Moving Toward Drought Risk Management:
The Need for a Global Strategy

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Introduction

Drought is considered by many to be the most complex but least understood of all natural hazards, affecting more people than any other hazard (Hagman, 1984). However, there remains much confusion within the scientific and policy communities about its characteristics. It is precisely this confusion that explains, to some extent, the lack of progress in drought preparedness in most parts of the world.

Drought is a slow-onset, creeping natural hazard that is a normal part of climate for virtually all regions of the world; it results in serious economic, social, and environmental impacts. Drought onset and end are often difficult to determine, as is its severity. The impacts of drought are largely nonstructural and spread over a larger geographical area than are damages from other natural hazards. The nonstructural characteristic of drought impacts has certainly hindered the development of accurate, reliable, and timely estimates of severity and, ultimately, the formulation of drought preparedness plans by most governments. The impacts of drought, like those of other hazards, can be reduced through mitigation and preparedness.

Drought preparedness planning should be considered an essential component of integrated water resources management. Increasing society's capacity to cope more effectively with the extremes of climate and water resources variability (i.e., floods and droughts) is a critical aspect of integrated water resources management. Drought preparedness planning will

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also provide substantial benefit in preparing for potential changes in climate. Historically, more emphasis has been given to flood management than drought management. With increasing pressure on water and other natural resources because of increasing and shifting populations (i.e., regional and rural to urban), it is imperative for all nations to improve their capacity to manage water supplies during water-short years.

Drought risk is a product of a region's exposure to the natural hazard and its vulnerability to extended periods of water shortage (Wilhite, 2000a). If nations and regions are to make progress in reducing the serious consequences of drought, they must improve their understanding of the hazard and the factors that influence vulnerability. It is critical for drought-prone regions to better understand their drought climatology (i.e., the probability of drought at different levels of intensity and duration) and establish comprehensive and integrated drought EWSs that incorporate climate, soil, and water supply factors such as precipitation, temperature, soil moisture, snow pack, reservoir and lake levels, ground water levels, and stream flow.

Vulnerability to drought is dynamic and influenced by a multitude of factors, including increasing and regional shifts in population, urbanization, technology, government policies, land use and other natural resource management practices, desertification processes, water use trends, and increasing environmental awareness. Therefore, the magnitude of drought impacts may increase in the future as a result of an increased frequency of occurrence of the natural event (i.e., meteorological drought), changes in the factors that affect vulnerability, or a combination of these elements. All drought-prone nations should develop national drought policies and preparedness plans that place emphasis on risk management rather than following the traditional approach of crisis management, where the emphasis is on reactive, emergency response measures. Crisis management decreases self-reliance and increases dependence on government and donors.

Drought: The Concept

Drought is a normal, recurring feature of climate; it occurs in virtually all climatic regimes. Drought occurs in high as well as low rainfall areas and is a temporary aberration, in contrast to aridity, which is a permanent feature of the climate and is restricted to low rainfall areas. Drought is the consequence of a natural reduction in the amount of precipitation received over an extended period of time, usually a season or more in length, although other climatic factors (such as high temperatures, high winds, and low relative humidity) are often associated with it in many regions of the world and can significantly aggravate the severity of the event. Drought is also related to the timing (i.e., principal season of occurrence, delays in the start of the rainy season, occurrence of rains in relation to principal crop growth stages) and the effectiveness of the rains (i.e., rainfall intensity, number of rainfall events). Thus, each drought year is unique in its climatic characteristics. This factor complicates the estimation of impacts.

Drought differs from other natural hazards in several ways. First, since the effects of drought often accumulate slowly over a considerable period of time and may linger for years after the termination of the event, the onset and end of drought is difficult to determine. Because of this, drought is often referred to as a creeping phenomenon. Climatologists continue to struggle with recognizing the onset of drought and scientists and policy makers continue to debate the basis (i.e., criteria) for declaring an end to a drought.

Second, the absence of a precise and universally accepted definition of drought adds to the confusion about whether or not a drought exists and, if it does, its degree of severity.

