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8: Reducing the Impacts of Drought: Progress Toward Risk Management

DONALD A. WILHITE

INTRODUCTION

Images of malnutrition, famine and a degraded African landscape were commonplace during the 1980s and appear likely to continue well into the 1990s and beyond. Glantz (1987) has shown that drought has hindered the ability of much of sub-Saharan Africa to achieve a sustained level of agricultural production and, as a result, has retarded progress toward economic development. Linkages between drought and economic development, although most obvious in Africa, exist throughout much of the developing world.

The impacts of drought in developed countries differ substantially from those experienced in much of the developing world. Absent are the widespread occurrences of food shortages, which may lead to malnutrition and famine, and large-scale evidence of land degradation. However, economic costs, particularly in the agricultural, energy and transportation sectors, are substantial. The recent droughts in the United States and Canada have been stark reminders of the vulnerability of all nations to this extreme climatic event. This increased awareness of the economic, social and environmental costs of drought is leading a growing number of nations, both developed and developing, to seek a more proactive approach to drought management. These nations now realize that they can no longer afford to divert scarce financial resources to drought relief programs that do little to reduce, and may actually increase, vulnerability to subsequent periods of water shortage.

The purpose of this chapter is to present a case study of the recent progress that has been made by some countries in reducing their vulnerability to drought. Progress toward drought preparedness will be discussed for the United States of America, South Africa, and Australia. Although many countries have made significant progress in this area in recent years, these countries were chosen because of what is considered dramatic philosophical changes in the way drought

and its management are perceived by government. The intent is for other drought-prone regions to examine these approaches and consider adapting them to their particular social, political and environmental setting.

The chapter is divided into three parts. The first will present an overview of drought and drought planning that will serve as background information for later discussions of recent drought policy and program changes in the United States, Australia and South Africa, all discussed in the second section. The final section provides a brief description of a generic planning process that is being promoted as one method of developing comprehensive preparedness plans for dealing with future episodes of drought.

DROUGHT OVERVIEW

Drought as a natural hazard

Drought differs from other natural hazards (such as floods, hurricanes and earthquakes) in several ways. First, since the effects of drought accumulate slowly over a considerable period of time, and may linger for years after the termination of the event, a drought's onset and end are difficult to determine. Because of this, 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 about whether or not a drought exists and, if it does, its severity. Third, drought impacts are less obvious and are spread over a larger geographical area than is damage that results from other natural hazards. Drought seldom results in structural damage. For these reasons the quantification of impacts and the provision of disaster relief are far more difficult tasks for drought than they are for other natural hazards.

Although drought represents a considerable climatic risk in semi-arid regions, it is a normal part of the climate for

virtually all climatic regimes. Drought 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. Many people associate the occurrence of drought with the Great Plains of North America, Africa's Sahelian region, India or Australia; they may have difficulty visualizing drought in Southeast Asia, Brazil, Western Europe or the eastern United States, regions perceived by many to have a surplus of water.

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' (Wilhite and Glantz 1985). 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 significantly aggravate the severity of the event. Drought is also related to the timing (i.e. principal season of occurrence, delays in the start of the rainy season, occurrence of rains in relation to principal crop growth stages) and the effectiveness of the rains (i.e. rainfall intensity, number of rainfall events).

Responding to drought: a historical perspective

Governments have traditionally relied on a wide range of potential actions to deal with the impacts of water shortages on people and various economic sectors. In the United States, agencies of the federal government and both houses of Congress typically respond by making massive amounts of relief available to the affected areas. This generally takes the form of short-term emergency measures to agricultural producers, such as feed assistance for livestock, drilling of new wells and low-interest farm operating loans. In the section below, the primary features of drought policy in the United States and Australia are compared. In addition, the approaches taken historically by Brazil and India are described briefly.

United States and Australia

Wilhite (1986) compared drought policy in the United States and Australia to learn more about the approaches taken by two drought-prone nations to deal with the effects of drought. For that study, the principal features of drought policy were grouped into three categories: organizational, response and evaluation (see Table 1).

Organizational features are planning activities that provide timely and reliable assessments, such as a drought early-warning system, and procedures for a coordinated and

efficient response, such as drought declaration and revocation. These characteristics would be the foundation of a provincial, regional or national drought plan. Response features refer to assistance measures and associated administrative procedures that are in place to assist individual citizens or businesses experiencing economic and physical hardship because of drought.

Numerous assistance measures are available in the United States but few are intended specifically for drought. Table 2 lists the federal assistance programs used in the United States during the 1976–7 drought. Until recently, relief arrangements in Australia were included, for the most part, under the Natural Disaster Relief Arrangement agreements. These are now in the process of being discontinued as part of a proposed new national drought policy that will be discussed in a later section of this paper. Relief measures, by state, used during the 1982–3 severe drought in Australia are illustrated in Table 3.

Evaluation of organizational procedures and drought assistance measures in the post-drought recovery period is the third category of drought policy features. It is critical that governmental response efforts be evaluated during the post-drought period in order to avoid repeating the same mistakes during subsequent droughts. This evaluation is best accomplished by a nongovernmental organization, such as a university or private research group, that will be unbiased in its assessment. In Australia, governments have been more conscientious in their evaluation of drought response efforts. In the United States, the federal government has not routinely evaluated the performance of response-related procedures or drought assistance measures. Aspects of the 1976–7 drought were evaluated by the General Accounting Office (1979) and Wilhite *et al.* (1986). Responses to the 1987–9 droughts were examined by Riebsame *et al.* (1990).

Brazil

The most drought-prone region of Brazil is in the Northeast, often referred to as the 'drought polygon.' This region has a long history of drought, and the government has followed a variety of approaches to the problem, dating back to the Imperial Inquiry Commission that responded to the drought of 1877–9. One of the positive steps taken early to deal with the problem was the creation of the Department of Works to Overcome Drought (DNOCS) in 1909 (Pessoa 1987). Its purpose was to collect basic information about the region, including technical-scientific studies and maps, and to establish a meteorological and hydrological network for monitoring climate and water resources. In the 1960s, the Superintendency for Northeast Development (SUDENE) was created to expand existing monitoring networks, conduct hydrogeological research and integrated studies of potential natural resources, and map soil and mineral resources.

