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A Methodology for Drought Preparedness

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Abstract

Drought is a normal, recurrent feature of climate that affects virtually all countries to some degree. The number of drought-induced natural disasters has grown significantly since the 1960s, largely as a result of increasing vulnerability to extended periods of precipitation deficiency rather than because of an increase in the frequency of meteorological droughts. This increase in drought-induced natural disasters has resulted in a considerable growth of interest in drought mitigation and preparedness worldwide. The purpose of a national preparedness plan is to reduce societal vulnerability to drought through the adoption of preventive, anticipatory policies and programs. This paper describes a ten-step planning process that nations can follow to develop a drought preparedness plan. This process, originally developed in 1987, has been the basis of discussions at training seminars on drought preparedness for developing nations in Africa, Asia, and Latin America. It has also been adopted, with appropriate modifications, by state or provincial governments and by municipalities. The process is intended to be flexible so that governments can add, delete, or modify the suggested steps, as necessary.

Keywords: drought, drought preparedness, drought mitigation, sustainable development

1. Introduction

The trend is clear: vulnerability to natural hazards is escalating, and at an increasing rate. Worldwide, economic damages attributed to natural disasters have tripled in the last three

decades, from an estimated \$40 billion in the 1960s to \$120 billion by the end of the 1980s (Domeisen, 1995). Only one natural disaster resulted in losses exceeding \$1 billion before 1987; since then, 13 natural disasters have resulted in losses greater than \$1 billion (Domeisen, 1995). Although many significant drought episodes with losses exceeding \$1 billion have occurred since 1987, none were included in this assessment. It is common for droughts to be omitted from these assessment figures because it differs from other natural hazards by its slow-onset nature and because it seldom results in structural damage or loss of life.

The number of reported natural disasters has increased significantly in the past three decades as well. For example, the number of floods reported increased from 142 in the 1960s to 603 in the 1980s; the number of droughts increased from 62 in the 1960s to 237 during the 1980s (Centre for Research in the Epidemiology of Disasters, 1991, as cited in Blaikie et al., 1994). Drought is also one of the most under-reported natural disasters because the sources of most of these statistics are international aid or donor organizations. Unless countries afflicted by drought request assistance from the international community or donor governments, the droughts are not reported. Thus, severe droughts such as those that occurred in Australia, Uruguay, Brazil, Canada, Spain, Italy, and the United States in recent years are not included in these statistics.

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, the droughts of the early to mid-1980s in sub-Saharan Africa are reported to have adversely affected more than 40 million persons (Office of Foreign Disaster Assistance, 1990). Experience with drought in both developing and developed countries during the past several decades and the magnitude of associated impacts demonstrates that vulnerability to extended periods of water shortage is escalating, and at an accelerating pace. For example, the drought of 1988 in the United States resulted in estimated impacts of nearly \$40 billion (Riebsame et al., 1990), making this single-year drought the costliest disaster in American history. Falkenmark (1992) has estimated that the number of persons living in countries with water stress or chronic water scarcity will increase from 300 million to more than 3 billion by the year 2025.

Coping strategies for responding to and preparing for drought are numerous and range from individual or household level to national level. Parry and Carter (1987) have classified the policy responses of governments to climatic variability or extreme climatic events into three broad types: pre-impact programs for impact reduction; post-impact government interventions; and contingency arrangements or preparedness plans. Pre-impact government programs are defined as those that attempt to mitigate the future effects of climatic variations. Examples related to drought include the development of an early warning system, augmentation of water supplies, demand reduction (such as water conservation programs), and crop insurance. Post-impact government interventions refer to those reactive programs or tactics implemented by government in response to drought or some other extreme climatic event. This includes a wide range of reactive emergency measures such as low-interest loans, transportation subsidies for livestock and livestock feed, provision of food, water transport, and drilling wells for irrigation and public water

supplies. This reactive crisis management approach has been criticized by scientists, government officials, and many relief recipients as inefficient, ineffective, and untimely (Wilhite, 1993). More recently, the provision of emergency relief in times of drought has also been criticized as being a disincentive to the sustainable use of natural resources because it does not promote self-reliance (Brower, 1993; White et al., 1993). In fact, this approach may increase vulnerability to drought. Contingency arrangements refer to the development of policies and plans that can be useful in preparing for drought. These are usually developed at national and provincial levels with linkages to the local level. Preparedness plans can reduce vulnerability to drought.

Until recently, nations had devoted little effort to drought preparedness, preferring instead the traditional reactive or crisis management approach. Deficiencies in the crisis management approach to drought assessment and response are well documented (Wilhite, 1992). They include: (1) lack of appropriate climatic indices and early warning systems; (2) insufficient data bases for assessing water shortages and potential impacts; (3) inadequate tools and methodologies for early estimations of impacts in various sectors; (4) insufficient information flow within and between levels of government on drought severity, impacts, and appropriate policy responses; (5) inappropriate or untimely emergency assistance programs; (6) poorly targeted emergency assistance programs that do not reach vulnerable population groups and economic sectors; (7) meager financial and human resources that are poorly allocated; (8) lack of emphasis on proactive mitigation programs aimed at reducing vulnerability to drought; (9) institutional deficiencies that inhibit effective emergency response; and (10) lack of coordination of policies and programs within and between levels of government.

Increasingly, nations are pursuing a more proactive approach that emphasizes the principles of risk management and sustainable development. Because of the multitude of impacts associated with drought and the numerous governmental agencies that have responsibility for some aspect of monitoring, assessment, mitigation, and planning, developing a policy and plan must be an integrated process within and between levels of government. Following a brief overview of the concept of drought, this paper outlines a generic process that can be adopted by governments that want to develop a more comprehensive and proactive approach to drought management and planning. This process is timely, given the declaration of the 1990s as the International Decade for Natural Disaster Reduction and other global initiatives on sustainable development and desertification. To be successful, these initiatives must address issues of natural hazards management. One of the goals of the international convention on desertification held in Paris, France, in June 1994 is to foster development of preparedness plans for drought-prone nations.