Realistically, definitions of drought must be region and application (or impact) specific. This is one explanation for the scores of definitions that have been developed (Wilhite and Glantz, 1985). Although many definitions exist, many do not adequately define drought in meaningful terms for scientists and policy makers. For example, the thresholds for declaring drought are arbitrary in that they are not linked to specific impacts in key economic sectors. These types of problems are the result of a misunderstanding of the concept by those formulating definitions and the lack of consideration given to how other scientists or disciplines will eventually need to apply the definition in actual drought situations (e.g., assessments of impact in multiple economic sectors, drought declarations or revocations for eligibility to relief programs).

Third, drought impacts are nonstructural in contrast to floods, hurricanes, and most other natural hazards. Its impacts are spread over a larger geographical area than are damages that result from other natural hazards. For these reasons, the quantification of impacts and the provision of disaster relief are far more difficult tasks for drought than they are for other natural hazards. Emergency managers, for example, are more accustomed to dealing with impacts that are structural and localized, responding to these events by restoring communication and transportation channels, providing emergency medical supplies, ensuring safe drinking water, and so forth. These characteristics of drought have hindered the development of accurate, reliable, and timely estimates of severity and impacts and, ultimately, the formulation of drought contingency plans by most governments.

Fourth, several types of drought exist, and the factors or parameters that define it will differ from one type to another. For example, meteorological drought is principally defined by a deficiency of precipitation from expected or “normal” over an extended period of time, while agricultural drought is best characterized by deficiencies in soil moisture. This parameter is a critical factor in defining crop production potential. Hydrological drought, on the other hand, is best defined by deficiencies in surface and subsurface water supplies (i.e., reservoir and ground water levels, streamflow, and snowpack). These types of drought may coexist or may occur separately.

Drought severity is dependent not only on the duration, intensity, and spatial extent of a specific drought episode, but also on the demands made by human activities and vegetation on a region's water supplies. The characteristics of drought, along with its far-reaching impacts, make its effects on society, economy, and environment difficult to identify and quantify. This continues to represent a formidable challenge to those scientists involved in operational climate assessments.

Drought Characteristics and Severity

As previously stated, droughts differ from one another in three essential characteristics: intensity, duration, and spatial coverage. Intensity refers to the degree of the precipitation shortfall and/or the severity of impacts associated with the shortfall. It is generally measured by the departure of some climatic index from normal and is closely linked to duration in the determination of impact. Many indices of drought are in widespread use today, such as the decile approach (Lee 1979, Coughlan 1987) used in Australia, the Palmer Drought Severity Index and Crop Moisture Index (Palmer 1965 and 1968, Alley 1984) in the United States, and the Yield Moisture Index (Jose et al. 1991) in the Philippines and elsewhere. A relatively new index that has gained considerable popularity in the United States and worldwide is the Standardized Precipitation Index (SPI), developed by McKee et al. (1993 and 1995). The SPI will be discussed in greater detail in later sections of this chapter. This index is currently in use as a part of a routine monitoring program in more than 40 countries.

Another distinguishing feature of drought is its duration. Droughts usually require a minimum of two to three months to become established but then can continue for months or years. The magnitude of drought impacts is closely related to the timing of the onset of the precipitation shortage, its intensity, and the duration of the event. As droughts extend from one season to another and from one year to another, the potential impacts become much greater since surface and subsurface water supplies continue to be depleted and a larger number of users are affected. From an agricultural perspective, consecutive years of drought depletes farm income and places in serious jeopardy the financial solvency of farm or ranch operations.

Droughts also differ in terms of their spatial characteristics. The areas affected by severe drought evolve gradually, and regions of maximum intensity shift from season to season. During the drought of 1934 in the United States, the area affected was approximately 65 per cent of the country. By contrast, drought affected more than 95 per cent of the Great Plains region in 1934. In the United States, it is unusual for drought not to exist in a portion of the country each year. In the United States, the per cent area experiencing severe to extreme drought has usually been greater than 10 per cent for the period from 1895 to 2001. A recent analysis of drought occurrence by the U.S. National Drought Mitigation Center (NDMC) for the 48-contiguous states in the United States demonstrated that severe and extreme drought affected more than 25% of the country in one out of four years.

