

Drought Planning and Risk Assessment: Status and Future Directions

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Abstract: Although drought is a normal, recurring feature of climate, little progress has been made in drought management in most parts of the world. The progress in drought planning that has been achieved in some countries and regions can be useful for other drought-prone regions. In this paper, a drought planning process, originally developed in 1991 for state-level government in the United States, is suggested as a model for governments at various levels to follow in the development of a drought plan. The process, which emphasizes risk management rather than crisis management, is based on the three primary components of a drought plan: monitoring and early warning; risk and impact assessment; and mitigation and response. The steps in the process are generic and easily adaptable to all drought-prone regions.

Key words: Drought planning, drought policy, drought risk management, drought early warning, drought mitigation

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). For example, in Sub-Saharan Africa, the droughts of the early to mid-1980s were reported to have adversely affected more than 40 million people (Office of Foreign Disaster Assistance, 1990). The 1991-92 drought in southern Africa affected 20 million people and resulted in a deficit of cereal supplies of more than 6.7 million tons (SADCC, 1992). Lessons from developed and developing countries demonstrate that drought results in significant impacts, regardless of level of development, although the character of these impacts will differ profoundly (Subbiah, 1993; Benson and Clay, 1998 and 2000; Wilhite, 2000a; Wilhite and Vanyarkho, 2000).

Drought is a normal feature of climate and its recurrence is inevitable. However, there remains much confusion within the scientific and policy community about its characteristics. It is precisely this confusion that explains, to some extent, the lack of progress in drought management in most parts of the world. The purpose of this paper is fourfold. First, an overview of the concept of drought will be provided to help readers understand the complexity of the hazard. Second, the status of drought preparedness and drought policy and planning will be discussed in the context of the United States, particularly at the state level. Third, a review of the status and progress in selected sub-Saharan African countries will be included and compared to the experiences of the United States. Finally, drought policy and planning needs will be discussed in the context of a 10-step drought planning process first published in 1991 (Wilhite,

1991) and subsequently revised and updated for various audiences (Wilhite, 1992a and 1996; Wilhite *et al.*, 1999). The goal is to demonstrate how this planning methodology could be employed, with appropriate modifications, to address future drought policy and planning needs in other drought-prone regions.

Drought as a Natural Hazard

Drought differs from other natural hazards such as floods, tropical cyclones, and earthquakes in several ways. First, the onset and end of drought are difficult to determine because the effects of drought accumulate slowly over a considerable period of time and may linger for years after the termination of the event. Hence, drought is often referred to as a creeping phenomenon. Second, the absence of a precise and universally accepted definition of drought adds to the confusion, both in terms of recognition and its degree of severity. Realistically, definitions of drought must be region, application, or impact specific. This is one explanation for the scores of definitions that have been developed. Wilhite and Glantz (1985) analyzed more than 150 definitions in their classification study, and many more exist. Third, drought impacts are 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 contingency plans by most governments.

Drought is a normal, recurring feature of climate; it occurs in virtually all climatic regimes. It occurs in high as well as low

rainfall areas. It is a temporary aberration, in contrast to aridity, which is a permanent feature of climate in low rainfall areas (Bruins and Berliner, 1998). Drought is the consequence of a natural reduction in the amount of precipitation during an extended period of time, usually a season or more in length. Other climatic factors such as high temperatures, high winds, and low relative humidity are often associated with drought. These factors can significantly aggravate the severity of the event. Drought is also related to the timing and effectiveness of the rains: principal season of occurrence, delays in the start of the rainy season, occurrence of rains in relation to principal crop growth stages, rainfall intensity, and number of rainfall events. Thus, each drought year is unique in its climatic characteristics and impacts.

Drought severity is dependent not only on the duration, intensity, and geographical 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 it difficult, although not impossible, to identify and quantify its effects on society, economy, and environment.

Drought has both a natural and social component (Fig. 1). The risk associated with drought for any region is a product of both the region's exposure to the event (i.e., probability of occurrence at various severity levels) and the vulnerability of society to the event. The natural event (i.e., meteorological drought) is a result of the occurrence of persistent large-scale disruptions in the global circulation pattern of the atmosphere. Exposure to drought varies

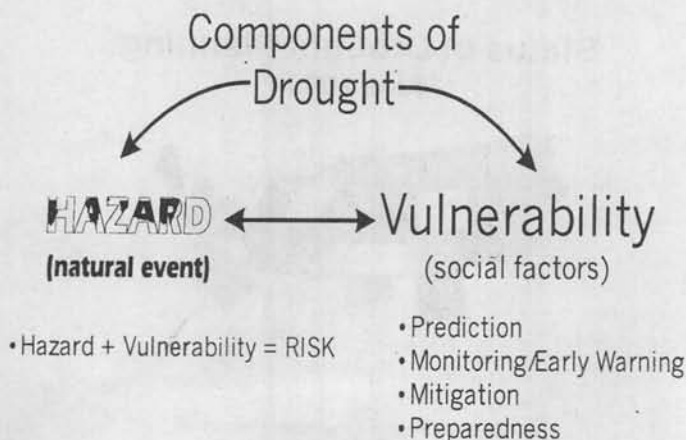


Fig. 1. Components of Drought.

spatially and there is little, if anything, that we can do to alter drought occurrence. Vulnerability, on the other hand, is determined by social factors such as population, demographic characteristics, technology, policy, and social behavior. These factors change over time, and thus vulnerability is likely to increase or decrease in response to these changes. Subsequent droughts in the same region will have different effects, because societal characteristics will have changed. The thrust of the discussion included in this paper is to emphasize that much can be done to lessen societal vulnerability to drought through proactive preparedness and response planning.