2. The Concept of Drought

Drought is a normal, recurrent feature of climate for virtually all climatic regimes. It is a temporary aberration that occurs in high as well as low rainfall areas. Drought therefore differs from aridity since the latter is restricted to low rainfall regions and is a permanent feature of climate. The character of drought is distinctly regional, reflecting unique meteorological, hydrological, and socioeconomic characteristics.

Drought should be considered relative to some long-term average condition of balance between precipitation and evapotranspiration in a particular area, a condition often perceived as "normal." It 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 aggravate the severity of the event. Drought is also related to the timing and effectiveness of the rains.

Drought differs from other natural hazards in several ways. First, it is a "creeping phenomenon," making its onset and end difficult to determine. The effects of drought accumulate slowly over a considerable period of time, and may linger for years after the termination of the event. 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 severity. Third, drought impacts are less obvious and spread over a larger geographical area than are damages that result from other natural hazards. Drought seldom results in structural damage. For these reasons the quantification of impacts and the provision of disaster relief is a far more difficult task for drought than it is for other natural hazards.

Because drought affects so many economic and social sectors, scores of definitions have been developed by a variety of disciplines. In addition, because drought occurs with varying frequency in nearly all regions of the globe, in all types of economic systems, and in developing and developed countries alike, the approaches taken to define it should be impact and region specific. The lack of a precise and objective definition in specific situations has been an obstacle to understanding drought, which has led to indecision and/or inaction on the part of managers, policy makers, and others. It must be accepted that the importance of drought lies in its impacts.

Drought has been grouped by type as follows: meteorological, hydrological, agricultural, and socioeconomic (Wilhite and Glantz, 1985). Meteorological drought is expressed solely on the basis of the degree of dryness (often in comparison to some "normal" or average amount) and the duration of the dry period. Definitions of meteorological drought must be considered as region specific since the atmospheric conditions that result in deficiencies of precipitation are highly variable from region to region. Hydrological droughts are concerned more with the effects of periods of precipitation shortfalls on surface or subsurface water supply (i.e., stream flow, reservoir and lake levels, ground water) rather than with precipitation shortfalls. Hydrological droughts are usually out of phase or lag the occurrence of meteorological and agricultural droughts. Water in hydrologic storage systems (e.g., reservoirs, rivers) is often used for multiple and competing purposes, further complicating the sequence and quantification of impacts. Competition for water in these storage systems escalates during drought, and conflicts between water users increase significantly. Because regions are interconnected by hydrologic systems, drought occurring upstream may result in serious impacts downstream as surface and subsurface water supplies are affected, even though downstream areas may not be experiencing meteorological drought. Upstream changes in land use (e.g., deforestation, changes in cropping patterns) may alter runoff and soil infiltration rates, which may affect the frequency and severity of droughts downstream.

Finally, socioeconomic drought associates the supply and demand of some economic good with elements of meteorological, hydrological, and agricultural drought. Time and space processes of supply and demand are the two basic processes that should be considered for inclusion in an objective definition of drought. For example, the supply of an economic good (e.g., water, forage, hydroelectric power) is weather dependent. In most instances, demand is increasing as a result of increasing population and/or per capita consumption. Therefore, drought could be defined as occurring when the demand exceeds supply as a result of a weather-related supply shortfall. This concept of drought supports the strong symbiosis that exists between drought and human activities, reemphasizing the importance of managing natural resources in a sustainable manner.

3. Developing a Drought Preparedness Plan

The factors that may stimulate governments to develop drought plans are numerous and vary from one country to another. These factors may be external, such as the call for the development of drought plans by the World Meteorological Organization (WMO) in 1986 (Obasi, 1986), or internal, such as the occurrence of severe drought and concomitant economic, social, and environmental impacts that significantly affect a nation's economy and progress toward development goals. Although both external and internal factors are important, internal support ultimately must be present for the process to move forward. Unfortunately, the response efforts of many nations have had little, if any, effect on reducing vulnerability, largely because of their emphasis on emergency assistance. In fact, vulnerability to drought has increased in some settings because of relief recipients' expectations for assistance from government or donors. If farmers or other relief recipients expect government or donors to assist them during times of distress, this practice will discourage or be a disincentive for self-reliance. In marginal agricultural regions, the provision of relief to farmers may promote land use practices that may not be sustainable in the long term. Disincentives to proper management of the natural resource base characterize the provision of relief in most countries.

The decision to prepare a drought plan almost always rests with a high-ranking political official. If this official does not initiate the plan development process, the person must be convinced of the need for a plan and the benefits that will accrue if the process is to go forward. This may be a formidable and time-consuming task. Proponents of a plan must begin by determining support for the planning process within key government agencies and assess what expertise exists within the country to assist with the process. Consensus building is an important part of the process that (if done properly) will enhance the chances of successfully initiating and completing the plan. In some cases, a national or regional water resources management or development plan may already exist and a drought plan, once completed, could be incorporated into this broader strategy.

Although the principles of drought planning have been known for some time, progress toward preparedness in most countries has been conspicuously absent. This lack of progress would indicate that impediments or constraints to drought planning exist and must be addressed if the planning process is to be successful.

4. Constraints to Drought Planning

Institutional, political, budgetary, and human resource constraints often make drought planning difficult (Wilhite and Easterling, 1987a). One major constraint that exists worldwide is a lack of understanding of drought by politicians, policy makers, technical staff, and the general public. Lack of communication and cooperation among scientists and inadequate communication between scientists and policy makers on the significance of drought planning also complicate efforts to initiate steps toward preparedness. Because drought occurs infrequently in some regions, governments may ignore the problem or give it low priority. Inadequate financial resources to provide assistance and competing institutional jurisdictions between and within levels of government may also serve to discourage governments from undertaking planning. Other constraints include technological limits (such as difficulties in predicting and detecting drought), insufficient data bases, and inappropriate mitigation technologies.