Drought Policy and Preparedness

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. Preparedness refers to pre-disaster activities designed to increase the level of readiness or improve operational and institutional capabilities for responding to a drought episode. Mitigation is short- and long-term actions, programs, or policies implemented during and in advance of drought that reduce the degree of risk to human life, property, and productive capacity. These actions are most effective if done before the event. Emergency response will always be a part of drought management because it is unlikely that government and others can anticipate, avoid, or reduce all potential impacts through mitigation programs. A future drought event may also exceed the "drought of record" and the capacity of a region to respond. However, emergency response should be used sparingly and only if it is consistent with longer term drought policy goals and objectives.

A national drought 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 EWSs and associated information delivery systems, developing preparedness plans at various levels of government, adopting mitigation actions and programs, and creating a safety net of emergency response programs that ensure timely and targeted relief.

The traditional approach to drought management has been reactive, relying largely on crisis management. This approach has been ineffective because response is untimely, poorly coordinated, and poorly targeted to drought stricken groups or areas. In addition, drought response is post-impact and relief tends to reinforce existing resource management methods. It is precisely these existing resource management practices that have often increased societal vulnerability to drought (i.e., exacerbated drought impacts). The provision of drought relief only serves to reinforce the status quo in terms of resource management. Many governments and others now understand the fallacy of crisis management and are striving to learn how to employ proper risk management techniques to reduce societal vulnerability to drought and, therefore, lessen the impacts associated with future drought events.

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 (i.e., crisis and risk management), rather than only the crisis management portion of this cycle. In the past, 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. As often occurs in drought-prone regions, another drought event is likely to occur before the region fully recovers from the last event. Past experience suggests that little attention has been given to the risk management portion of this cycle, i.e., preparedness, mitigation, and prediction/early warning actions that could reduce future impacts and lessen the need for government intervention in the future. Because of this emphasis on crisis management, society has generally moved from one disaster to another with little, if any, reduction in risk.

Two important trends in drought management are: (1) improved drought monitoring tools and early warning systems and (2) an increased emphasis on drought policy, preparedness, and mitigation. Recent trends in each of these areas are discussed below.

Monitoring Drought: *Unique Challenges and Recommendations*

Effective drought EWSs are an integral part of efforts worldwide to improve drought preparedness. Timely and reliable data and information must be the cornerstone of effective drought policies and plans. Monitoring drought presents some unique challenges because of droughts distinctive characteristics, as previously discussed. In addition, several types of drought exist, and the factors or parameters that define it will differ from one type to another. For example, meteorological drought is principally defined by a deficiency of precipitation from expected or "normal" over an extended period of time, while agricultural drought is best characterized by deficiencies in soil moisture. This parameter is a critical factor in defining crop production potential. Hydrological drought, on the other hand, is best defined by deficiencies in surface and subsurface water supplies (i.e., reservoir and ground water levels, streamflow, and snowpack). and impacts generally lag the occurrence of meteorological and agricultural drought. These types of drought may coexist or may occur separately.

An expert group meeting on early warning systems for drought preparedness sponsored by the World Meteorological Organization (WMO) and others recently documented the status of drought EWSs in several countries, the shortcomings and needs of drought EWSs, and recommendations on how these systems can help in achieving a greater level of drought preparedness (Wilhite et al., 2000). This meeting was organized as part of WMO's contribution to the UNCCD meeting in Bonn, Germany, in December 2000. This report documented recent efforts in drought EWS in countries such as Brazil, China, Hungary, India, Nigeria, South Africa, and the United States, but also noted the activities of regional drought monitoring centers in eastern and southern Africa and efforts in West Asia and North Africa. The shortcomings of current drought EWS were noted in the following areas:

$ *data networks*–inadequate density and data quality of meteorological and hydrological networks and the lack of data networks on all major climate and water supply parameters;
$ *data sharing*–inadequate data sharing between government agencies and the high cost of data limits the application of data in drought preparedness, mitigation, and response;
$ *early warning system products*–data and information products are often not user friendly and users are often not trained in the application of this information to decision making;
$ *drought forecasts*–unreliable seasonal forecasts and the lack of specificity of information provided by forecasts limit the use of this information by farmers and others;
$ *drought monitoring tools*–inadequate indices for detecting the early onset and end of drought, although the Standardized Precipitation Index (SPI) was cited as an important new monitoring tool;
$ *integrated drought/climate monitoring*–drought monitoring systems should be integrated and based on multiple indicators to fully understand drought magnitude, spatial extent, and impacts;
$ *impact assessment methodology*–lack of impact assessment methodology hinders impact estimates and the activation of mitigation and response programs;
$ *delivery systems*–data and information on emerging drought conditions, seasonal forecasts, and other products are often not delivered to users in a timely manner;

