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SUMMARY – Drought is the most complex of all natural hazards. The lack of progress in drought preparedness planning and the development of national drought policies is a reflection of this complexity. With the demand for water increasing because of expanding population, urbanization, changes in land use, and many other factors, the time to move to a more risk-based drought management approach is now. Given projected increases in temperature and uncertainties regarding the amount, distribution, and intensity of precipitation, the frequency, severity, and duration of drought may increase in the future. Making the transition from crisis to drought risk management is difficult because governments and individuals typically address drought-related issues through a reactive approach and very little institutional capacity exists in most countries for altering this paradigm. Drought mitigation planning is directed at building the institutional capacity necessary to move away from this crisis management paradigm. This change is not expected to occur quickly – it is in fact a gradual process that requires changes in government policies and human behavior. Developing improved drought monitoring and early warning systems in support of drought preparedness planning and policy is an urgent need for all drought-prone counties.

Key words: Drought mitigation, drought monitoring, early warning, drought planning, drought policy.

Introduction

Drought is natural part of climate that affects nearly every region on earth (Wilhite, 2000a, Wilhite and Buchanan, 2005). Although specific definitions of drought may vary by sector and region, drought generally originates from a deficiency of precipitation over an extended period of time, resulting in a water shortage for some activity, group, or environmental sector.

The frequency of drought occurrence is highly variable from location to location because of differing climate controls that result in different climatic regimes. Each drought is unique in its intensity, duration, and spatial extent. An event may persist for a few months or for several years and, for some locations, for a decade or more. One of the distinctive characteristics of drought that separates it from other natural hazards is its spatial extent. Drought also tends to affect large numbers of people principally because of its impact on both water supply and demand. For example, according to the Centre for Research on the Epidemiology of Disasters (CRED, 2006), droughts account for less than 5 percent of all disaster occurrences in Asia, but they account for approximately 30 percent of all people affected by natural disasters on the continent (Fig. 1).

In fact, throughout the world, drought ranks first among all natural hazards in terms of the number of people directly affected (Obasi, 1994; Hewitt, 1997; Wilhite, 2000a). However, some regions are more prone to drought disasters because of the frequency of the hazard itself and societal vulnerability. Each country also differs in its capacity to effectively prepare for and respond to drought. Therefore, the number of people affected by drought and the types of impacts experienced will vary by region. For example, Fig. 2 reveals the especially high number of people who are affected by drought in Iran, India, and China (CRED, 2006).

Despite significant improvements in weather monitoring and warning systems, government programs and public education, and the development of new tools and technologies, the costs resulting from disasters around the world are still high and rising, indicating growing vulnerability to natural hazards (Changnon, 1993; Wilhite, 2000b; Bender, 2002). Along with this realization comes the acknowledgement that past attempts to manage drought and its impacts through a reactive, crisis management approach have been ineffective, poorly coordinated, and untimely. The crisis management approach has been followed in both developed and developing countries. Because of

the ineffectiveness of this approach, greater interest has evolved in recent years in the adoption of a more proactive risk-based management approach in some countries.