Policy makers and bureaucrats need to understand that droughts, like floods, are a normal feature of climate. Their recurrence is inevitable. Although we cannot influence the occurrence of the natural event (i.e., meteorological drought), we can lessen vulnerability through more reliable forecasts, improved early warning systems, and appropriate and timely mitigation and preparedness measures. Drought manifests itself in ways that span the jurisdiction of numerous bureaucratic organizations (e.g., agricultural, water resources, health, and so forth) and levels of government (e.g., national, state, and local). Competing interests, institutional rivalry, and the desire to protect their agency missions (i.e., "turf protection") impede the development of concise drought assessment and response initiatives. To solve these problems, policy makers and bureaucrats, as well as the general public, must be educated about the consequences of drought and the advantages of preparedness. Drought is an interdisciplinary problem that requires input by many disciplines and policy makers.

The development of a drought preparedness plan is a significant step in adopting a preventive, anticipatory approach to resource management. Planning, if undertaken properly and implemented during nondrought periods, can improve governmental ability to respond in a timely and effective manner during periods of crisis. Thus, planning can mitigate and, in some cases, prevent impacts while reducing physical and emotional hardship. Planning is a dynamic process that must incorporate both traditional and emerging technologies and take into consideration socioeconomic, agricultural, technological, and political trends.

It is sometimes difficult to determine the benefits of drought preparedness versus the costs of being unprepared. There is little doubt that preparedness requires financial and human resources that are, at times, scarce. This cost has been and will continue to be an impediment. Preparedness costs are fixed and occur now while drought costs are uncertain and will occur later. Further complicating this issue is the fact that the costs of drought are not solely economic. They must also be stated in terms of human suffering, damage to biological resources, and the degradation of the physical environment, items whose values are inherently difficult to estimate.

Post-drought evaluations have shown assessment and response efforts of governments with a low level of preparedness to be largely ineffective, poorly coordinated, untimely, and inefficient in terms of the allocation of resources. Although government expenditures for drought relief are significant and unanticipated, they are usually poorly documented. However, a few examples do exist. During the droughts of the mid-1970s in the United States, specifically 1974, 1976, and 1977, the federal government spent more than \$7 billion on drought relief programs (Wilhite et al., 1986). As a result of the drought of 1988, the federal government spent \$3.9 billion on drought relief programs and \$2.5 billion on farm credit programs (Riebsame et al., 1990). A disaster relief package was also passed by the U.S. Congress in August 1989 in response to a continuation of drought conditions. Between 1970 and 1984, state and federal government in Australia expended more than A\$925 million on drought relief under the Natural Disaster Relief Arrangements (Wilhite, 1986). The Republic of South Africa spent R2.5 billion for drought relief from the mid-1970s to the mid-1980s (Wilhite, 1987). When compared to these expenditures, a small investment in mitigation programs in advance of drought would seem to be a sound economic decision. The rationale for implementing preventive measures must be weighed not only against a retrospective analysis of relief costs but also against future relief costs and savings accrued through reduced economic, social, and environmental impacts. Though difficult to quantify, these savings will be significant.

It is equally important to remind decision makers and policy officials that, in most instances, drought planning efforts will use *existing* political and institutional structures at appropriate levels of government, thus minimizing start-up and maintenance costs. It is also quite likely that some savings may be realized as a result of improved coordination and the elimination of some duplication of effort between agencies or levels of government. Also, plans should be incorporated into general natural disaster and/or water management and development plans wherever possible. This reduces the cost of preparedness substantially. Politicians and many other decision makers simply must be better informed about drought, its impacts, and alternative management approaches and how existing information and technology can be used more effectively to reduce impacts, and at a relatively modest cost.

5. Developing a Drought Policy and Preparedness Plan: A Methodological Approach

A planning process was developed recently in the United States to facilitate the preparation of drought plans by state government decision makers (Wilhite, 1991; 1992). This process was based on methodology originally proposed in 1987 to synthesize the discussions and recommendations of participants at an international symposium and workshop on drought (Wilhite and Easterling, 1987b). For the application of this methodology to states in the United States, those states with drought plans were studied in order to extract the best attributes of those plans for incorporation in the process (Wilhite, 1991; 1992). This process has also been modified for application to developing countries through direct interaction with foreign governments resulting from a series of regional training seminars on drought management and preparedness, organized and conducted by the International Drought Information Center at the University of Nebraska-Lincoln (fig. 1). The first of

these seminars was held in 1989 in Botswana for eastern and southern Africa. This seminar was followed by seminars in Asia (1991) and Latin America (1993). The ten-step drought planning methodology was used as a primary instructional resource for these meetings. These seminars were sponsored by the United Nations Environment Program (UNEP), United States National Oceanic and Atmospheric Administration (NOAA), and the World Meteorological Organization (WMO). In Latin America, the training seminar was also sponsored by the Organization of American States. An outgrowth of these training seminars was the publication of a guidebook for developing countries, *Preparing for Drought* (1992), sponsored by UNEP. A fourth training seminar was held in 1995 in the Gambia for the West African region. This meeting was sponsored by the WMO.