Progress in Drought Policy and Planning in the United States

Since 1982, there has been a rapid development of drought plans by state governments in the United States. In 1982, only three states (Colorado, New York, and South Dakota) had completed drought plans. In 2000, thirty states have drought plans in place, and Texas, Hawaii, Arizona,

Louisiana, Georgia, and Massachusetts are moving forward with plan development (Fig. 2). Numerous state drought plans are available through the National Drought Mitigation Center's web site (<http://enso.unl.edu/ndmc/>). Most state drought plans place primary emphasis on response (i.e., post-impact programs and actions), largely because there was little understanding of how drought-related impacts could be reduced through mitigative actions when these plans were first developed in the 1980s. Also, states have traditionally relied on the federal government to provide disaster assistance during periods of severe drought. Today, most states give some attention to mitigation, although this emphasis is quite variable from state to state. Mitigation is at the foundation of the drought plan recently developed by New Mexico. Utah and Nebraska have revised existing plans to place more emphasis on mitigation, and Texas and Georgia are emphasizing mitigation in plans currently under development. In the early years of state-level drought planning, Colorado's drought plan served as a model for others

Status of Drought Planning June 2000



Fig. 2. Status of Drought Planning.

to emulate, and many states borrowed heavily from its organizational structure and operating procedures. Other states that place more emphasis on mitigation are now serving as models.

The basic goal of state drought plans is to improve the effectiveness of state response efforts by enhancing monitoring and early warning, risk and impact assessment, and response and mitigation programs. Plans are also directed at improving co-ordination within agencies of state government and between state and federal government. The growth in the number of states with drought plans demonstrates an increased concern about the potential impacts of extended water shortages and the complexity of those impacts. Drought plans are at the foundation of improved drought management in the United States, but only if they emphasize risk assessment and mitigation programs and actions.

Local, federal, and tribal governments are also giving greater attention to drought planning. Local drought or water shortage planning efforts in several states have been the direct result of state-level planning efforts. State drought plans often require local water suppliers to develop a drought plan that follows certain precise guidelines in order to be approved by the state. At the federal level, the US 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 Congress in July 1998 and directed at development of 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.

Drought Preparedness Status in Sub-Saharan Africa

Drought is a major threat to sustainable livelihoods in many parts of sub-Saharan Africa, in particular in dryland areas of arid and semi-arid regions (Glantz, 1987). Recent drought events have had serious economic, social, and environmental consequences and have resulted in land degradation, human migrations or relocations, famine, diseases, and loss of human life (UNDP/UNSO, 2000). In 1986, approximately 185 million people living in the dryland areas of Africa were at risk and 30 million were immediately threatened (Keck and Dinar, 1994). It is estimated that 65 million ha of productive land have become desertified on the southern edge of the Sahara in the past 50 years (United Nations, 1986). Drought has affected nearly all of the countries in western, eastern, and southern Africa in the past two decades, and in many cases on more than one occasion. These droughts have resulted in a recurring deficiency of food supplies and the need for interventions by governments and international donors to alleviate food shortages to avert major losses of human life. For example, the 1991-92 drought in southern Africa resulted in a deficit of more than 6.7 million tons of cereal supplies, which affected more than 20 million people (Keck and Dinar, 1994). Past drought response programs have been reactive and have done little, if anything, to reduce the impacts of future droughts.

In 1997, a project was initiated under sponsorship of UNDP/UNSO (2000) to assess the status of drought preparedness and mitigation activities in selected sub-Saharan African countries. UNDP/UNSO commissioned country and regional

consultants to prepare country and regional assessments. Before these reports were initiated, a set of guidelines was prepared for each country and regional consultant to follow to ensure a greater level of consistency in the final products. This approach not only facilitated assessment but also simplified synthesis of this material.

The conclusions summarized here are drawn from 11 southern African countries: Angola, Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, South Africa, Swaziland, Zambia, and Zimbabwe. Three main questions were addressed as part of this summarization process. First, what is the status of drought preparedness (i.e., institutional capacity) within each country? Second, what constraints exist with regard to policy and plan development? Third, what are the primary drought policy and planning needs? These questions were evaluated from the perspective of the critical components of a drought preparedness plan (Wilhite, 2000b): (1) monitoring and early warning, (2) risk and impact assessment, and (3) mitigation and response.

Common themes on the current status of drought preparedness and institutional capacity in sub-Saharan Africa included the following:

- there is no permanent government body to deal with drought issues;
- drought response is often coordinated through natural disaster authority;
- drought relief is directed toward human relief, protection of key assets, and recovery;
- post-drought evaluation of response is not usually undertaken;

- formal drought plans are rare and mainly directed at response actions;
- drought and famine early warning systems commonly co-exist;
- vulnerability assessments often exist for sectors, groups, and areas at risk;
- mitigation actions focus on economic diversification and poverty reduction;
- drought management is increasingly viewed as part of the development process; and
- drought policies are usually lacking.