Table 1. *Comparison of drought policy features as of 1984: United States and Australia*

Features	United States	Australia
<i>Organization</i>		
National drought plan	None	Study in progress
State drought plans	In selected states	Through NDRA agreements
National drought early-warning system	Joint USDA/NOAA Weather Facility	Bureau of Meteorology
Agricultural impact assessment techniques	Available, but generally unreliable	Not available
Responsibility for drought declaration	Federal	State
Geographic unit of designation	County	Unit varies between states
Declaration procedures	Standard for all states; varies by program/agency	Varies between states; standard within states
<i>Response</i>		
State fiscal responsibility for assistance measures	Negligible, if any	Defined by NDRA agreements up to base amounts; varies by state
State administrative responsibility for assistance measures	No responsibility for federal measures	Defined by NDRA agreements and by federal measures
Eligibility requirements and provisions of drought assistance measures	Standard within programs for all designated counties	Varies by state for NDRA core measures; standard for federal programs
National crop insurance program	All-risk federal program	Rainfall insurance feasibility study in progress
<i>Evaluation</i>		
Post-drought documentation and evaluation of procedures and measures	No routine evaluation by government	Routine evaluation by federal and state governments

Source: NDRA, National Disaster Relief Arrangements; USDA/NOAA, US Department of Agriculture/National Oceanic and Atmospheric Administration.

In spite of the long history of actions taken to respond to drought in Northeast Brazil, the severe drought of 1979–83 found the region even more vulnerable to water shortages (Pessoa 1987). As a result, in 1985 the Civil Defense Plan was developed under the leadership of SUDENE to address both drought and flood problems. The purpose of the plan was to reduce the risks and impacts to the population and provide aid as necessary. The plan also triggers a drought watch system that produces more detailed climatological analyses and advisories.

Assistance programs have been of two types (Pessoa 1987). First, rural credit, water supply and food distribution programs are expanded to meet the needs of the distressed area. Second, public works projects are initiated to employ rural refugees in a variety of tasks, including:

- building water structures;
- transporting water supplies via tank trucks;
- providing reasonably priced staple food items;
- distributing food to ease social tension;
- planting trees;

- distributing fodder;
- supplying seeds;
- supporting small irrigation operations;
- distributing construction equipment;
- supporting literacy programs.

As a result of continuing problems in responding effectively to drought in the region, the government supported the conduct of a regional training seminar on drought management and preparedness in which the University of Nebraska's International Drought Information Center was one of the organizers and participants. As a result of this seminar, FUCEME (the State Meteorological Foundation of Ceará) is leading an effort aimed at enhancing regional coordination on drought planning.

India

Drought and famine mitigation efforts have had a long history in India, beginning with the adoption of 'famine codes' by several provincial governments in 1883 (Sinha *et al.* 1987). In 1975, the 'Drought Code' and 'Good Weather

Table 2. *Drought-related federal assistance programs used to respond to the 1976–7 drought in the United States, by agency*

Agency	Program name
<i>Department of Agriculture</i>	
Farmers Home Administration (FmHA)	Emergency Loans ^a Emergency Livestock Loans Farm Operating Loans Farm Ownership Loans Soil and Water Loans Irrigation and Drainage Loans Community Program Loans
Agricultural Stabilization and Conservation Service (ASCS)	Emergency Conservation Measures Emergency Livestock Feed Agricultural Conservation ^a Disaster Payments
Federal Crop Insurance Corp (FCIC)	Federal Crop Insurance ^a
Forest Service (FS)	Cooperative Forest Fire Control Cooperative Forest Insect and Disease Management Rural Community Fire Protection Drought-Related Stewardship
Soil Conservation Service (SCS)	Great Plains Conservation Resource Development and Conservation Conservation Technical Assistance Watershed Protection and Flood Prevention
<i>Department of the Interior</i>	
Bureau of Reclamation (BuRec)	Emergency Fund Drought Emergency ^a Drought-Related Technical Assistance
Bureau of Land Management (BLM)	Grazing Privilege Drought-Related Stewardship
Fish and Wildlife Service (FWS)	Drought-Related Stewardship
Southwest Power Administration	Emergency Electric Service ^a
<i>Economic Development Administration (EDA), Department of Commerce</i>	Community Emergency Drought Relief Economic Adjustment Public Works Impact Projects
<i>Small Business Administration (SBA)</i>	Emergency Drought Disaster Loans ^a Physical Disaster Loans Economic Injury Disaster Loans
<i>Federal Disaster Assistance Administration (FDAA), Department of Housing and Urban Development</i>	Disaster Assistance (Hay Transportation, Cattle Transportation, Emergency Livestock Feed, Forest Fire Suppression)
<i>Federal Power Commission/Federal Energy Administration (FPC/FEA)</i>	Drought-Related Services and Activities
<i>Employment and Training Administration (ETA), Department of Labor</i>	Unemployment Insurance Grants to States Farm Workers Comprehensive Employment and Training Programs (CETA) Employment Services
<i>General Services Administration (GSA)</i>	Donation of Federal Surplus Personal Property Sale of Federal Surplus Personal Property
<i>Defense Civil Preparedness Agency (DCPA), Department of Defense</i>	Civil Defense-Federal Surplus Personal Property Donations

Note: ^a Programs in the White House drought package.

Source: WESTPO (1977).