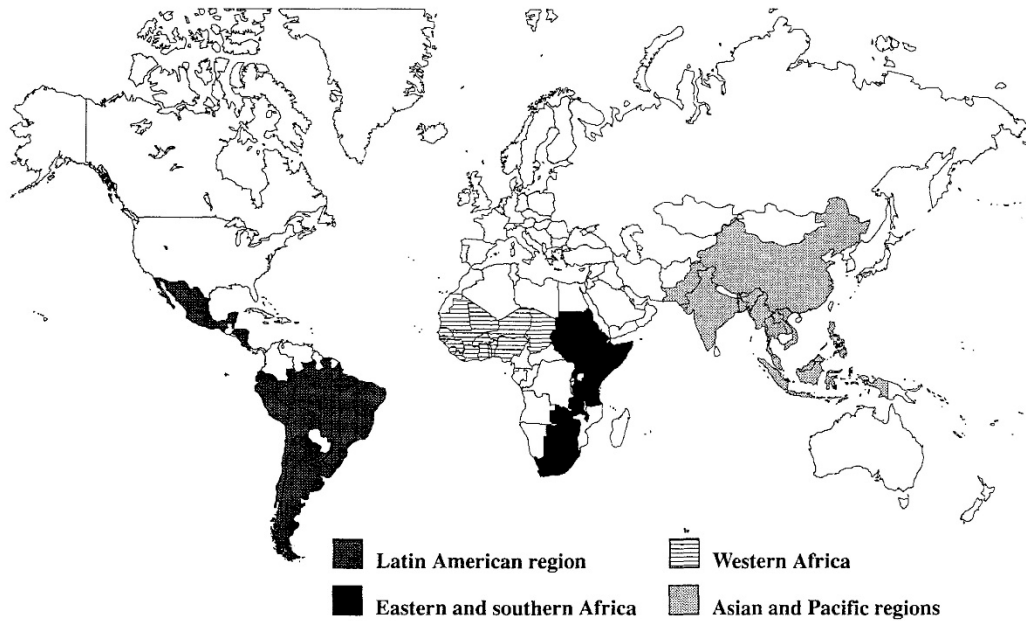


Figure 1. Countries participating in the four regional training seminars on drought management and preparedness, conducted between 1989 and 1995.

The planning process has been used or proposed for use in other political settings and geographical scales (i.e., local, state, regional, and national) (e.g., Great Lakes Commission, 1990; SARCCUS, 1990; Oladipo, 1993; Wilhite and Rhodes, 1994; Moran, 1995). The framework described below outlines the ten steps considered essential to the planning process (fig. 2). The first four steps actually involve appraising the resources available to support plan development and designing tactics to gain public support for the process. The process addresses the principal issues associated with drought planning and is intended to be flexible (i.e., governments can add, delete, or modify steps as necessary).

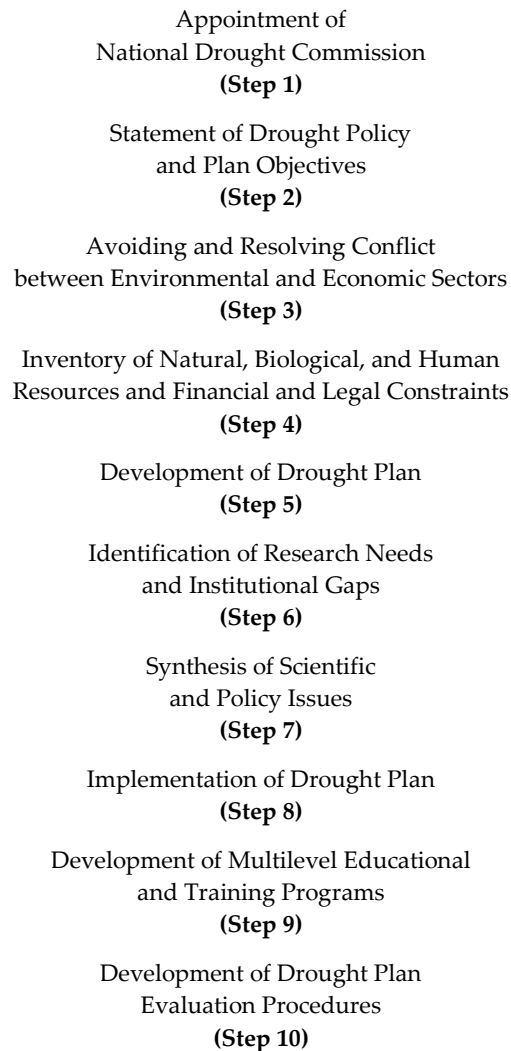


Figure 2. The ten-step methodology proposed for the development of a national drought plan.

Step 1. Appointment of National Drought Commission

The planning process is initiated through the appointment of a national drought authority or commission (NDC). The appropriate name for this group (e.g., *commission, committee, or taskforce*) will vary from region to region. The NDC has two purposes. First, during plan development, the NDC will supervise and coordinate the development of the preparedness plan. Second, after the plan is implemented and during times of drought when the plan is activated, the NDC will assume the role of policy coordinator, reviewing alternative policy response options and making recommendations to political officials. The NDC is central to this planning process and will be referred to throughout the discussion of the proposed methodology.

The NDC should include representatives of the most relevant mission agencies, recognizing the multidisciplinary nature of drought, its diverse impacts, and the importance of both the assessment and response components in any comprehensive plan, and how this plan must be integrated with long-term sustainable development objectives. Agencies to consider for inclusion on the commission are meteorological services, agriculture, water resources, planning, public water supply, natural resources, environmental protection, health, finance, economic and rural development, emergency management, and tourism. A representative from the head of state's office should also be included. Consideration should be given to including key representatives from universities, media (or a public information specialist), and environmental and/or special public interest groups. The purpose of including a public information specialist is to guarantee that the NOC gives attention to how it will communicate information about drought severity and mitigative actions with the public during drought periods. The actual make-up of the NOC would be quite different from one country to another, reflecting different political infrastructures and the unique combination of economic, social, and environmental impacts associated with drought.

The NDC will need to consider at a later time whether it would be prudent to formalize the plan through the legislative (or some other) process. The danger in not formalizing the plan is that a change in political or administrative leadership may lead to the decay of the plan's infrastructure. It must be emphasized that political interest in drought quickly wanes when the crisis is over; concern and panic during a drought are swiftly replaced by apathy once the rains have returned and drought conditions have abated. Likewise, institutional memory is short. A drought plan (and associated infrastructure) that is ad hoc by nature may cease to exist in a relatively short time. Formalizing the plan after its completion will guarantee that the infrastructure is in place to assist future generations in managing water resources during periods of scarcity.