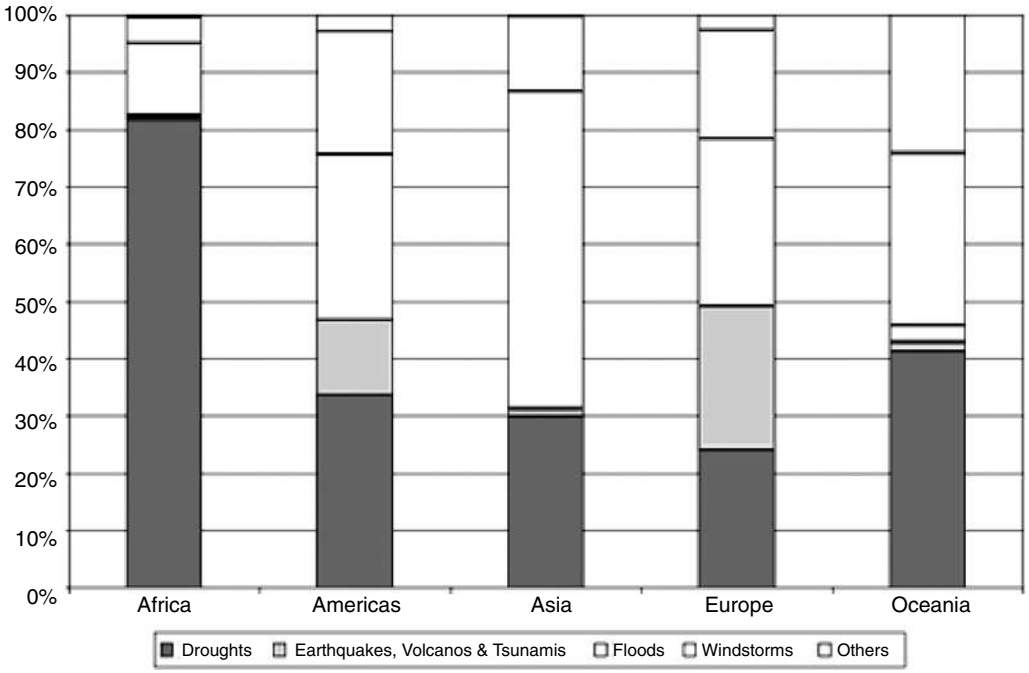

Fig. 1. Proportion of persons affected by each disaster type per continent (CRED, 2006).

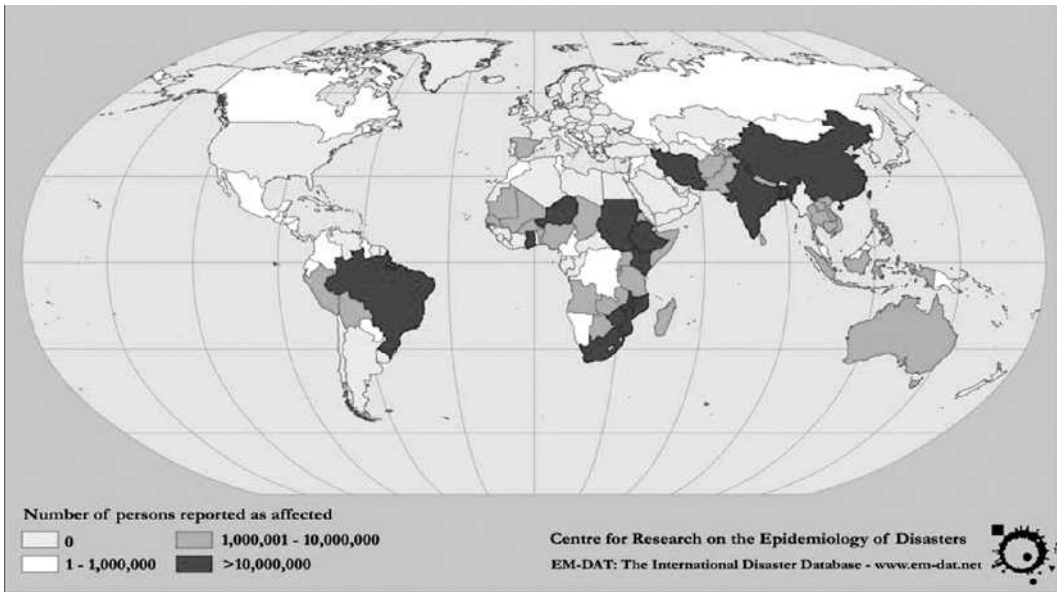

Fig. 2. Number of persons reported affected by drought disasters: 1970-2006 (CRED, 2006).

Principles of drought policy with linkages to drought mitigation planning

Implementing a drought policy can be the instrument necessary to alter a nation's approach to drought management. In the past decade or so, drought policy and preparedness has received increasing attention from governments, international and regional organizations, and nongovernmental organizations. Simply stated, a national drought policy should establish a clear set of principles or operating guidelines to govern the management of drought and its impacts. The policy

should be consistent and equitable for all regions, population groups, and economic sectors and consistent with the goals of sustainable development. The overriding principle of drought policy should be an emphasis on risk management through the application of preparedness and mitigation measures. This policy should be directed toward reducing risk by developing better awareness and understanding of the drought hazard and the underlying causes of societal vulnerability. The principles of risk management can be promoted by encouraging the improvement and application of seasonal and shorter-term forecasts, developing integrated monitoring and drought early warning systems and associated information delivery systems, developing preparedness plans at various levels of government, adopting mitigation actions and programs, creating a safety net of emergency response programs that ensure timely and targeted relief, and providing an organizational structure that enhances coordination within and between levels of government and with stakeholders.