Table 3. *Drought relief measures available in Australia under the Natural Disaster Relief Arrangements, by state, as of March 1983*

Measure	New South Wales	Victoria	Queensland	South Australia	Western Australia	Tasmania	Northern Territory
<i>Concessional loans</i>							
Carry-on loans to primary producers	*	*	*	*	*	*	*
	(Maximum amount ranges from \$20 000 to \$40 000, with interest at 4%. Repayment period generally 7 years with discretionary repayment holiday of 1–3 years in some cases.)						
Restocking loans to primary producers	*	(1)	*	(1)	(2)	(1)	NA
	(Maximum amount ranges from \$20 000 to \$30 000, repayable over 7–10 years, at 4–5% interest rate.)						
Loans for purchase of fodder	*	NA	NA	NA	NA	NA	NA
	(Loans to dairy companies, repayable over 5 years, at 4% interest rate.)						
Loans for supply of water	NA	NA	(2)	NA	NA	NA	NA
	(80% of cost to local authorities for augmentation of town water supplies. Repayable over 7–9 years at 3–4% interest rate.)						
Carry-on loans for small business	NA	*	(2)	*	*	NA	NA
	(Maximum amount of \$40 000, repayable over 7–10 years at 4% interest rate.)						
Loans to cereal growers	(2)	NA	NA	NA	(2)	NA	NA
<i>Freight concessions</i>							
Stock movement	*	*	*	*	*	NA	*
	(Applies to rail and road at 75%.)						
Fodder	*	*		*	*	NA	*
	(Applies to rail and road, generally at 50–75% concession.)						
Water to primary producers	*	*	*	*	NA	NA	NA
	(Applies to private vehicle, generally at 75% concession.)						
Water to state, local or semigovernment authorities	NA	*	*	*	*	NA	NA
Machinery and equipment	NA	NA	(2)	NA	NA	NA	NA
Stock slaughter subsidy for primary producers	(2)	NA	(2)	(2)	(2)	(2)	(2)
	(Generally \$10–15 per head for cattle and \$1–3 per head for sheep.)						
Stock disposal subsidy to local, state and semigovernment authorities	*	*	*	*	*	NA	NA
	(Generally \$1 per head for cattle and 15 cents per head for sheep.)						
<i>Other subsidies</i>							
Water	*	*	(2)	*	(2)	NA	NA
	(Generally applies to drilling wells for towns or stock water at 75–100% concession.)						
Agistment	NA	(2)	(2)	NA	(2)	(2)	NA
	(Rate of \$1.00–1.75 per head of cattle and 10–12.5 cents per head for sheep and/or 50–75% of cost of adjustment.)						
Other	NA	(2)	(2)	NA	(2)	NA	NA

Notes:

*, included in core measures; NA, not available; (1), included in carry-on loans; (2), available but not part of core measures.

Code' were adopted. The Drought Code is anticipatory, providing a list of alternative cropping strategies that should be adopted when there is evidence of drought. These include anticipating conditions of food scarcity early in the season, maximizing production and alternating cropping patterns in irrigated areas, making mid-season corrections in crop planting in unirrigated areas, and building up seed and fertilizer buffers to implement the drought coping strategy. The Good Weather Code outlines the scientific, administrative and planning steps necessary to take full advantage of a good monsoon season to increase production of food grains. The Drought Watch group exists at the national level, made up of representatives of the Ministry of Agriculture, Meteorology Department, Indian Council of Agricultural Research, and Ministry of Information and Broadcasting, to monitor weather conditions throughout the country. This group receives regular reports from similar groups at the state and district levels.

The strategies currently being used by the Indian government to reduce vulnerability are a combination of emergency and long-term programs. These tactics include early monsoon forecasts; improved communication systems; provision of resources such as credit, fertilizers, pesticides, and power for increasing production; assistance to farmers in poor monsoon years; maintenance of adequate prices; maintenance of reasonable buffer stocks of food grains in strategic locations; and improved transportation systems (Sinha *et al.* 1987). The government has also undertaken a nationwide satellite monitoring program to provide early warning of the potential impacts of drought on agricultural production (Thiruvengadachari 1991). Evidence would seem to indicate that the drought-prone areas of India are less vulnerable to drought today than they were several decades ago because of the country's maintenance of buffer stocks of food for distribution during times of shortage (A. R. Subbiah, personal communication).

The Agro-Meteorology Service of India is striving to improve weather predictions, prepare climatological information for agricultural decision making, develop delivery systems to provide timely collection and distribution of data and information to users, and develop advisories on agricultural operations for contingency cropping practices during drought.

RECENT PROGRESS IN DROUGHT PREPAREDNESS

Governments worldwide have shown increased interest in drought planning since the early 1980s. Several factors have contributed to this interest. First, the widespread occurrence of severe drought over the past several decades and, specifically, the years during and following the extreme ENSO

event of 1982–3 focused attention on the vulnerability of all nations to drought. Second, the costs associated with drought are now better understood by some governments. These costs include not only the direct impacts of drought but also the indirect costs (i.e. personal hardship, the costs of response programs, retardation of economic development and accelerated environmental degradation). Nations can no longer afford to allocate scarce financial resources to short-sighted response programs that do nothing to mitigate the effects of future droughts. Finally, the intensity and frequency of extreme meteorological events such as drought may increase, given projected changes in climate associated with increasing concentrations of carbon dioxide and other atmospheric trace gases. Droughts are a climatic certainty and recent events worldwide have highlighted the importance of preparing now for future episodes. From an institutional point of view, learning today to deal more effectively with climatic events such as drought may serve us well in preparing proper response strategies to long-term climate-related issues.

Global concern exists within the scientific and policy communities about the inability of governments to respond to drought in an effective and timely manner. In the past decade, numerous 'calls for action' for improved drought planning and management have been issued by national governments, professional organizations, international organizations, and others. The challenge of changing the perception of policy makers and scientists worldwide about drought is a formidable one. The typical mode of operation for government in dealing with natural hazards is crisis management. It is indeed a difficult task for government to engage in long-range planning. However, the progress currently being made in planning for future drought demonstrates a new awareness and improved understanding of drought and its economic, social and environmental impacts.

United States

In the past decade, droughts have been a prevalent feature of the American landscape. These droughts have resulted in significant impacts in a myriad of sectors, including agriculture, transportation, energy, recreation and health; they have also had adverse environmental consequences. In society's attempt to cope with the effects of these extended periods of water shortage in recent years, the inadequacy of federal contingency planning efforts has been confirmed once again. The inability of the United States government to respond effectively has also illustrated the inflexibility of existing water management systems and policies as well as the lack of coordination between and within levels of government.