$ *global early warning system*–no historical drought data base exists and lack of a global drought assessment product based on one or two key indicators could be helpful to international organizations, NGOs, and others.

Participants of the expert group meeting on drought EWS made several recommendations. Those recommendations that pertained directly to early warning systems were that these systems were an integral part of an drought preparedness and mitigation plans and that priority should be given to improving existing observation networks and establishing new meteorological, agricultural, and hydrological networks.

Drought Policy and Preparedness

There are four key components of an effective drought risk reduction strategy (O'Meagher et al., 2000). These include the availability of timely and reliable information on which to base decisions; policies and institutional arrangements that encourage assessment, communication, and application of that information; a suite of appropriate risk management measures for decision makers; and actions by decision makers that are effective and consistent. In 1992, Australia adopted a National Drought Policy that applied these components through three objectives. These objectives were: (1) to encourage primary producers and other sections of rural Australia to adopt self-reliant approaches to managing for climatic variability; (2) to maintain and protect Australia=s agricultural and environmental resource base during periods of extreme climate stress; and (3) to ensure early recovery of agricultural and rural industries, consistent with long-term sustainable goals (O=Meagher et al., 2000). Australia=s national drought policy is widely known and its philosophy often replicated in other settings.

In the United States, there has been significant progress as well in addressing the impacts of drought through the development of preparedness plans. The most noticeable progress has been at the state level, where the number of states with drought plans has increased dramatically during the past two decades. In 1982, only three states had drought plans in place. In 2003, thirty-six states have developed plans and three states are at various stages of plan development. The basic goal of state drought plans should be to improve the effectiveness of preparedness and response efforts by enhancing monitoring and early warning, risk and impact assessment, and mitigation and response. Plans should also contain provisions (i.e., an organizational structure) to improve coordination within agencies of state government and between local and federal government. Initially, state drought plans largely focused on response efforts aimed at improved coordination and shortening response time; today the trend is for states to place greater emphasis on mitigation as the fundamental element of a drought plan. Thus, many plans are more pro-active, adopting a more risk management approach to drought management.

The growth in the number of states with drought plans suggests an increased concern at that level about the potential impacts and conflicts associated with extended water shortages and an attempt to address those concerns through planning. Initially, states were slow to develop drought plans because the planning process was unfamiliar. With the development of drought planning models (Wilhite, 1991; Wilhite et al., 2000) and the availability of a greater number of drought plans for comparison, drought planning has become a less mysterious process for states. As states initiate the planning process, one of their first actions is to study the drought plans of other states to compare methodology and organizational structure.

The rapid adoption of drought plans by states is also a clear indication of their benefits. Drought plans provide the framework for improved coordination within and between levels of government. Early warning and monitoring systems are more comprehensive and integrated and the delivery of this information to decision makers at all levels is enhanced. Many states are now making full use of the Internet to disseminate information to a diverse set of users and decision makers. Through drought plans, the risks associated with drought can be better defined and addressed with proactive mitigation and response programs. The drought planning process also provides the opportunity to involve numerous stakeholders early and often in plan development, thus increasing the probability that conflicts between water users will be reduced during times of shortage. All of these actions can help to improve public awareness of the importance of water management and the value of protecting our limited water resources.

With the tremendous advances in drought planning at the state level in the United States in recent years, it should come as no surprise that states have been extremely frustrated and dissatisfied with the lack of progress at the federal level. Early into the 1995-1996 drought that affected a large portion of the southwestern and south-central portions of the country, the lack of leadership and coordination at the federal level quickly became obvious and continued with subsequent drought episodes. Recent initiatives toward development of a national drought policy are the direct result of those frustrations (Wilhite, 2001).