Step 2. Statement of Drought Policy and Plan Objectives

As their first official action, the NOC must formulate a national drought policy and the objectives of the drought plan. The objectives of a drought *policy* differ from those of a drought *plan*. A clear distinction of these differences must be made at the outset of the planning process. A drought *policy* is broadly stated and expresses the purpose of government involvement in drought assessment, mitigation, and response programs. Ultimately, the goal of a national policy should be to reduce vulnerability to drought by encouraging sustainable development. Drought *plan* objectives are more specific and action-oriented. Typically, the objectives of drought policy have *not* been stated explicitly by government. What generally exists in many countries is a *de facto* policy, one defined by the most pressing needs of the moment. Ironically, under these circumstances, it is the specific instruments of that policy (such as relief measures) that define the objectives of the policy. Without clearly stated drought policy objectives, the effectiveness of assessment and response activities is difficult to evaluate.

The objectives of drought policy will differ considerably between countries. Based on a comparative analysis of drought assessment and response efforts in the United States and Australia, three objectives of a national policy have been proposed (Wilhite, 1986). First,

assistance should encourage or provide incentives for agricultural producers, municipalities, and other water-dependent sectors or groups to adopt appropriate and efficient management practices that help to mitigate the effects of drought. Mitigation is defined here as activities that reduce the degree of long-term risk to human life and property from natural and man-made hazards. Mitigation activities must be interpreted more broadly for drought than with other natural hazards because of the nonstructural nature of most of these impacts. Emergency assistance or relief measures in Australia (White et al., 1993), the United States (Wilhite, 1991), South Africa (Brower, 1993), and other countries have discouraged self-reliance by encouraging the adoption of management practices that are often inappropriate or unsustainable in a particular setting. This objective emphasizes accepting drought as a normal part of climate and preparing for or managing drought risks as a routine course of business.

Second, assistance, if provided, should be given in an equitable, consistent, and predictable manner to all without regard to economic circumstances, industry, or geographic region. The ultimate goal of a drought preparedness plan is to reduce vulnerability and the need for governmental intervention. However, when assistance must be provided, it will likely be provided in many forms, including technical aid. Whatever the form, those at risk must know what to expect from government during drought so that they can better prepare to manage that risk. The role of nongovernmental organizations (NGOs) in assistance efforts must also be precisely defined so that they complement governmental assistance efforts.

Third, the importance of protecting the natural and agricultural resource base must be recognized. This objective emphasizes the importance of promoting development that is sustainable in the long term. Clearly, many government programs and development projects have been shortsighted, increasing vulnerability to future episodes of drought. For example, agricultural policies that encourage the expansion of agriculture into marginal land areas are not sound when evaluated in the context of sustainability. The development of a national drought policy should lead to an evaluation of all pertinent government programs to ensure that they are consistent with the goals of that policy.

At the initiation of the planning process, members of the NDC should consider many questions pertaining to the development of a national drought policy, including the following:

- What is the purpose and role of government in preparing for drought, assessing impacts, and responding to drought?
- What should be the scope of the plan (i.e., agricultural, municipal water use, or multi-impact in design)?
- What consideration should be given to food supply and distribution or maintaining the nutritional status of various population groups?
- What are the linkages between drought and land degradation processes (i.e., desertification)?
- What are the most drought-prone areas of the country?
- What are the most vulnerable sectors of the nation's economy?

- What are the principal social and environmental concerns associated with drought?
- Who are the most vulnerable population groups?
- Will the drought plan be a vehicle to resolve conflict between water users during periods of shortage?
- What resources (human and financial) is the government (and donor organizations) willing to commit to the planning process and in support of the plan once it is completed?
- What are the legal and social implications of the plan?

Following the development of a national drought policy, the next action of the NDC is to identify the specific objectives of the plan. Drought planning is defined as actions taken by individual citizens, industry, government, NGOs, and others in advance of drought for the purpose of mitigating some of the impacts and conflicts associated with its occurrence (Wilhite, 1991). To be successful, drought planning must be integrated between levels of government, involving the private sector, where appropriate, early in the planning process. Some governments (e.g., Australia, India, South Africa) are now taking a more proactive approach to drought management. For the majority of nations, however, much remains to be done.

A general statement of purpose for a drought plan is to provide government with an effective and systematic means of assessing and responding to and mitigating the effects of drought. Drought plan objectives will, of course, vary between countries, and they should reflect the unique physical, environmental, socioeconomic, and political characteristics of those countries. Objectives that should be considered include the following:

1. To provide timely and systematic data collection, analysis, and dissemination of drought-related information.
2. To establish proper criteria to identify and designate drought-affected areas and to trigger the initiation and termination of various assessment and response activities by governmental agencies, NGOs, and others during drought emergencies.
3. To provide an organizational structure that assures information flow between and within levels of government and defines the duties and responsibilities of all agencies with respect to drought.
4. To develop a set of appropriate emergency and longer-term programs to be used in assessing, responding to, and mitigating the effects of extended periods of water shortage.
5. To provide a mechanism to ensure the timely and accurate assessment of drought impact on agriculture, industry, municipalities, wildlife, health, and other areas as appropriate.
6. To provide accurate and timely information to the media in order to keep the public informed of current conditions and response actions.
7. To establish and pursue a strategy to remove obstacles to the equitable allocation of water during shortages and to provide incentives to encourage water conservation.

8. To establish a set of procedures to evaluate and revise the plan on a continuous basis in order to keep the plan responsive to national needs. It is suggested that countries consider these objectives in the context of their vulnerability to drought and add to, delete, or modify them as appropriate.