There are four key components in an effective national drought strategy that has as its primary goal to lessen the risk associated with severe drought events and, therefore, reduce impacts. These components are: (i) the availability of timely and reliable information on which to base management and policy decisions; (ii) policies and institutional arrangements that encourage assessment, communication, and application of that information; (iii) a suite of appropriate risk management measures for decision makers; and (iv) actions by decision makers that are effective and consistent in support of a national drought strategy. A drought monitoring and early warning system is designed with the goal of providing timely and reliable information to decision makers (WMO, 2006). This information is provided through a delivery system that is appropriate for the country in question. This delivery system can be primarily Internet-based or it can rely on a combination of print and electronic materials distributed via the Internet, television, radio, or by fax to agricultural extension personnel or advisers. This drought policy should promote the development of decision-support tools to aid decision makers from agricultural producers to policy makers. Risk management measures or mitigation tools should be readily available to implement with the onset of drought conditions and tailored to the most vulnerable sectors, regions, and population groups. These measures must be developed in support of the national drought strategy and its principal goals as noted above. It will take some time for a full range of mitigation options to evolve for the most vulnerable sectors, regions, and population groups. The long-term goal is to create a more drought resilient society as discussed later in this chapter.

Drought mitigation planning: Objectives

As vulnerability to drought has increased globally, greater attention has been directed to reducing risks associated with its occurrence through the introduction of planning to improve operational capabilities (i.e., climate and water supply monitoring, building institutional capacity) and mitigation measures that are aimed at reducing drought impacts. This change in emphasis is long overdue. Mitigating the effects of drought requires the use of all components of the cycle of disaster management (Fig. 3), rather than only the crisis management portion of this cycle. Typically, when a natural hazard event and resultant disaster has occurred, governments and donors have followed with impact assessment, response, recovery, and reconstruction activities to return the region or locality to a pre-disaster state. Historically, little attention has been given to preparedness, mitigation, and prediction/early warning actions (i.e., risk management) that could reduce future impacts and lessen the need for government or donor intervention in the future. Because of this emphasis on crisis management, countries have generally moved from one disaster to another with little, if any, reduction in risk. In addition, in most drought-prone regions, another drought event is likely to occur before the region fully recovers from the previous event.

Past experience with drought management in most countries has been reactive or oriented toward managing the crisis. Individuals, government, and others consider drought to be a rare and random event. As a result, little, if any, planning is completed in preparation for the next event. Since drought is a normal part of climate, strategies for reducing its impacts and responding to emergencies should be well defined in advance. Almost without exception, the crisis management approach has been untimely and ineffective and drought relief measures are poorly targeted and do little to reduce vulnerability to the next drought. In fact, it has been demonstrated in many cases that drought relief actually increases vulnerability to future events by reducing the level of self-reliance and increasing dependence on external assistance. If governments and others provide assistance to those most affected by drought, what incentive is there for relief recipients to alter those resource management

practices that make them vulnerable? In addition, those agricultural producers and natural resource managers that employ best management practices (BMPs) are usually not eligible for drought assistance programs. In reality, governments are not only promoting poor management through the provision of drought relief, but rewarding it.