Previous studies have demonstrated that the impacts of both short-term and multi-year drought in the United States have been aggravated by poorly conceived or nonexistent

assessment and response efforts by governments. These efforts have been characterized as largely ineffective, poorly coordinated, and untimely (General Accounting Office 1979; Wilhite *et al.* 1986; Wilhite and Easterling 1987). As a result, there have been numerous 'calls for action' by regional and national organizations for the development of a national drought policy to coordinate federal response to drought. These calls include recommendations from the Western Governors' Policy Office (1978), General Accounting Office (1979), National Academy of Sciences (1986), Interstate Conference on Water Policy (1987), Environmental Protection Agency (Smith and Tirpak 1989), Great Lakes Commission (1990), and the American Meteorological Society (Orville 1990). The call from the Environmental Protection Agency (EPA) has come about as a result of the concern that exists about a possible increase in the frequency and severity of extreme events in association with projected changes in climate because of increasing concentrations of atmospheric trace gases.

Despite the numerous calls for the development of a national drought policy and plan, the federal government has not acted on these recommendations. The primary reason for the lack of progress by federal agencies seems to be the unique character and multidisciplinary nature of drought and the cross-cutting responsibilities of federal agencies for drought assessment and response programs. Clearly, a single federal agency must take the lead in coordinating the development of a national plan. It is less clear which federal agency should assume this responsibility. In the final analysis, it may take an executive order to initiate the process at this level. In the meantime, progress in drought management at the federal level has been sluggish and agency-specific (e.g. Corps of Engineers, Bureau of Reclamation).

Because of the factors mentioned above and an apparent lack of appreciation by federal agencies of the complexity and seriousness of drought management issues faced by states, it became clear to many states during the mid-1980s that progress toward a higher level of preparedness would be achieved only if they took the lead. Historically, state governments have played a passive role in governmental efforts to assess and respond to drought. During the widespread and severe drought of 1976–7, for example, no state had prepared a formal drought response strategy. In 1982, only three states had developed plans: South Dakota, New York and Colorado. Generally speaking, states have relied on the federal government to come to their rescue when water shortages reach near-disaster proportions by providing relief to drought victims.

At present, 23 states have prepared some type of formal drought contingency plan (Wilhite 1991a). The pattern of states with drought plans is illustrated in Fig. 1. This pattern is complex and can be only partially explained on the basis of the climatology of drought. Impediments to plan develop-

ment were discussed earlier in the chapter. However, each state's decision to develop (or not to develop) a drought plan is based on specific climatological, political, economic and demographic factors. An analysis of the relative importance of these factors has been completed but will not be discussed here (Wilhite and Rhodes 1994). For those states that have developed plans, planning efforts have often been conducted in conjunction with an overall water management planning initiative. Clearly, states can now be labelled policy innovators in drought planning.

An examination of existing state drought plans reveals that they have certain key elements in common. Administratively, a task force is responsible for the operation of the system and is directly accountable to the governor. The task force keeps the governor advised of water availability and potential problem areas; it also recommends policy options for consideration. Operationally, drought plans have three features in common. First, a water availability committee continuously monitors water conditions and prepares outlooks a month or season in advance. Since most of the information necessary to monitor water conditions comprehensively (i.e. precipitation and temperature, streamflow, groundwater levels, snowpack, soil moisture, meteorological forecasts) is available from state or federal agencies, the primary role of the committee is to coordinate the collection and analysis of this information and the delivery of products to decision makers on a timely basis. The committee assimilates this information and issues timely reports and recommendations. Second, a formal mechanism usually exists to assess the potential impacts of water shortages on the most important economic sectors. In some states this task is accomplished by a single committee or, more commonly, separate working groups are established to address each sector. Third, a committee or the task force referred to previously considers current and potential impacts and recommends response options to the governor.

Although many of the mitigative programs implemented by states during recent droughts can be characterized as emergency actions taken to alleviate the crisis at hand, these actions were often quite successful. As states gain more experience assessing and responding to drought, future actions will undoubtedly become more timely and effective. State drought preparedness plans will become broader in scope, addressing a wider range of potential mitigative actions, including more meaningful levels of intergovernmental coordination. In time this will help states avoid or reduce the impacts, conflicts and personal hardships associated with drought. To be successful, these plans should be integrated with local, regional and national plans, if they exist.

Fortunately, many resources are now available to assist governments in the drought planning process. The existence of model plans (Western States Water Council 1987; Wilhite

Figure 1: States in the contiguous United States with drought plans, as of 1991. (Alaska and Hawaii have not prepared drought plans.)

1990) and 23 state plans provide a critical reference for states desiring to develop a plan or revise an existing plan. In addition, several regional organizations have considerable experience in drought planning and can assist states in plan development (e.g. Delaware River Basin Commission, Great Lakes Commission, Western Governors' Association).

South Africa

Actions taken by the South African government in response to droughts have typically been poorly coordinated and assistance programs have been largely ineffective (C. R. Baard, personal communication 1985). According to Baard, the government has had difficulty assessing drought impact and making subsequent declarations, and no routine comprehensive evaluation of government drought policy and response efforts has been completed.

For many decades, drought assistance programs in South Africa concentrated mainly on providing relief to the livestock industry, with little attention to crop farming, either

dryland or irrigated (Wilhite 1987). The rationale behind this emphasis on the livestock industry in South Africa has been that 85% of all agricultural land in the country remains under native pastures, most of which lie in the dry zones of the western and northwestern part of the country. The incidence of drought in these drier zones is about one year in three. Only 15% of South Africa receives precipitation in excess of 500 millimeters per year. A serious drought that began in 1978 and affected, to varying degrees, 75% of South Africa resulted in significant expenditures by the government for drought relief. For example, during the 1984–5 fiscal year the government spent approximately R447 million in support of various relief programs (C. R. Baard, personal communication 1985). During the years 1987–9 the government allocated R1300 million to drought and flood relief schemes (Bruwer 1990). Expenditures of this magnitude represent a significant expenditure of funds and illustrate the serious threats that natural disasters pose to the country.