Step 3. Avoiding and Resolving Conflict between Environmental and Economic Sectors

Political, social, and economic interests often clash during drought conditions as competition for scarce water resources intensifies, and it may be difficult to achieve compromises under these circumstances. To reduce the risk of conflict between water users during periods of shortage, it is essential for the public to receive a balanced interpretation of changing conditions through the media and from other sources. The NOC should ensure that frequent, thorough, and accurate news releases are issued to explain changing conditions and complex problem areas that exist and situations in which solutions will require compromises on both sides. To lessen the potential for conflict, the views of citizens and environmental and other special interest groups must be considered in the drought planning process at an early stage. Although the level of involvement of these groups will no doubt vary from one setting to another, the power of these interest groups in policy making is worth noting. Public interest organizations in some countries have initiated and participated in the development of natural resource policies and plans for some time and have extensive experience with this process. The involvement of these groups in determining appropriate policy goals strengthens the overall policy and plan. Moreover, this involvement ensures that the diverse values of society are represented adequately in the policy and plan. Creating an advisory group made up of representatives of these groups is recommended as a means of addressing their concerns.

Step 4. Inventory of Natural, Biological, and Human Resources and Financial and Legal Constraints

An inventory of natural, biological, and human resources, including the identification of financial and legal constraints, may need to be initiated by the NOC. In many cases, much information already exists concerning available resources, particularly in the natural and biological resource areas. Generally speaking, less information is available in developing countries. It is also 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, human expertise, 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, or national agencies may be called into action.

Financial constraints would include costs of hauling water or livestock feed, new program or data collection costs, and so forth. These costs must be weighed against the losses

that may result in the absence of the drought plan. It should also be recognized that the financial resources available to government vary annually and from one administration to another. This may provide additional incentives for governments to formalize drought plans through the legislative or another process (see Step 1), thus assuring that funds to carry out existing programs are available. *Legal constraints* include user water rights, existing public trust laws, methods available to control usage, requirements for public water suppliers, and emergency and other powers of political and government officials during water shortages.

An inventory of these resources would reveal assets and liabilities that might enhance or inhibit fulfillment of the objectives of the planning process. This systematic survey should include resources available at various levels of government and the often unique resources available at universities. A comprehensive assessment of available resources would provide the information necessary for further action by the NDC. The NDC may also want to undertake an examination of drought plans available in adjacent and/or climatically similar countries.

Step 5. Development of the Drought Plan

The NDC will be the coordinating body for the development of a drought plan. Once completed, the plan is envisioned to follow a stepwise or phased approach as water conditions deteriorate and more stringent actions are needed. Thresholds must be established such that, when exceeded, certain actions are triggered within government agencies, as defined by the structure of the plan.

A drought plan should have three primary organizational components: monitoring or early warning, assessment of impact, and response. Although these are distinct activities, formal linkages will need to be incorporated in the plan for it to function properly and be responsive to provincial and local needs and evolving conditions. These three organizational components are discussed in detail below. The names given to these components are intended to be generic, principally referring to the function of the committees. An organizational chart illustrating the linkages between these components of the drought plan is shown in figure 3.

The organizational components shown in figure 3 represent the recommended structure of a national plan. It is essential that any national plan be integrated with provincial and local levels of government. These linkages are not depicted in the organizational chart. Each of the committees may have a counterpart at the provincial and local level with well-established linkages to the national committees. These provincial and local committees will facilitate not only data collection and feedback on programs and policies but also the dissemination of informational products and advisories and the implementation of policies.

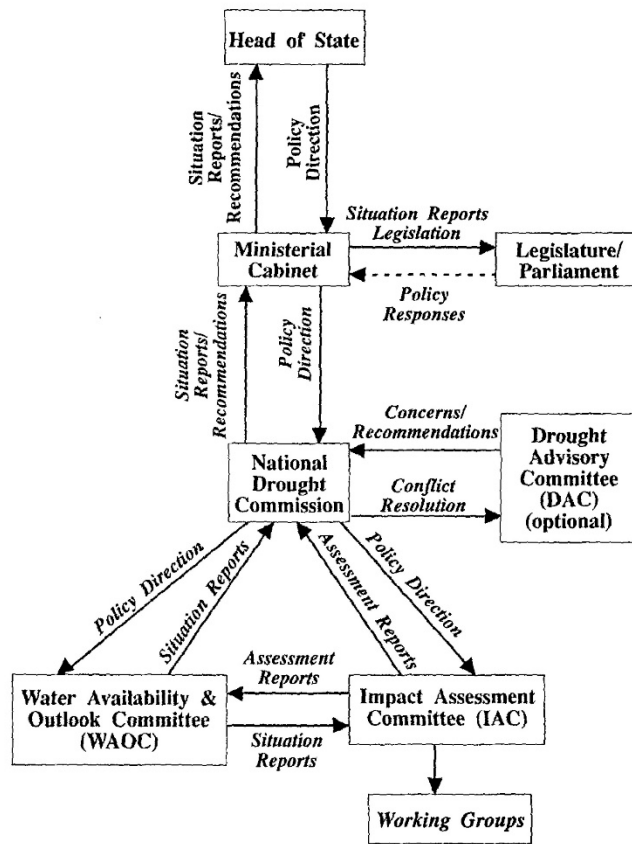


Figure 3. Suggested organizational structure of a national/provincial plan.

Monitoring Component: Water Availability and Outlook Committee (WAOC)

A water availability and outlook committee (WAOC) must be established to monitor current and estimate likely future water availability and moisture conditions. The chairperson of this committee should be a permanent member of the NDC. The WAOC would have five primary duties during the plan development process.

1. Inventory data availability and current observational networks.
2. Determine primary user needs and develop and/or modify current data and information delivery systems.
3. Define drought and develop response triggers.
4. Develop an early warning system.
5. Identify drought management areas.

Membership of the committee should include representatives from agencies with responsibilities for forecasting and monitoring the relevant indicators of the water balance (i.e., meteorological variables such as precipitation and temperature, soil moisture, snow pack, surface water storage, ground water, and streamflow). In some instances, many

agencies at national and other levels of government may have responsibility for monitoring these indicators. It is not necessary for all of these agencies to have representation on this committee. Rather, it is recommended that data and information on each of the applicable indicators be considered in the committee's evaluation of the water situation and outlook for the country.