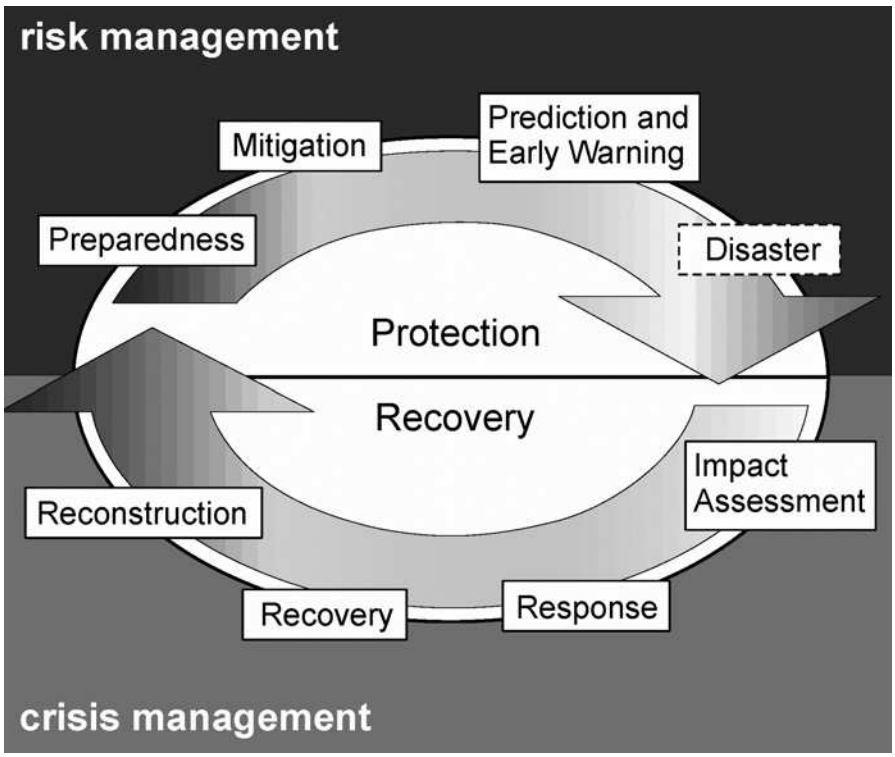

Fig. 3. The cycle of disaster management (source: National Drought Mitigation Center, University of Nebraska-Lincoln).

Making the transition from crisis to drought risk management is difficult because governments and individuals typically address drought-related issues through a reactive approach and very little institutional capacity exists in most countries for altering this paradigm. Drought mitigation planning is directed at building the institutional capacity necessary to move away from this crisis management paradigm. This change is not expected to occur quickly – it is in fact a gradual process that requires changes in government policies and human behavior.

Drought plan objectives will vary within and between countries and should reflect the unique physical, environmental, socioeconomic, and political characteristics of the region in question. A general set of drought mitigation planning objectives that are recommended for countries to consider include the following: (i) collect and analyze drought-related information in a timely and systematic manner; (ii) establish criteria for declaring drought emergencies and triggering various mitigation and response activities; (iii) provide an organizational structure and delivery system that assures information flow between and within levels of government; (iv) define the duties and responsibilities of all ministries, departments, and NGOs with respect to drought; (v) maintain an inventory of government programs previously used and available to respond to drought emergencies; (vi) identify the most drought-prone areas and vulnerable economic sectors, population groups, or environments; (vii) identify mitigation actions that can be taken to address vulnerabilities and reduce drought impacts; (viii) provide a mechanism to ensure timely and accurate assessment of drought's impacts on agriculture, industry, municipalities, wildlife, tourism and recreation, health, and other sectors; (ix) keep decision makers and the public informed of current conditions and mitigation and response actions by providing accurate, timely information; (x) establish and pursue a strategy to remove obstacles to the equitable allocation of water during shortages and establish requirements or provide incentives encouraging demand management; and (xi) establish a set of procedures to continually evaluate and exercise the drought mitigation plan with periodic revising so the plan will stay responsive to the needs of the country.

These objectives are an integral part of a drought mitigation plan developed through the application of the 10-step drought planning process which is described in detail by Wilhite *et al.* (2005). This planning process provides a set of guidelines or a checklist of the key elements of a drought plan and a process through which they can be adapted to any level of government (i.e., local, state or provincial, or national) or geographical setting as part of a natural disaster or sustainable development plan, integrated water resources plan, or as a stand alone drought mitigation plan. This planning process was based initially on interactions with many states in the United States and sought to incorporate their experiences and lessons learned. The process has gone through several iterations in the past decade in order to tailor it to specific countries or subsets of countries. It has also been the basis for discussions at a series of regional training workshops and seminars on drought management and preparedness held in the United States and throughout the world. With an increased interest in drought mitigation planning in recent years, this planning process has evolved to incorporate more emphasis on risk assessment and mitigation tools. One of the key attributes of this planning process is that it is intended to be generic and adaptable to any setting.

Like other hazards, the impacts of drought span economic, environmental, and social sectors and can be reduced through mitigation and preparedness. Because droughts are a normal part of climate variability for virtually all regions, it is important to develop plans to deal with these extended periods of water shortage in a timely, systematic manner as they evolve. To be effective, these plans must evaluate both a region's exposure and vulnerability to the hazard and incorporate these elements into a drought preparedness plan that is dynamic, evolving with societal changes. A comprehensive, integrated drought monitoring and early warning system is an integral part of drought preparedness planning.