As expected, there is a wide range of institutional capacity to respond to drought emergencies in southern Africa. Although some countries have a detailed organizational structure in place to coordinate the actions of government at various levels, as well as those of donors and non-governmental organizations (NGOs), most have not developed a permanent institutional capacity. One of the common problems with drought and other natural hazards is maintaining interest in planning beyond the relatively short window of opportunity that follows the event, given the on-again, off-again nature of drought. Interest in drought planning quickly wanes in the post-drought period when precipitation conditions have returned to normal or above-normal levels.

Botswana and South Africa clearly stand apart from the other countries included in this assessment in terms of their experiences and current status of drought planning. Although Botswana does not have an identified drought policy and plan, it has had a long history with various types of drought programmes. Drought preparedness planning is part of development planning

and institutional structure is well defined, with local involvement at the district level. In South Africa, the National Consultative Drought Forum was established in 1992 and is made up of representatives of government, church organizations, trade unions, and NGOs. The Forum has led to a shift from an exclusive emphasis on commercial farmers to a more comprehensive program that includes rural farmers, rural poor, and farm workers. Policy changes included greater equity for recipients of assistance. Drought policies have increasingly focused on improving levels of self-reliance, reducing risk in the agricultural sector, and stabilizing income. The National Drought Management Committee was established in 1995 with similar structures at the provincial and local levels of government. The primary objectives of this committee are to develop national disaster management policy, propose and review new legislation, promote community participation in disaster management, promote the establishment of an integrated disaster information system, and ensure risk reduction at the national level. The current government in South Africa is looking at additional drought policy revisions (Department of Constitutional Development, 1999).

No drought policy or plan currently exists in Angola, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Swaziland, Zambia, or Zimbabwe, although some infrastructure does exist in most of these countries to respond to drought conditions, but usually on a reactive or ad-hoc crisis management basis. Two early warning systems are often in place, one focusing on monitoring climate and water supply conditions and the other emphasizing issues associated with food

security. Vulnerable sectors, peoples, or regions have been identified in many of these countries but mitigation actions and programs have been limited. Mitigation actions are defined as actions instituted in advance of or during drought that reduce the impacts from the event. Response actions are generally a joint effort between government authorities, donors, NGOs, and others. Most of the countries mentioned above have made considerable progress in coordinating and incorporating the capacities of donors and NGOs in drought-related emergency responses. For example, in Swaziland, a consortium of NGOs has been identified to address the needs of vulnerable population groups.

Numerous constraints to drought policy and plan development were identified in the country reports. These included:

- poor quality of meteorological networks
- minimal understanding of drought impacts
- lack of institutional capacity
- low level of involvement by NGOs in drought management
- lack of understanding of household vulnerability
- inadequate financial resources for drought management and human resources development
- need for expanded extension services
- inequitable access to land
- limited coordination between government agencies
- reduced response/mitigation capability due to lack of drought policy and plan

Many of these constraints are addressed directly in the 10-step drought planning process discussed in the next section of this paper.

Future drought policy and planning needs were also identified in the country reports. Many of these needs are aimed at addressing the constraints referred to previously. In many countries it was reported that recommendations on drought policies and specific mitigation actions had been made in government reports or as a result of workshops focused on future drought planning and response needs. In many cases, however, these recommendations have not been implemented. For example, Namibia has developed a series of drought policy recommendations based on the elements of the 10-step drought planning process. The goal of the Namibian policy is to develop an efficient, equitable, and sustainable approach to drought management that shifts responsibility from government to the farmer. The tenets of that policy are to (1) ensure household food security is not compromised by drought; (2) encourage and help farmers adopt a self-reliant approach to drought risk; (3) preserve reproductive capacity of the national livestock herd during drought; (4) ensure a continuous supply of potable water to communities and livestock; (5) prevent degradation of the natural resource base; (6) enable rural inhabitants and the agricultural sector to recover quickly following drought; (7) ensure the health status of all Namibians; and (8) finance drought relief programs efficiently by establishing an independent and permanent national drought fund.

Increased interagency coordination and the need to enhance institutional capacity

were also considered important. Other needs identified included creation of a permanent national drought fund in support of mitigation and response measures, expanded meteorological networks and more comprehensive early warning systems, improved vulnerability assessments and vulnerability tracking systems, increased community participation and involvement, expanded NGO involvement in drought management, and the development of strategic grain reserves.

Methodology for Drought Preparedness Planning

In 1991, a 10-step planning process for states in the United States was published as a methodology for drought plan development (Wilhite, 1991). This process was intended to be generic and adaptable to the needs of any level of government in any drought-prone region. This process has been widely disseminated at workshops and conferences in the United States and internationally as well as through the literature (Wilhite, 1992b; 1996 and 2000b). The influence of the planning process is clearly evident in plans that have been or are being developed at various levels of government in every drought-prone region. The recent UNDP/UNSO (2000) review includes a review of the 10-step planning process and an assessment of the status of drought preparedness and mitigation in sub-Saharan Africa. This review provides clear evidence of the influence of the 10-step planning process in attempts by many countries to become better prepared for future drought events. The original planning process (Wilhite, 1991), although recognizing the need for developing mitigation tools to reduce the impacts of drought, did not place as

much emphasis on mitigation as is warranted today, given the growing emphasis on risk management in addressing the impacts associated with natural hazards. When first published, this planning process focused more attention on improving governmental response to drought emergencies through the development of greater institutional capacity directed at creating an appropriate organizational structure, improving monitoring capability, defining a more explicit decision-making authority for implementing response measures, and improving information flow and coordination between and within levels of government.