In the decades immediately preceding the 1980s, drought relief was provided through a phased approach, but only to

farmers in those areas officially designated by the government (Wilhite 1987). The principal purpose of these assistance programs was to help livestock farmers preserve their herds until dry conditions eased. This assistance was intended to apply only to extended or disaster droughts, although it was often difficult to distinguish between these and 'normal' droughts. Assistance provided was generally in the form of rebates (phase 1) for transportation costs incurred in importing livestock feed to the affected area or in shipping animals to areas where grass was available. If drought conditions continued to deteriorate, loans to purchase livestock feed (phase 2) were then made through the Agricultural Credit Board. A continuation of drought conditions brought about the availability of subsidies from the government to farmers to help pay for feed (phase 3). One of the principal difficulties with this phased approach was that it did not encourage farmers to adopt production strategies that favored a minimization of risk to the agricultural resource base (soil, water and vegetation), an approach more in harmony with environmental constraints (Bruwer 1990). Indeed, farmers prefer to strive for maximum production, regardless of the potential effects on the resource base.

After 1980, the drought relief scheme was modified, placing greater emphasis on the preservation of the agricultural resource base and the self-sufficiency of livestock farmers to endure droughts of other than disaster proportions (Bruwer 1990). The current approach requires a reduction in stock numbers as a prerequisite for eligibility for the forms of relief available during a 'disaster' drought. In order to facilitate this approach, the country was divided into grazing capacity zones. Grazing capacity is defined as the number of hectares per livestock unit which can be kept and maintained on the natural veld or grassland, as well as planted pastures, crop residues and any other fodder produced on the farm. This new relief scheme provided for rebates on the transportation costs of livestock feed, incentives for stock reduction, loans and subsidies for the cost of livestock feeds in order to maintain the herd nucleus, and subsidies for finishing stock in feedlots. Incentives were in the form of monthly payments to farmers and were calculated on a per livestock unit basis. Consideration was given to the type of stock (i.e. large versus small) in the calculation of incentives. Other types of assistance now available to farmers during droughts include a water quota subsidy for irrigators and incentives for converting marginal cultivated lands to perennial pasture crops in both summer and winter rainfall zones.

To administer the new drought policy and relief scheme an institutional structure was established. This structure included a National Drought Committee (NDC), with multiagency representation, to advise the Minister of Agriculture on drought assistance matters and to scrutinize applications for assistance from affected areas (Bruwer

1989). District Drought Committees (DDC) were also established at the local level to consider all applications for the designation or revocation of disaster drought areas according to the criteria specified by the NDC. The NDC is responsible for approving or rejecting these applications. The DDC is composed of the magistrate (chair) and representatives of the District Farmers' Union, Agricultural Credit Committee, Soil Conservation Committee, and the Department of Agriculture and Water Supply.

On the basis of experiences with the new drought policy during the 1980s, the government of South Africa is convinced that the new relief scheme has contributed significantly to sustained agricultural production and development, helped to maintain rural communities and infrastructure, counteracted unemployment, reduced political pressure, and increased cooperation between agricultural groups and government, thus promoting mutual acceptance of responsibility for coping with disasters (Bruwer 1990). However, Bruwer has noted some deficiencies and shortcomings of the current system. These include the lack of adequate indices to identify disaster droughts, lack of suitable assessment procedures and inadequate monitoring techniques (including an improved weather station network). A considerable amount of drought-related research also needs to be undertaken, including post-drought audits of past relief efforts.

To assist the DDCs with the evaluation of drought intensity and the determination of eligibility for drought relief, the government recently implemented a scheme that provides for greater uniformity, objectivity and accuracy in the assessment of drought impact. The main elements evaluated by the procedure are climate, veld, pastures and crops, livestock and water (Roux 1991).

The process of developing a better approach to drought management in South Africa is not complete. The government continues to strive for better ways to reduce the risk of drought through proactive measures. According to Bruwer, 'society is demanding a more rational, cost effective and proactive approach' for future drought relief schemes. It is essential that this approach reduce the taxpayer's burden and provide incentives for diminishing natural resource degradation.

Australia

The Australian constitution does not delegate specific powers covering natural disaster relief to the federal government. These powers belong primarily to the states, which, as a result, have taken a more active role in drought response than state governments in the United States and elsewhere.

Before 1971, natural disaster relief and restoration was provided at a state's request by joint federal/state financing

Table 4. *Expenditures in Australian states under Natural Disaster Relief Arrangements, by type of disaster, 1970-1 to 1983-4 (A\$ thousands)*

	New South Wales	Victoria	Queensland	South Australia	Western Australia	Tasmania	Northern Territory	Total
1970-1	3 239	—	15 623	—	—	596	—	19 458
1971-2	458	—	3 143	—	—	—	—	3 601
1972-3	—	—	—	—	—	—	—	—
1973-4	987	—	—	—	—	—	—	987
1974-5	160	—	—	—	—	—	—	160
1975-6	—	—	—	—	—	—	—	—
1976-7	1 120	1 626	—	—	3 023	—	—	5 769
1977-8	2 620	1 228	2 785	13 580	17 999	—	—	38 212
1978-9	3 013	1 422	5 165	9 257	8 070	—	—	26 927
1979-80	—	—	2 208	2 225	12 560	—	—	16 993
1980-1	66 810	—	22 768	—	20 142	—	—	109 720
1981-2	31 018	—	9 608	—	5 081	295	—	46 002
1982-3	53 645	34 796	51 982	27 380	12 653	1 282	—	181 738
1983-4 (estimate)	21 500	8 100	63 300	4 600	22 100	1 900	—	121 500
Total	184 570	47 172	176 582	57 042	101 628	4 073	—	571 067

Source: National Drought Consultative Committee (1984).

on a one-to-one cost-sharing basis. No limit was set on the level of funding that could be provided by the federal government. In 1971 the Natural Disaster Relief Arrangements (NDRA) were established, whereby states were expected to meet a certain base level or threshold of expenditures for disaster relief from their own resources (Department of Primary Industry 1984). Disasters provided for in this arrangement are droughts, cyclones, storms, floods and bush fires. These expenditure thresholds were set according to 1969-70 state budget receipts and therefore varied between states. The base levels were raised in 1978 and 1984 (National Drought Consultative Committee 1984; Keating 1984). Under the NDRA system, the federal government agreed to provide full reimbursement of eligible expenditures after the thresholds for state expenditures on natural disasters were reached. The NDRA formalized, for the first time, joint federal-state natural disaster relief arrangements.