It is important for the WAOC to be a permanent committee, meeting regularly to determine the status of and outlook for water conditions. The committee should meet on a monthly basis throughout the year or regularly just preceding and during the period of most concern. One advantage of regular meetings is that the committee will function as a team because of continuous interaction. Another advantage is that a permanent committee can be useful in the early warning of emerging and potentially serious water problems, whether they are due to shortage or surplus situations. It is common for shortage and surplus situations to exist simultaneously within a country. WAOC meetings will be more frequent if climatic conditions warrant.

Impact Component: Impact Assessment Committee (IAC)

During periods of drought, impacts will be far-reaching and cut across economic sectors and the responsibilities of various levels of government. The impact assessment committee (IAC) will represent those economic sectors most likely to be affected by drought (e.g., agriculture, transportation). The IAC should be composed of an interagency team of agency heads or their representatives, and its chairperson should be a permanent member of the NDC. It may also be advisable to include university scientists and representatives of international organizations that have expertise in early estimations of impact. The IAC should consider both direct and indirect losses resulting from drought. Often drought assistance is provided only to those experiencing direct losses while agricultural and other businesses experiencing secondary impacts are largely ignored. Because of the obvious dependency of the IAC on the WAOC, frequent communication between the two is essential.

The IAC must give significant attention to the full range of impacts associated with drought and mechanisms to lessen those impacts, and also determine how to target assistance to those economic sectors or vulnerable population groups as the need arises. One of the principal deficiencies of past response efforts has been the inability of government to direct the necessary form of assistance to the economic sector or population group in a timely manner. Assistance that is misdirected or untimely is of little or no value and quite costly to taxpayers. The IAC must work closely with both the WAOC and the NDC to ensure that this does not occur.

Mitigation and Response Component: National Drought Commission

The third and final element of a drought plan is the mitigation and response component. The responsibility of this component is to pursue the creation of long-term programs to lessen vulnerability to drought while acting on the information and recommendations of the IAC. The IAC should evaluate the range of assistance available from government and other sources to assist agricultural producers, municipalities, and others during times of emergency. As individuals become more self-reliant, the need for government intervention

will diminish. Because this is a policy-making body, it should be composed of senior-level policy officials, precisely the same make-up as the NDC. Therefore, in addition to overseeing the development of the preparedness plan, the NDC should assume the mitigation and response role following plan development.

During the plan development process, the NDC should inventory all forms of assistance available during severe drought from government and nongovernment sources. The NDC should evaluate short-term programs for their ability to address emergency situations and long-term mitigation programs for their ability to reduce vulnerability to drought. The NDC may want to consider transferring this task to the IAC. The NDC (or IAC) should also recommend other forms of assistance programs that could be developed to respond to drought. During periods of drought, the NDC will make recommendations to the head of state or appropriate representative concerning specific actions that need to be taken.

Drought assistance should be defined in a very broad way to include all forms of technical and relief programs available from government and nongovernment sources. Rational response options must be determined for each of the principal impact sectors identified by the IAC. These options should examine appropriate drought mitigation measures on three timescales: (1) short-term (reactive or emergency) measures implemented during drought, (2) medium-term (recovery) measures implemented to reduce the length of the post-drought recovery period, and (3) long-term (proactive) measures or programs implemented in an attempt to reduce societal vulnerability to future drought. In many instances, local input should be sought to determine the forms of assistance needed by the various impact sectors.

Societal vulnerability to drought may be influenced substantially by nondrought-related actions taken or policies implemented during nondrought periods. The national drought policy formulated in Step 2 will be especially beneficial at this time. Government must consider the effects of emergency programs on long-term development objectives and guard against implementing emergency programs that draw resources from development programs or interfere with their fulfillment, as has happened in Brazil (Magalhaes, 1993). Emergency programs should foster the achievement of development objectives.

Step 6: Identification of Research Needs and Institutional Gaps

Step 6 is to be carried out concurrently with Step 5. The purpose of this step is to identify research needed in support of the objectives of the drought plan and to recommend research projects to remove deficiencies that may exist. It is unlikely that research needs and institutional gaps will be known until the various committees formed in association with the drought planning process have been through the planning process. Compiling information on research needs and institutional gaps is a function of the NDC. For example, the WAOC may recommend establishing or enhancing an existing groundwater monitoring network. The NDC may find it desirable to create a multidisciplinary scientific advisory panel that could evaluate research proposals, establish funding priorities, and seek financial support from appropriate international or regional organizations, NGOs, or donor governments.

It is likely that institutional deficiencies will be identified as part of Step 6. Agency responsibilities or missions may need to be modified to support activities of the drought plan, modifications that may require legislative action.

Step 7: Synthesis of Scientific and Policy Issues

Previous steps in the planning process have considered scientific and policy issues separately, concentrating largely on assessing the status of the science or on the existing or necessary institutional arrangements to support the plan. An essential aspect of the planning process is the synthesis of the science and policy of drought and drought management. This is the purpose of Step 7.

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 that affect drought response. A panel of researchers and policy experts have concluded that communication and understanding between the science and policy communities is poorly developed and must be enhanced if the drought planning process is to be successful (Wilhite and Easterling, 1987a). Direct and extensive contact 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 NDC should consider various alternatives to bring these groups together.

Crucial to this integration process is the provision within the planning process of a means to facilitate scientific information exchange between scientists and policy makers. Since this is not their primary mission, it is unlikely that scientists will freely devote extensive attention to tailoring and otherwise making available research results on a frequent or continuous basis. One way to achieve this interaction is to appoint a specific liaison person or group to facilitate this exchange.