The 10-step planning process was presented and used as a basis for discussions on drought planning at a series of regional drought training seminars organized by the International Drought Information Center, University of Nebraska (Wilhite, 1996). These seminars were held in eastern and southern Africa, Asia, and Latin America from 1989 to 1993, with sponsorship from the UN Environment Program, World Meteorological Organization, and US National Oceanic and Atmospheric Administration. One of the challenges presented to participants at these training seminars was to modify the 10-step planning process to best fit the needs of participating countries. Following this series of workshops, the planning process was published by the UN Environment Program (Wilhite, 1992a). This process continues to be revised (Wilhite, 1996 and 2000b; Wilhite *et al.*, 1999) as necessary to keep the process current. Drought planning workshops conducted by the National Drought Mitigation Center (NDMC) in the United States, Mexico, Brazil, Morocco,

Hungary, and South Africa since 1997 have also used the 10-step process as an organizational tool to facilitate the development of drought preparedness plans with mitigation and risk assessment as key components.

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. For example, losses associated with natural hazards in the United States averaged more than \$54 billion per year between 1992 and 1996 (Carolwicz, 1996), and the Federal Emergency Management Agency (FEMA, 1995) estimates annual losses because of drought in the United States at \$6-8 billion per year. Mitigating the effects of drought requires the use of all components of the cycle of disaster management (Fig. 2), rather than only the crisis management portion of this cycle. In the past, when a natural hazard event and resultant disaster has occurred, governments have followed with impact assessment, response, recovery, and reconstruction activities to return the region or locality to its pre-disaster state. 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 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. In fact, many response

measures instituted by governments, international organizations, and donors have actually increased vulnerability by increasing dependency on internal or external assistance. All components of the cycle of disaster management should be addressed in a comprehensive hazards mitigation plan, but greater attention needs to be placed on pre-disaster activities than has occurred in the past.

The country and regional reports from the UNDP/UNSO project cited above show that the evolving organizational structures for drought management in Africa are similar to those found in the United States and elsewhere. The goal of the 10-step planning process (Fig. 3) is to derive a plan that

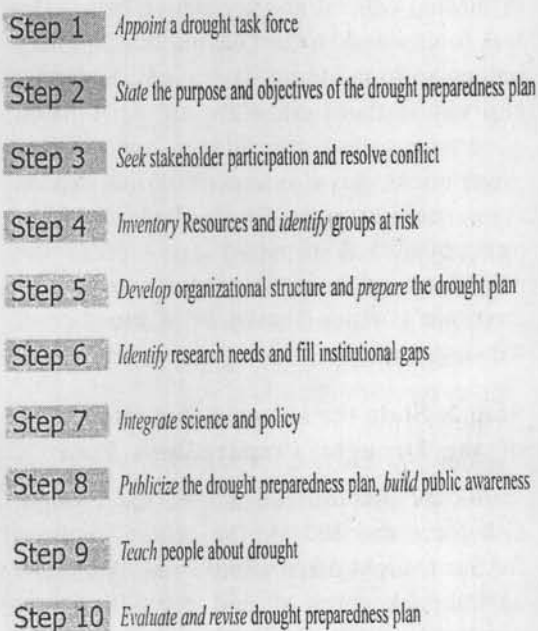
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- Step 1 *Appoint a drought task force*
 - Step 2 *State the purpose and objectives of the drought preparedness plan*
 - Step 3 *Seek stakeholder participation and resolve conflict*
 - Step 4 *Inventory Resources and identify groups at risk*
 - Step 5 *Develop organizational structure and prepare the drought plan*
 - Step 6 *Identify research needs and fill institutional gaps*
 - Step 7 *Integrate science and policy*
 - Step 8 *Publicize the drought preparedness plan, build public awareness*
 - Step 9 *Teach people about drought*
 - Step 10 *Evaluate and revise drought preparedness plan*

Fig. 3. 10-Step Planning Processing.

is dynamic, reflecting changing government policies, technologies, natural resources

management practices, and so forth. It is intended to serve as a checklist to identify the issues that should be addressed in plan development, with appropriate modifications. An overview of the steps included in the planning process follows.

Step 1: Appoint Drought Task Force

The drought planning process is initiated through the appointment of a drought task force. The task force has two purposes. First, the task force will supervise and coordinate plan development. Second, after the plan is developed and during times of drought when the plan is activated, the task force will coordinate actions, implement mitigation and response programs, and make policy recommendations to the appropriate person or elected official and legislative body. The task force should reflect the multidisciplinary nature of drought and its impacts, including representatives of state or provincial government, districts, villages, and national government. It is also imperative that experts from universities be included where appropriate. A representative from the president or prime minister's office or governor's office should be a member of the task force.

Step 2: State the Purpose and Objectives of the Drought Preparedness Plan

As its first official action, the drought task force should state the general purpose for the drought preparedness plan. Members of the task force should consider many questions as they define the purpose of the plan, such as the:

- purpose and role of government in drought mitigation and response efforts;
 - scope of the plan;
 - most drought-prone areas;
 - most vulnerable economic and social sectors;
 - role of the plan in resolving conflict between water users and other vulnerable population groups during periods of shortage;
 - current trends (e.g., land and water use, population growth) that may increase/decrease vulnerability and conflicts in the future;
 - resources (human and economic) that the government and others are willing to commit to the planning process;
 - legal and social implications of the plan; and
 - principal environmental concerns caused by drought.
- A generic statement of purpose is to provide government with an effective and systematic means of assessing drought conditions, developing mitigation actions and programs to reduce risk in advance of drought, and developing response options that minimize economic stress, environmental losses, and social hardships during drought.
- The task force should then identify the specific objectives of the plan. Drought plan objectives will, of course, vary between countries and should reflect unique physical, environmental, socioeconomic, and political characteristics. Objectives that government should consider include the following:
- Collect, analyze and disseminate drought-related information in a timely and systematic manner.