Drought mitigation and preparedness

To reduce the recurring impacts of drought, some countries are striving to obtain a higher level of mitigation and preparedness through development of national disaster reduction platforms as part of efforts such as the Hyogo Framework for Action and the United Nations Convention to Combat Desertification, or as part of separate national initiatives (ISDR, 2007). Additional drought risk reduction work is also being implemented at the grassroots level by local NGOs, state or provincial governments, and concerned citizens.

Such efforts are aimed at identifying and implementing strategies in advance of drought to reduce the likelihood of negative effects when drought does occur (i.e., mitigation), and developing contingency action plans to implement as drought conditions evolve in order to effectively respond to the situation (i.e., preparedness).

Some of the factors that have contributed to the trend toward drought mitigation and preparedness policies are spiraling costs of impacts associated with drought, the complexity of impacts on sectors well beyond agriculture, increasing concerns over social and environmental well-being, rising water conflicts between users, and an increasing number of professional practitioners and policy makers that recognize the importance of drought mitigation and planning.

Another factor that has helped promote the trend for more emphasis on drought mitigation and preparedness is the availability of drought planning methodologies. These methodologies have helped provide guidance to drought planners. For example, methodologies have been developed by Wilhite (1991) and Knutson *et al.* (1998) of the National Drought Mitigation Center (NDMC) in the United States to assist planners in preparing for drought. These strategies were merged by Wilhite *et al.* (2000, 2005) to place a greater emphasis on risk analysis in drought planning. The resulting strategy provides a set of guidelines or a checklist of the key elements of a drought plan and a process through which they can be adapted to any level of government (i.e., local, state or provincial, or national) or geographical setting as part of a natural disaster or sustainable development plan, an integrated water resources plan, or stand-alone drought mitigation plan.

Climate change, with its threat of an increased frequency of drought events in the future, has also caused greater anxiety about the absence of drought preparedness. According to the Intergovernmental Panel on Climate Change (IPCC, 2007), freshwater availability in Central, South, East and Southeast Asia, particularly in large river basins, is projected to decrease as a result of

climate change, which, along with population growth and increasing demand arising from higher standards of living, could adversely affect more than a billion people by the 2050s. Furthermore, it is projected that crop yields could decrease up to 30% in Central and South Asia by the middle of the 21st century. Taken together and considering the influence of rapid population growth and urbanization, the risk of hunger is projected to remain very high in several developing countries. Endemic morbidity and mortality due to diarrheal disease primarily associated with floods and droughts are also expected to rise in East, South and Southeast Asia because of projected changes in the hydrological cycle associated with global warming. The IPCC findings also indicate dramatic changes in temperature and precipitation conditions for the Mediterranean region and a likely increase in drought frequency and intensity. Concomitant impacts on water supply and demand would also be expected to occur.

NDMC's 10-step drought planning process

The NDMC's 10-step drought planning process is illustrated in Fig. 4. As stated in Wilhite *et al.* (2000, 2005), steps 1-4 focus on making sure that the right people are brought together, have a clear understanding of the process, know what the drought plan should accomplish, and are supplied with adequate data to make fair and equitable decisions when formulating and writing the actual drought plan. Step 5 describes the process of developing an organizational structure for completion of the tasks necessary to prepare the plan. A detailed risk analysis is undertaken in conjunction with this step in order to construct a vulnerability profile for key economic sectors, population groups, regions, and communities, as well as to develop a list of recommended actions to reduce drought risk. Steps 6-7 detail the need for ongoing research and coordination between scientists and policy makers. Steps 8 and 9 stress the importance of promoting and testing the plan before the drought occurs. Finally, step 10 emphasizes revising the plan to keep it current and evaluating its effectiveness in the post-drought period. Although the steps are sequential, many of these tasks are addressed simultaneously under the leadership of a drought task force and its complement of committees and working groups. These steps, and the tasks included in each, provide a "checklist" that should be considered and may be completed as part of the planning process.