Step 8: Implementation of the Drought Plan

The drought plan should be implemented by the NDC to give maximum visibility to the program and credit to the agencies and organizations that have a leadership or supporting role in its operation. As with emergency response plans for other natural hazards, all or a portion of the system should be tested under simulated drought conditions before it is implemented. A "virtual reality" drought simulation exercise has been developed recently in the United States to assist decision makers in the decision process (Werick, 1994). It is also suggested that announcement and implementation occur just before the most drought-sensitive season to take advantage of inherent public interest. In an agricultural setting, this would be in advance of planting or at some other critical time during the growing season. The cooperation of the media is essential to publicizing the plan, and they must be informed fully of the rationale for the plan as well as its purpose, objectives, assessment and response procedures, and organizational framework. If a representative of the media or a public information specialist is a member of the NDC, as recommended, this person should be an invaluable resource in carrying out this step of the planning process.

Training of personnel who will be actively involved in the operation of the plan is also critical if the plan is to achieve its specified goals. This training should include not only persons in the principal national agencies involved in the activated plan but also persons at the provincial and local levels of government who will provide valuable input in the decision-making process. The key players in the drought plan must thoroughly understand their responsibilities during drought and how these responsibilities relate to those of other organizations and levels of government. If they do not understand the plan and how it functions, it will fail.

In the absence of drought over several consecutive years, the NDC should conduct simulation exercises to keep leadership informed of their responsibilities during drought. This is a common practice in natural disaster mitigation (e.g., earthquakes, hurricanes); it should be no different for drought. Changes in political leadership, retirements, promotions, and transfers to other positions can disrupt the integrity of the plan.

Step 9: Development of Multilevel Educational and Training Program

Educational and training programs should concentrate on several points. First, a greater level of understanding must be established to heighten public awareness of drought and water conservation and the ways in which individual citizens and the public and private sectors can help to mitigate impacts in the short and long term. The educational process might begin with the development of a media awareness program. This program would include provisions to improve the media's understanding of the drought problem and the complexity of the management issues involved, as well as a mechanism to ensure the timely and reliable flow of information to all members of the media (e.g., via news conferences). Second, the NDC should initiate an information program aimed at educating the general population about drought and water management and what they can do as individuals to conserve water in the short run. Educational programs must be long-term in design, concentrating on achieving a better understanding of water conservation issues among all age groups and economic sectors. If such programs are not developed, governmental and public interest in and support for drought planning and water conservation will wane during periods of nondrought conditions.

Step 10: Development of Drought Plan Evaluation Procedures

The final step in the establishment of a drought plan is the creation of a detailed set of procedures to ensure adequate evaluation. To maximize the effectiveness of the plan, two modes of evaluation must be in place:

1. An ongoing or operational evaluation program that considers how societal changes such as new technology, the availability of new research results, legislative action, and changes in political leadership may affect the operation of the plan.
2. A post-drought evaluation program that documents and critically analyzes the assessment and response actions of government, NGOs, and others as appropriate and implements recommendations for improving the system.

The first mode of evaluation is intended to express drought planning as a dynamic process, rather than a discrete event. The operational evaluation program is proposed to keep the drought assessment and response system current and responsive to national needs. Following the initial establishment of the plan, it should be monitored routinely to ensure that societal changes that may affect water supply and/or demand or regulatory practices are considered for incorporation. Accordingly, drought plans should be revised periodically.

The second mode of evaluation is the post-drought audit, which should be conducted or commissioned by governments in response to each major drought episode. Institutional memory fades quickly following drought as a result of changes in political administration, natural attrition of persons in primary leadership positions, and the destruction of critical documentation of events and actions taken. Post-drought evaluations should include an analysis of the physical aspects of the drought: its impacts on soil, groundwater, plants, and animals; its economic and social consequences; and the extent to which predrought planning was useful in mitigating impacts, in facilitating relief or assistance to stricken areas, and in post-drought 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. Provisions must be made to implement the recommendations emanating from this evaluation process. Evaluations of previous responses to severe drought are recommended as a planning aid to determine those actions (both technical and relief) that have been most effective.

The post-drought evaluation process will identify numerous topics that may require research in order for them to be more adequately addressed during future drought episodes. For example, little is known about the effects of government drought assistance programs. Do they facilitate or hinder the recovery process? Extensive research may be required on the environmental and socioeconomic effects of prolonged rainfall deficiency on various hydrological features such as the depletion of soil water and shallow groundwater. Investigation of the effects of drought on land use, vegetation, and soil is essential to the impact assessment process.

To ensure an unbiased appraisal, governments should place the responsibility for evaluating drought and societal response to it in the hands of nongovernmental organizations such as universities and/or specialized agencies or corporations. An excellent example of this practice in operation is the evaluation of India's Food for Work Program (Sinha et al., 1987). Although the program is implemented by state government, it is evaluated by an independent body, the Planning Commission (Wilhite and Easterling, 1989). Private foundations, research organizations, and international organizations should be encouraged to support post-drought evaluations.

6. Summary and Conclusions

Post-drought evaluations of government response to drought have demonstrated that the reactive or crisis management approach has led to ineffective, poorly coordinated, and untimely responses. The magnitude of economic, social, and environmental losses in the past several decades in developing and developed countries has pointed out the vulnerability

of all nations to extended episodes of severe drought. Increased awareness and understanding of drought has led a growing number of governments to take a more proactive approach to drought management by attempting to reduce impacts in the short term and vulnerability in the long term. This approach must integrate drought policy with issues of sustainable development.

The development of drought policies that promote risk management and the preparation of contingency plans exemplify a philosophical change by governments in their approach to drought management. Drought preparedness plans promote greater coordination within and between levels of government; improved procedures for monitoring, assessing, responding to, and mitigating severe water shortages; and more efficient use of natural, financial, and human resources.

It is recommended that the governments of all drought-prone nations immediately proceed to formulate drought preparedness plans. The essential elements to consider in the formulation of these plans were presented in this paper in a ten-step process to facilitate plan development. A preparedness plan will lead to a more effective, efficient, and timely approach to drought management, with greater emphasis on long-term vulnerability reduction rather than short-term emergency response. Governments are advised to consider this proposed planning process carefully, modifying or adapting it to their particular circumstances by adding or deleting steps as necessary.

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