- Establish criteria for declaring drought and triggering various mitigation and response activities.
- Provide an organizational structure that assures information flow between and within levels of government, as well as with nongovernmental organizations, and define the duties and responsibilities of all agencies with respect to drought.
- Maintain a current inventory of drought assistance programs used in assessing and responding to drought emergencies, and provide a set of appropriate action recommendations.
- Identify drought-prone areas and vulnerable sectors, population groups, and environments.
- Identify mitigation actions that can be taken to address vulnerabilities and reduce drought impacts.
- Provide a mechanism to ensure timely and accurate assessment of drought's impacts on agriculture, livestock production, industry, municipalities, wildlife, health, and other areas, as well as specific population groups.
- Keep the public informed of current conditions and response actions by providing accurate, timely information to media in print and electronic form.
- Establish and pursue a strategy to remove obstacles to the equitable allocation of water during shortages and provide incentives to encourage water conservation.
- Establish a set of procedures to continually evaluate and exercise the plan and periodically revise the plan so it will stay responsive to the needs of

the people and government ministries.

Step 3: Seek Stakeholder Participation and Resolve Conflict

Social, economic, and environmental values often clash as competition for scarce water resources intensifies. Therefore, it is essential for task force members to identify all citizen groups that have a stake in drought planning (stakeholders) and their interests. These groups must be involved early and continuously to enable fair representation and effective drought management and planning. Airing concerns early in the process gives participants a chance to develop understanding of one another's various viewpoints, and to generate collaborative solutions.

Step 4: Inventory Resources and Identify Groups at Risk

An inventory of natural, biological, and human resources, including the identification of constraints that may impede the planning process, may need to be initiated by the task force. The amount and variety of information available will vary considerably between settings. It is important to determine the vulnerability of these resources to periods of water shortage that result from drought. *Resources* include, for example, physical and biological resources, infrastructure, and capital available to government. The most obvious natural resource of importance is water: where is it located, how accessible is it, of what quality is it? *Biological resources* refer to the quantity and quality of grasslands/rangelands, forests, wildlife, and so forth. *Human resources* include the labor needed to develop water resources, lay pipeline, haul water and livestock feed,

process citizen complaints, provide technical assistance, and direct citizens to available services. In addition, representatives of government determine what local, state/provincial, federal/national agencies, or NGOs may need to be enlisted for action.

In drought preparedness planning, making the transition from crisis to risk management is difficult because, historically, little has been done to understand and address the risks associated with drought. To solve this problem, areas of high risk should be identified, as should actions that can be taken before a drought occurs to reduce those risks. Risk is defined by both the exposure of a location to the drought hazard and the vulnerability of that location to periods of drought-induced water shortages (Blaikie *et al.*, 1994). Drought is a natural event; it is important to define the exposure (i.e., frequency of drought of various intensities and durations) of various parts of the country to the drought hazard. Some areas are likely to be more at risk than others. Vulnerability, on the other hand, is defined by social factors such as land use patterns, government policies, social behavior, water use, population, economic development, diversity of economic base, cultural composition, and so forth. The drought task force should address these issues early in the planning process so they can provide more direction to the committees and working groups that will be developed under Step 5 of the planning process.

Step 5: Prepare/Write Drought Preparedness Plan

This step describes the process of establishing relevant committees to develop

the plan's components and write the plan. The drought preparedness plan should have three primary components: monitoring and early warning, risk and impact assessment, and mitigation and response. It is recommended that a committee be established to focus on the first two needs; the mitigation and response function can in most instances be carried out by the drought task force after receiving input from the other committees. These committees will have their own tasks and goals, but well-established communication and information flow between committees is still a necessity to ensure effective planning.

Monitoring committee

A reliable assessment of water availability and its outlook for the near- and long-term is valuable information in both dry and wet periods. During a drought, the value of this information increases. The monitoring committee should include representatives from agencies with responsibilities for monitoring climate and water supply, traditionally meteorological, hydrological, and agricultural services. It is recommended that data and information on each of the relevant indicators (e.g., precipitation, temperature, evapotranspiration, long-range weather forecasts, soil moisture, streamflow, ground water, reservoir and lake levels, and snowpack) be considered in the committee's evaluation of the water situation and outlook for the country. The agencies responsible for collecting, analyzing, and disseminating data and information will vary according to each country's infrastructure. The monitoring committee should meet regularly, especially in advance of the peak demand season.

Following each meeting, reports should be prepared and disseminated to the drought task force, as well as to donors/NGOs and the media. The chairperson of the monitoring committee should be a permanent member of the drought task force. In many countries, this will be someone from the department of meteorological services. If conditions warrant, the task force would brief the prime minister or president about the contents of the report, including any recommendations for specific actions. It is essential for the public to receive a balanced interpretation of changing conditions. The monitoring committee should work closely with public information specialists to keep the public well informed.