The U.S. Congress and the president are currently considering actions that could be taken in response to recommendations issued in May 2000 by the National Drought Policy Commission (NDPC). These recommendations were in response to the National Drought Policy Act, passed by the U.S. Congress in July 1998 and directed at developing a national drought policy that would emphasize preparedness and mitigation in future drought management efforts. One of the NDPC=s recommendations strongly endorses drought planning at all levels of government. An interim National Drought Council has been formed, composed of federal and nonfederal members, and it is expected that legislation will be introduced in 2003 that will lead to a more permanent national drought council and a national drought policy.

Summary and Future Challenges

Drought is an insidious natural hazard that is a normal part of the climate of virtually all regions. It should not be viewed as merely a physical phenomenon. Rather, drought is the result of an interplay between a natural event and the demand placed on water supply by human-use systems.

There are many challenges before us if we are to improve our management of droughts. First, drought must be accepted as a natural hazard within the natural hazard community of scientists and policy makers. Because of its slow-onset characteristics and lack of structural impacts, it is often disregarded. This lack of recognition of the importance of drought by the natural hazards community has been an impediment to obtaining adequate research support and, in many instances, an obstacle to building awareness among policy makers at the local, national, regional, and international level. This lack of awareness in turn has resulted in an underappreciation of drought and its far-reaching impacts. It has also perpetuated the process of dealing with drought in a crisis management mode when the knowledge and technology necessary to improve preparedness and mitigation impacts is readily available.

A second challenge is to build awareness of drought as a normal part of climate. It is often considered to be a rare and random event–thus the lack of emphasis on preparedness and mitigation. Improved understanding of the different types of drought and the need for multiple definitions and climatic/water supply indicators that are appropriate to various sectors, applications, and regions is a critical part of this awareness-building process.

A third challenge is to erase misunderstandings about drought and society's capacity to mitigate its effects. Many people consider drought to be purely a physical phenomenon. We may ask, If drought is a natural event, what control do we have over its occurrence and the impacts that result? Drought originates from a deficiency of precipitation over an extended period of time. The frequency or probability of occurrence of these deficiencies varies spatially and represents a location's exposure to the occurrence of drought. Some regions have greater exposure than others, and we do not have the capacity to alter that exposure.

As with other natural hazards, drought has both a physical and social component. It is the social factors, in combination with our exposure, that determines risk to society. Some of the social factors that determine our vulnerability are level of development, population growth and its changing distribution, demographic characteristics, demands on water and other natural resources, government policies (sustainable versus nonsustainable resource management), technological changes, social behavior, and trends in environmental awareness and concerns. It is obvious that well-conceived policies, preparedness plans, and mitigation programs can greatly reduce societal vulnerability and, therefore, the risks associated with drought.

A fourth challenge is to convince policy and other decision makers that investments in mitigation are more cost effective than post-impact assistance or relief programs. Evidence from around the world, although sketchy, illustrates that there is an escalating trend of losses associated with drought in both developing and developed countries. Also, the complexity of impacts is increasing. It seems clear that investments in preparedness and mitigation will pay large dividends in reducing the impacts of drought. A growing number of countries are realizing the potential advantages of drought planning. Governments are formulating policies and plans that address many of the deficiencies noted from previous response effortsBefforts that were largely reactive. Most of the progress made in drought preparedness and mitigation has been accomplished in the past decade or so. Although the road ahead will be difficult and the learning curve steep, the potential rewards are numerous. The crisis management approach of responding to drought has existed for many decades and is ingrained in our culture and reflected in our institutions. Movement from crisis to risk management will certainly require a paradigm shift. The victims of drought have become accustomed to government assistance programs. In many instances, these misguided and misdirected government programs and policies have promoted the nonsustainable use of natural resources. Many governments have now come to realize that drought response in the form of emergency assistance programs only reinforces poor or nonsustainable actions and increases self reliance.

Policies that encourage self-reliance and the sustainable use of natural resources will be more effective in the long term and will reduce the need for government and donor intervention. A critical first step is to identify and quantify the sectors and peoples at risk from drought. Once this step is completed, policies, plans, and mitigation programs can be formulated to address these vulnerabilities in a systematic manner.

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