At the time of the establishment of NDRA, a special set of core measures (i.e. federal government-approved drought assistance measures) had evolved in each state on the basis of 30 years of government involvement in disaster relief. These measures were particularly relevant to the needs of each state because they had been designed by state government in response to its own disaster-related experiences.

Tables 4 and 5 provide data on state and federal expenditures for drought aid from 1970-1 to 1983-4 under the NDRA. The magnitude of state expenditures is significant,

especially when compared with the limited financial responsibility of states in the United States. The total for all states was just over A\$570 million. Of this total, approximately A\$180 million was expended during 1982-3 and A\$120 million during 1983-4. Federal expenditures to the states for drought aid under the NDRA arrangements (Table 5) were just under A\$370 million, or about A\$200 million less than the total state expenditures. The largest share of the assistance was provided to Queensland and New South Wales.

In addition to the cost-sharing measures described above, two federal drought assistance schemes were available during the 1982-3 drought. These were the Drought Relief Fodder Subsidy Scheme and the Drought Relief Interest Subsidy Scheme (National Drought Consultative Committee 1984). The Fodder Subsidy Scheme provided a payment to drought-declared primary producers to help defray the cost of fodder for sheep and cattle. The administrative costs of this program were covered by the states. The amount of the subsidy was based on 50% of the price of feed wheat and the nutritive value of the fodder relative to wheat; Commonwealth expenditures under this program were about A\$104 million during 1982-3 and A\$18 million through February 1984.

The Drought Relief Interest Subsidy Scheme provided payments to eligible primary producers to cover all interest payments exceeding 12% per year. To be eligible, producers had to have been drought declared and could not have

Table 5. *Commonwealth of Australia payments under Natural Disaster Relief Arrangements, estimated by type of disaster, 1970-1 to 1983-4 (A\$ thousands)*

	New South Wales	Victoria	Queensland	South Australia	Western Australia	Tasmania	Northern Territory	Total
1970-1	450	—	13 632	—	—	16	—	14 098
1971-2	—	—	1 502	—	—	—	—	1 502
1972-3	—	—	46	—	—	—	—	46
1973-4	38	—	—	—	—	—	—	38
1974-5	114	—	—	—	—	—	—	114
1975-6	—	—	—	—	—	—	—	—
1976-7	779	716	—	—	2 134	—	—	3 629
1977-8	1 458	399	3 091	12 350	15 269	—	—	32 567
1978-9	743	173	2 942	5 430	6 036	—	—	15 324
1979-80	—	-229	1 224	-270	6 922	—	—	7 647
1980-1	42 447	—	14 780	-737	13 523	—	—	70 013
1981-2	14 554	—	5 162	—	2 239	267	—	22 222
1982-3	32 557	22 695	37 297	18 368	7 731	—	—	118 648
1983-4 (estimate)	11 800	4 600	45 300	4 300	15 300	600	—	81 900
Total	104 940	28 354	124 976	39 441	69 154	833	—	367 748

Source: National Drought Consultative Committee (1984).

available financial assets in excess of 12% of the total farm debt. Expenditures for the program, not including administrative costs, were about A\$3 million in 1982-3 and A\$23 million through February 1984.

The Livestock and Grain Producers Association (LGPA) of New South Wales strongly commended the state and federal governments of Australia for their drought assistance measures. LGPA based its conclusions on the achievement of what it considers to be the first priority of drought aid in Australia – the preservation of the national sheep and cattle herd. Through the preservation of these resources, farm and non-farm income was able to recover more quickly than after previous episodes of severe drought. LGPA estimated that, had government not intervened in 1982-3, some 15-20 million sheep would have been slaughtered. As a result, post-drought recovery would have been delayed, at a cost to the national economy of A\$500 million over a 5-year period (Anonymous 1983). However, the Australian Agricultural Council (1983) concluded, 'With the exception of concessional finance and information, existing policy measures, including those introduced during the current (1982-83) drought, do not perform well in achieving the objectives of drought policy which it considered important. In summary, the nearly \$300 million of expenditures was not cost effective.'

These contrasting views of the cost effectiveness of recent drought measures in Australia reflect the recent controversy

over state and federal involvement in drought aid. Several other studies have been completed (National Farmers' Federation 1982; South Australian Department of Agriculture 1983; Stott 1983), each providing recommendations for future drought policy. A National Drought Consultative Committee (NDCC) was appointed by the Minister for Primary Industry in 1984 to review Australian drought policy.

In April 1989 the Commonwealth government decided to remove drought from the NDRA scheme described previously. Following this action, a drought policy review was recommended by the Commonwealth in May 1989 under the leadership of the Minister for Primary Industries and Energy. The objectives of this review (Drought Policy Review Task Force 1990) were to (1) identify policy options that encourage primary producers and other segments of rural Australia to adopt self-reliant approaches to the management of drought; (2) consider the integration of drought policy with other relevant policy issues; and (3) advise on priorities for Commonwealth government action in minimizing the effects of drought in the rural sector. An important aspect of this policy review was to examine the extent to which the policies of the Commonwealth government promote more effective farm management given the seasonality of climates and climatic variability. The task force concluded that the relief measures that have been used in the past have not provided a positive incentive for effective farm manage-

ment or responsible land management. On the contrary, it was determined that common misperceptions of drought have guided past policies by government, leading to a process of crisis management or 'gambling on the weather' by the agricultural community (Drought Policy Review Task Force 1990).