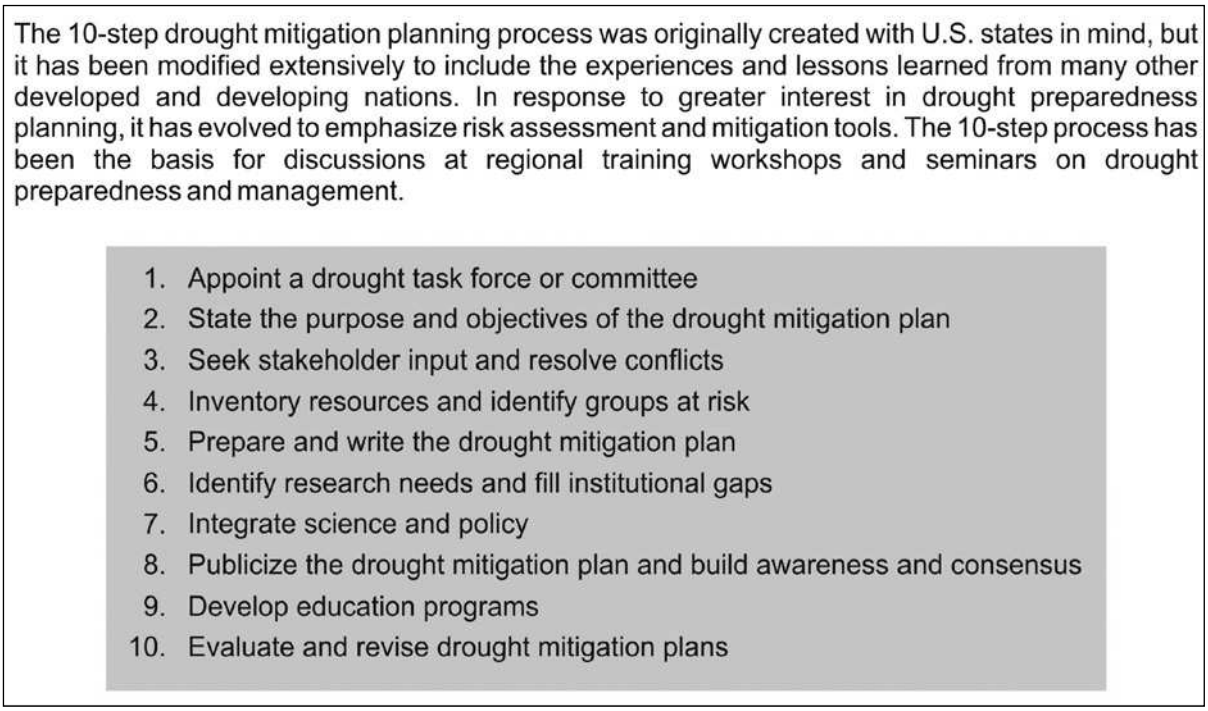

Fig. 4. The 10-step drought mitigation planning process, developed by the National Drought Mitigation Center (source: National Drought Mitigation Center, University of Nebraska-Lincoln).

To be effective, these plans must evaluate a region's drought risk and identify and implement proactive strategies to reduce the potential for negative effects. Drought risk is based on a combination of the threat of the hazard occurring (e.g., frequency, duration, and severity) and the vulnerability of the populations exposed to drought. Vulnerability can be defined as "the conditions determined by physical, social, economic, and environmental factors or processes, that increase the susceptibility of a community to the impact of hazards" (ISDR, 2007). Drought will cause different effects depending on the vulnerability of local people, institutions, and the environment. Similarly, the effects of drought can be reduced by taking proactive measures to reduce vulnerabilities.

Conclusions

Drought is the most complex of all natural hazards. The lack of progress in drought preparedness planning and the development of national drought policies is a reflection of this complexity. As countries move towards a higher level of preparedness, drought monitoring and early warning systems become paramount because these systems provide the information necessary to make timely decision regarding the management of water and other natural resources. Just as critically important is the development of delivery systems that provide decision makers at all levels and for all primary sectors with data and information that will assist them in making timely decisions. These decision support tools provide end users with information they need to reduce the most serious consequences of drought and reduce the need for government and donor intervention in the form of drought assistance and relief. The goal is to create more drought resilient societies. With the demand for water increasing because of expanding population, urbanization, changes in land use, and many other factors, the time to move to a more risk-based drought management approach is now. Given projected increases in temperature and uncertainties regarding the amount, distribution, and intensity of precipitation, the frequency, severity, and duration of drought may increase in the future. Developing improved drought monitoring and early warning systems in support of drought preparedness planning and policy is an urgent need for all drought-prone countries.

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