACI and argues that the framework should be systematic enough to allow for comparability across countries and contexts, but with the option of being tailored as needed.

In the last chapters of the paper, the authors used the 10-step methodology for developing drought strategies that was created by Wilhite (1991) and Wilhite, Hayes, and Knutson (2005) and subsequently codified by the World Meteorological Organization (WMO) and Global Water Partnership (GWP) (2014) to help organize the necessary stages for a proper BACI assessment. In this way, the authors embed the BACI assessment in the overall development of a drought risk management strategy. This is a first approach designed to guide those responsible for BACI assessments to ask the right questions at different stages in a structured manner.

Key next steps for the Integrated Drought Management Programme (IDMP), the World Bank, and the entire community of experts, authorities, operators, and institutions dealing with drought management will be to experiment with this broad draft conceptual guidance by applying it in multiple contexts. The aim will be twofold: (a) test the guidance for its usability and clarity and use feedback to improve the guidance with more concrete methodologies and technical tools within each of the steps and (b) develop more case study examples to showcase how this process can be undertaken and how it can be advantageous to stimulate positive action.

This methodology can be improved and demonstrate how to do the assessment for drought, and if it can be widely accepted as a standard, it can support the shift away from fragmentary approaches that do not contain comparable results. Moreover, it can help contribute to the broader move away from reactive drought management and toward proactive drought risk management.

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