The primary objectives of the monitoring committee are as follows:

- Adopt a workable definition of drought that could be used to phase in and phase out drought assistance programs initiated in response to drought. It may be necessary to adopt more than one definition of drought in identifying impacts in various economic, social, and environmental sectors.
- Establish drought management areas (i.e., subdivide the country into more conveniently sized districts by political boundaries, shared hydrological characteristics, climatological characteristics, or other means such as drought probability or risk).
- Develop a drought monitoring system. Responsibility for collecting, analyzing, and disseminating the data is often divided among various ministries or agencies. The monitoring committee's challenge is to coordinate and integrate

the analysis so decision makers and the public receive early warning of emerging drought conditions. Drought early warning systems and other complementary systems to monitor food security/famine issues are in place in many countries.

- Inventory quantity and quality of data from current observation networks. A variety of networks exist that monitor key elements of the hydrologic system. Meteorological data are important but represent only one part of a comprehensive monitoring system. Other physical indicators must be monitored to reflect impacts of drought on agriculture, households, industry, energy production, and other water users.
- Determine the data needs of primary users. Soliciting input on expected new products or obtaining feedback on existing products is critical to ensuring that products meet the needs of primary users and therefore will be used in decision making. Training on how to use or apply products in routine decision making is also essential.
- Develop and/or modify current data and information delivery systems. People need to be warned of drought as soon as it is detected, but often are not. Information needs to reach people in time for them to use it in making decisions.

Risk assessment committee

Drought impacts cut across many sectors and across normal divisions of responsibility for government ministries. These impacts have been classified by Wilhite and Vanyarkho (2000). As discussed in Step

4, impacts are the result of exposure to the drought hazard (i.e., probability of occurrence) and a combination of economic, environmental, and social factors. Therefore, to reduce vulnerability to drought, it is essential to identify relevant impacts and assess their underlying causes.

Information on drought's impacts and their causes is crucial for reducing risk before drought occurs and for appropriate response during drought. The membership of the risk assessment committee should represent economic sectors, social groups, and ecosystems most at risk from drought. The committee's chairperson should be a member of the drought task force.

The most effective approach to follow in determining vulnerability to and impacts of drought is to create a series of working groups under the aegis of the risk assessment committee. The responsibility of the committee and working groups is to assess sectors, population groups, and ecosystems most at risk and identify appropriate and reasonable mitigation measures to address these risks. Working groups would be composed of technical specialists representing each of the sectors, groups, or ecosystems at risk. The chair of each working group, as a member of the risk assessment committee, would report directly to it. With this model, the responsibility of the committee is to direct the activities of each of the working groups and make recommendations to the drought task force on mitigation actions. The number of working groups will vary considerably, reflecting important impact sectors.

A methodology for assessing and reducing the risks associated with drought has recently been completed as a result of collaboration

between the NDMC and the Western Drought Coordination Council's (WDCC) Mitigation and Response Working Group (Knutson *et al.*, 1998) and is available on the WDCC's web site as a .pdf document at <http://enso.unl.edu/wdcc/products/risk.pdf>. The guide focuses on identifying and prioritizing drought impacts, determining their underlying causes, and choosing actions to address the underlying causes. This methodology can be employed by each of the working groups. This effort requires an interdisciplinary analysis of impacts and management options available.

The choice of specific actions to deal with the underlying causes of the drought impacts will depend on the economic resources available and related social values. Typical concerns are associated with cost and technical feasibility, effectiveness, equity, and cultural perspectives. This process has the potential to lead to the identification of effective and appropriate drought risk reduction activities that will reduce long-term drought impacts, rather than ad hoc responses or untested mitigation actions that may not effectively reduce the impact of future droughts.

Wilhelmi (1999) recently developed a GIS-based methodology for the assessment of agricultural drought risk in Nebraska. In this study it was hypothesized that the key biophysical and social factors that defined agricultural drought risk were climate, soils, land use, and access to irrigation. The framework for derivation of an agricultural drought risk map was created through development of a numerical weighting scheme to evaluate the drought potential of the classes within each factor. This methodology has direct transferability to

other drought-prone agricultural regions if the appropriate data or data layers are available for inclusion in the GIS-based analysis. With modifications in this methodology, it could also be used in an operational assessment of risk before and during the early stages of the growing season to assist farmers in making critical farm management decisions.

Mitigation and response committee

Mitigation and response actions could be under the responsibility of the drought task force or could be assigned to a separate committee. The task force, working in cooperation with the monitoring/early warning and risk assessment committees, should have the knowledge and experience to understand drought mitigation techniques, risk analysis (economic, environmental, and social aspects), and drought-related decision-making processes at all levels of government. The task force, as originally defined, is composed of senior policy makers from various ministries and, possibly, representatives from NGOs. Therefore, they are in an excellent position to recommend and/or implement mitigation actions, request assistance through various programs, or make policy recommendations to the legislative body or the prime minister/president.

Mitigation and response actions must be determined for each of the principal impact sectors identified by the risk assessment committee. Wilhite (1997) recently completed an assessment of drought mitigation technologies implemented by states in the United States in response to drought conditions during the late 1980s and early 1990s. However, the transferability

of these technologies to specific situations in other locations needs to be evaluated.

Writing the plan

With input from each of the committees and working groups, the drought task force, with the assistance of professional writing specialists, will draft the drought preparedness plan. After several iterations, it is recommended that public meetings, discussions, or hearings be held to explain the purpose, scope, and operational characteristics of the plan.