Several objectives of a newly defined national drought policy emerged from the task force review. These objectives are to (1) encourage primary producers and other segments of rural Australia to adopt self-reliant approaches in managing for climatic variability; (2) facilitate the maintenance and protection of Australia's agricultural and environmental resource base during periods of increasing climate stress; and (3) facilitate the early recovery of agricultural and rural industries consistent with long-term sustainable levels. Within this framework, numerous more specific objectives of these policies were stated. The primary thrust of this change in national policy is from one of crisis management to one of risk management. The intent of the task force was to apply this approach at two management levels: farm and government policy. This integrated approach is the foundation of the proposed changes in national policy, changes that have met with some resistance. The proposed changes are presently under review.

ADVANCING DROUGHT PREPAREDNESS IN THE 1990s

Drought policy versus planning objectives

Drought planning is defined as actions taken by individual citizens, industry, government, and others in advance of drought for the purpose of mitigating some of the impacts and conflicts associated with its occurrence (Wilhite 1991b). From an institutional perspective, a drought preparedness plan should include, but is not limited to, the following elements:

- (1) A comprehensive, integrated monitoring/early warning system to provide decision makers at all levels with information about the onset, continuation and termination of drought conditions and their severity.
- (2) Operational impact assessment programs to determine reliably the likely effects of drought in a timely manner.
- (3) An institutional structure for coordinating governmental actions, including information flow within and between levels of government, and drought declaration and revocation criteria and procedures.
- (4) Appropriate drought assistance programs (both technical and relief) with predetermined eligibility and implementation criteria.
- (5) Financial resources to maintain operational programs and to initiate research required to support drought assessment and response activities.

- (6) Educational and public awareness programs designed to promote an understanding and adoption of appropriate drought mitigation and water conservation strategies among the various economic sectors most affected by drought.

To be successful, drought planning must be integrated between levels of government, involving the private sector, where appropriate, early in the planning process. As we have seen from the discussion presented in the previous section, progress has been made by some governments in taking a more proactive approach to drought management. For the majority of nations, however, much needs to be done. This final section of this chapter presents some key factors that should be considered by governments attempting to adopt the risk management approach in future drought response efforts.

Prior to the development of a drought preparedness plan, government officials should formulate a drought policy to define what they hope to achieve with that plan (Wilhite 1991b). The objectives of a drought policy differ from those of a drought plan. There must be a clear distinction of these differences at the outset of the planning process. A drought policy will be broadly stated and should express the purpose of government involvement in drought assessment, mitigation and assistance programs. 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, including the United States, 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 assistance measures, including grants and low-interest loans, and so forth), particularly at the federal level, 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 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 alleviate the effects of drought. Past relief measures have, at times, discouraged the adoption of appropriate management techniques. Assistance should also be provided in an equitable, consistent and predictable manner to all without regard to economic circumstances, industry or geographic region. Assistance can be provided in the form of technical aid or relief measures. Whatever the form, those at risk would know what to expect from government during drought and thus would be better prepared to manage risks. At least one objective should also seek to protect the natural and agricultural resource base. Degradation of these

resources can result in spiralling economic, environmental and social costs.

The objectives of drought policy can be achieved only if they are formulated at the initiation of the planning process. The entire planning process can then be structured around these basic themes. One question that government officials must address is the purpose and role of government involvement in drought mitigation efforts. Other questions should address the scope of the plan; identification of geographic areas, economic sectors and population groups that are most at risk; principal environmental concerns; and potential human and financial resources to invest in the planning process. Answers to these and other questions should help to determine the objectives of drought policy and therefore provide a focus for the drought planning process.

Constraints to drought planning

Institutional, political, budgetary and human resources constraints often make drought planning difficult (Wilhite and Easterling 1987, 1991). 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 drought planning. 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 drought 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 should understand that droughts, like floods, are a normal feature of climate. Their recurrence is inevitable. Drought manifests itself in ways that span the jurisdiction of numerous bureaucratic organizations (e.g. agricultural, water resources, health) and levels of government (e.g. federal, state and local). Competing interests, institutional rivalry and '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 planning requires input by several disciplines, and decision makers must play an integral role in this process.

The development of a drought plan is a positive step that demonstrates governmental concern about the effects of a

potentially hazardous and recurring phenomenon. Planning, if undertaken properly and implemented during non-drought 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 some impacts while reducing physical and emotional hardship. Planning is a dynamic process that must incorporate new technologies and take into consideration socioeconomic, agricultural and political trends.

It is sometimes difficult to determine the benefits of drought planning versus the costs of drought. There is little doubt that drought preparedness requires financial and human resources that are, at times, scarce. This cost has been and will continue to be an impediment to the development of drought plans. 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 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 state and federal governments with a low level of preparedness to be largely ineffective, poorly coordinated, untimely and economically inefficient. Unanticipated expenditures for drought relief programs are devastating to government budgets. For example, 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. 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. A disaster relief package was also passed by the US 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. The Republic of South Africa has spent R2.5 billion on drought relief in the past decade. When compared with these expenditures, a small investment in mitigation programs in advance of drought would seem to be a sound economic decision. In developing countries, droughts devastate regional and national economies and significantly hinder the development process.

It is 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. Also, drought plans should be incorporated into general natural disaster

and/or water management plans wherever possible. This would reduce the cost of drought preparedness substantially. Politicians and many other decision makers must simply be better informed about drought, its impacts, and alternative management approaches and how existing information and technology can be used more effectively to reduce the impact of drought at a relatively modest cost.

The development of a drought policy and plan: the ten-step process

A planning process was developed recently in the United States in order to facilitate the preparation of drought contingency plans by state government decision makers (Wilhite 1990, 1991). The proposed process is intended to assist government decision makers in improving drought mitigation efforts through more timely, effective and efficient assessment and response activities. The framework below presents the principal steps in the planning process in order for government to address its drought-related concerns. However, the process is intended to be flexible (i.e. governments can add, delete or modify steps as necessary).