Step 6: Identify Research Needs and Fill Institutional Gaps

As research needs and gaps in institutional responsibility become apparent during drought planning, the drought task force should compile a list of those deficiencies and make recommendations to the appropriate ministry on how to remedy them. Step 6 should be carried out concurrently with Steps 4 and 5. For example, the monitoring committee may recommend establishing or enhancing an existing ground water monitoring program. Another recommendation may be to initiate research on the development of a climate or water supply index to help monitor water supplies and trigger specific actions by government.

Step 7: Integrate Science and Policy

An essential aspect of the planning process is integrating the science and policy of drought management. The policy maker's understanding of the scientific issues and technical constraints involved in addressing problems associated with drought is often negligible. Likewise, scientists generally 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 poorly developed and must be enhanced if the planning process is to be successful.

Good communication is required between the two groups in order to distinguish what is feasible from what is desirable for a broad range of science and policy issues. Integration of science and policy during the planning process will also be useful in setting research priorities and synthesizing current understanding. The drought task force should consider various alternatives to bring these groups together and maintain a strong working relationship.

Step 8: Publicize the Drought Preparedness Plan, Build Public Awareness

Themes to emphasize in writing news stories during and after the drought planning process could include how the drought preparedness plan is expected to relieve impacts of drought and what changes people might be asked to make in response to different degrees of drought, such as restricted use of water for nonessential uses, or not irrigating certain crops at certain times. It may be useful to refresh people's memories ahead of time on circumstances that would lead to water use restrictions.

During drought, the task force should work with public information professionals to keep the public well informed of the current status of water supplies, whether conditions are approaching trigger points that will lead to requests for voluntary use restrictions, and how victims of drought can

access assistance and what types of assistance are available.

Step 9: Teach People about Drought

A broad-based education program to raise awareness of short- and long-term water use and management issues will help ensure that people know how to respond to drought when it occurs and that drought planning does not lose ground during nondrought years. It would be useful to tailor information to the needs of school-age children, small business, industry, households, utilities, and other groups. The task force or a participating agency should consider developing presentations and educational materials for events such as a water awareness week, community observations of Earth Day, relevant trade shows, specialized workshops, and other gatherings that focus on natural resource stewardship or management.

Step 10: Evaluate and Revise Drought Preparedness Plan

The final step in the planning process is to create a detailed set of procedures to ensure adequate plan evaluation. Periodic testing, evaluation, and updating of the drought preparedness plan is essential to keep the plan responsive to local and national needs. To maximize the effectiveness of the system, two modes of evaluation must be in place:

Ongoing evaluation

An ongoing or operational evaluation keeps track of how societal changes such as new technology, government policies, population growth and shifts, political leadership, and other factors may affect drought risk and the operational aspects of

the drought preparedness plan. Drought risk may be evaluated quite frequently while the overall drought preparedness plan may be evaluated less often. An evaluation under simulated drought conditions (*i.e.*, drought exercise) is recommended before the drought plan is implemented. Additional simulations should be organized periodically as needed.

Post-drought evaluation

A post-drought evaluation documents and analyzes the assessment and response actions of government, nongovernmental organizations, and others, and implements recommendations for improving the system. Without post-drought evaluations, it is difficult to learn from past successes and mistakes, as institutional memory fades.

Post-drought evaluation should include an analysis of the climatic and environmental aspects of the drought; its economic and social consequences; and the extent to which pre-drought planning was useful in mitigating impacts, in facilitating relief or assistance to stricken areas, and in post-recovery. Attention must also be directed to situations in which drought-coping mechanisms worked and where societies exhibited resilience; evaluations should not focus only on those situations in which coping mechanisms failed. Evaluations of previous responses to severe drought are also a good planning aid.

To ensure an unbiased appraisal, governments may wish to place the responsibility for evaluating drought and societal response to it in the hands of independent nongovernmental organizations such as universities and/or specialized research institutes.

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. Drought should be considered relative to some long-term average condition of balance between precipitation and evapotranspiration.

Previous responses to drought in most countries have been, for the most part, reactive (*i.e.*, crisis management). This approach has been demonstrated to be ineffective, poorly coordinated, and untimely in all political and geographical settings; more importantly, it has done little to reduce the risks associated with drought. In fact, the economic, social, and environmental impacts of drought have increased significantly in recent decades. A similar trend exists for all natural hazards.

The 10-step planning process, which is discussed in this paper, has been used at all levels of government in the United States and in many countries to guide the development of a drought preparedness plan. The goal of this planning process is to derive a plan that is dynamic and incorporates greater emphasis on risk management and the adoption of appropriate mitigation actions. This approach is developed around the three primary components of a drought preparedness plan: monitoring and early warning, risk and impact assessment, and mitigation and response. The 10 steps included in this process are considered to be generic, enabling governments to choose those steps and components that are most applicable to their situation. With appropriate modifications, it is felt that this process could

be helpful to many countries in addressing issues associated with drought preparedness as an integral part of planning for sustainable development.

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, and it has 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 that are appropriate to various sectors, applications, and regions is a critical part of this awareness-building process. Four elements are important to include in a useful definition of drought. First, definitions must include some measure of the intensity or magnitude of the precipitation deficiency. Second, duration is an important

distinguishing feature of drought (in comparison to other natural hazards) and must be linked to intensity to determine the severity of the event. Third, a threshold should be selected as a reference point to determine the onset and termination of drought. Fourth, the threshold chosen should be linked to specific impacts in one or more sectors. Thresholds typically have been chosen arbitrarily and, as a result, have not captured the importance of this linkage to impacts in one or more sectors. This factor has limited the usefulness of definitions in triggering specific response or mitigation programs.

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 results 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 determine 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), 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 to this author 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 efforts-efforts 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. 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 unsustainable 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 unsustainable actions.

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.

References

- Benson, C. and Clay, E. 1998. *The Impact of Drought on Sub-Saharan African Economies: A Preliminary Examination*. World Bank Technical Paper No. 402, Washington, DC.
- Benson, C. and Clay, E. 2000. The economic dimensions of drought in Sub-Saharan Africa. In *Drought: A Global Assessment* (Ed. D.A. Wilhite), Vol. 1, pp. 287-311. Routledge Publishers, London, England.
- Blaikie, P., Cannon, T., Davis, I. and Wisner, B. 1994. *At Risk: Natural Hazards, People's Vulnerability, and Disasters*, Routledge Publishers, London, England.
- Bruins, H.J. and Berliner, P.R. 1998. Bioclimatic aridity, climatic variability, drought and desertification: Definitions and management options. In *The Arid Frontier-Interactive Management of Environment and Development* (Eds. H.J. Bruins and H. Lithwick), pp. 97-116. Kluwer Academic Publishers, Dordrecht.
- Carolwicz, M. 1996. *Natural Hazards Need Not Lead to Natural Disasters*, EOS Volume 77, No. 16, pp. 149, 153.
- Department of Constitutional Development 1999. *White Paper on Disaster Management*, Ministry for Provincial Affairs and Constitutional Development, Pretoria, South Africa.
- FEMA 1995. *National Mitigation Strategy*, Federal Emergency Management Agency, Washington, D.C.

- Glantz, M.H. 1987. *Drought and Hunger in Africa: Denying Famine a Future*, Cambridge University Press, Cambridge.
- Hagman, G. 1984. *Prevention Better than Cure: Report on Human and Natural Disasters in the Third World*, Swedish Red Cross, Stockholm.
- Keck, A. and Dinar, A. 1994. *Water Supply Variability and Drought in Sub-Saharan Africa: Physical and Economic Perspectives for a Comprehensive Water Strategy*, draft, Washington, D.C.
- Knutson, C., Hayes, M. and Phillips, T. 1998. *How to Reduce Drought Risk*, a guide prepared by the Preparedness and Mitigation Working Group of the Western Drought Coordination Council; National Drought Mitigation Center, Lincoln, Nebraska.
- Office of Foreign Disaster Assistance 1990. *Annual Report*, Office of Foreign Disaster Assistance, Washington, DC.
- SADCC 1992. *Food Security Bulletin*, SADC, Gaborone, Botswana.
- Subbiah, A.R. 1993. Indian drought management: From vulnerability to resilience. In *Drought Assessment, Management, and Planning: Theory and Case Studies* (Ed. D.A. Wilhite), pp. 157-179. Kluwer Academic Publishers, Boston, Massachusetts, USA.
- United Nations 1986. *Countries Stricken by Desertification and Drought*, General Assembly, Economic and Social Council, New York.
- UNDP/UNSO 2000. *Report on the Status of Drought Preparedness and Mitigation in Sub-Saharan Africa*, United Nations (Volume 1: Synthesis). UN Development Programme, Office to Combat Desertification and Drought, New York.
- Wilhelmi, O.V. 1999. *Methodology for Assessment Vulnerability to Agricultural Drought: A Nebraska Case Study*, Ph.D. dissertation, University of Nebraska, Lincoln, Nebraska, USA.
- Wilhite, D.A. 1991. Drought planning: A process for state government. *Water Resources Bulletin* 27(1): 29-38.
- Wilhite, D.A. 1992a. Drought. In *Encyclopaedia of Earth System Science*, Vol. 2, pp. 81-92. Academic Press, San Diego, California.
- Wilhite, D.A. 1992b. *Preparing for Drought: A Guidebook for Developing Countries*, Climate Unit, United Nations Environment Program, Nairobi, Kenya.
- Wilhite, D.A. 1996. A methodology for drought preparedness. *Natural Hazards* 13: 229-252.
- Wilhite, D.A. 1997. State actions to mitigate drought: Lessons learned. *Journal of the American Water Resources Association* 33(5): 961-968.
- Wilhite, D.A. (Ed) 2000a. *Drought: A Global Assessment* (Volumes 1 and 2), Routledge Publishers, London, England.
- Wilhite, D.A. 2000b. Preparing for drought: A methodology. In *Drought: A Global Assessment* (Ed. D.A. Wilhite), Vol. 2, pp. 89-104. Routledge Publishers, London, England.
- Wilhite, D.A. and Glantz, M.H. 1985. Understanding the drought phenomenon: The Role of definitions. *Water International* 10: 111-120.
- Wilhite, D.A., Hayes, M., Knutson, C. and Smith, K.H. 1999. *A Methodology for Drought Planning*. A report prepared for the Bureau of Reclamation, Denver, Colorado; National Drought Mitigation Center, Lincoln, Nebraska.
- Wilhite, D.A. and Vanyarkho, O. 2000. Drought: Pervasive impacts of a creeping phenomenon. In *Drought: A Global Assessment* (Ed. D.A. Wilhite), Vol. 1, pp. 245-255. Routledge Publishers, London, England.