The intent here is not to present a detailed discussion of each of these steps. What is included is a very brief description of the purpose and elements of each step as these relate to the overall planning process. This process must be modified or adapted to each region, adding or deleting steps as appropriate.

Step 1. Appointment of national/state drought task force or committee

The drought task force (DTF) or committee should be appointed by the president, governor or designated government official and include representatives from all relevant agencies of government. This task force will be composed of senior policy makers.

The DTF has two purposes. First, during plan development, the DTF will supervise and coordinate the development of the plan. Second, after the plan is implemented and during times of drought when the plan is activated, the DTF will assume the role of policy coordinator – reviewing and recommending alternative policy response options to the appropriate policy official. The makeup of the DTF should recognize the multidisciplinary nature of drought and its impacts and include representatives of both state and federal government. The DTF should consider including a representative of the media or a public information specialist in an advisory capacity so that the proper mechanisms are incorporated into the plan to ensure public awareness of drought severity and the actions implemented by government.

Environmental and public interest groups may also be

included on the DTF, or they may serve in an advisory capacity. The actual makeup of the task force is expected to be highly variable between states or countries, reflecting the variety of economic sectors affected and political infrastructure. Membership should be kept relatively small so that size does not become an impediment to the planning process. What is envisioned is the development of an infrastructure that can not only assess and respond to short-term reductions in water supply due to drought, but also can address questions of changes in vulnerability in the long term.

Step 2. Statement of drought policy and planning objectives

The first official action of the DTF will be the determination of a drought policy. This policy will lead to the development of a general statement of purpose for the drought plan.

A general statement of purpose for a drought plan could be to provide an effective and systematic means of assessing and responding to drought conditions. The DTF then must identify specific objectives of the plan. Drought plan objectives and their applications will vary between countries or states, reflecting the unique physical, environmental, socioeconomic and political characteristics of each location. Some objectives that might be considered include:

- (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 of the state and to trigger the initiation and termination of various assessment and response activities by governmental agencies 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. To ensure adequate coordination between the federal and state governments, this structure should be integrated with national drought policies (if they exist).
- (4) To maintain a current inventory of assistance programs used in assessing and responding to drought emergencies and provide a set of appropriate action recommendations.
- (5) To provide a mechanism to assure 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 the needs of the state.

Step 3. Resolving conflict between environmental and economic sectors

Political, social and economic values often clash during drought conditions as competition for scarce water resources intensifies, and it may be difficult to achieve compromises. 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. The DTF should ensure that frequent, thorough and accurate news releases are issued to explain changing conditions and complex problem areas. To lessen conflict and develop satisfactory solutions, it is essential that the views of citizens and public and environmental interest groups be considered in the drought planning process at an early stage. Although the level of involvement of these groups will no doubt vary notably, the power of public interest groups in policy making is considerable. Public interest organizations have initiated and participated in the development of natural resource policies and plans for some time and have considerable experience with this process. The involvement of these groups in determining appropriate policy goals strengthens the overall policy and plan. Moreover, this involvement assures that the diverse values of society are adequately represented in the policy and plan.

Step 4. Inventory of natural, biological, and human resources and financial and legal constraints

The DTF should undertake an inventory of natural, biological and human resources, including the identification of financial and legal constraints. Resources include, for example, natural and biological resources, human expertise, infrastructure, and capital available to government. Financial constraints include costs of hauling water or hay, new program or data collection costs, and so forth; legal constraints include user water rights, existing public trust laws, methods available to control usage, requirements for contingency plans for water suppliers, and emergency and other powers of the government during water shortages. An inventory of these resources would reveal assets and liabilities that might have an effect on the planning process; in addition, a comprehensive assessment of available resources would provide the information necessary for further action by the task force.

Step 5. Development of the drought plan

The DTF will be the coordinating body for the development of a drought plan. 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

Figure 2: Linkages and suggested organizational components of the drought plan.

structure of the plan. A flow chart illustrating these linkages and the suggested components of the drought plan is shown in Fig. 2.

A drought plan possesses three essential elements: monitoring, impact assessment and response. These elements are the basis for three committees: (1) Water Availability and Outlook Committee (WAOC); (2) Impact Assessment Committee (IAC); and (3) Drought Response Committee or Drought Task Force (DTF). Although each committee has its own distinct activities, formal linkages will need to be incorporated in the plan for the committees to function properly and be responsive to state needs and changing conditions. The WAOC's activities would include defining drought and developing triggers, identifying drought management areas, developing a monitoring system for drought, completing an inventory of observation networks, determining primary users and their needs, and developing data and information delivery systems. Membership of the committee should include representatives from agencies with responsibilities for forecasting and monitoring the principal indicators of the water balance.

During periods of drought, impacts will be far-reaching and cut across economic sectors and the responsibilities of government agencies. The IAC will represent those economic sectors most likely to be affected by drought. The IAC chairperson should be a permanent member of the DTF; the rest of the committee should consist of an interagency team

of agency heads or their representatives. The IAC should consider both direct and indirect losses resulting from drought, since its effects ripple through the economy. Because of the obvious dependency of the IAC on the WAOC, frequent communication is essential. What is recommended is a series of working groups responsible for anticipating and identifying drought-related impacts in each economic sector. The responsibility of the IAC is to coordinate the activities of each of the working groups and make policy response recommendations to the DTF.

A drought response committee comprising senior-level officials will act on the information and recommendations of the IAC and evaluate the state and federal programs available to assist agricultural producers, municipalities, and others during times of emergency. The makeup of this committee is envisioned to be roughly the same as that of the DTF. Therefore, for maximum efficiency the DTF can assume this function once the plan has been developed and fully implemented. The DTF will present its recommendations to the governor.

During the plan development process, the DTF should make an inventory of all forms of assistance available from government during severe drought and evaluate these programs for their ability to address short-term emergency situations and as long-term mitigation programs to reduce vulnerability to drought. The DTF should also be aware of the proper protocol for requesting federal assistance.

Step 6. Identification of research needs and institutional gaps

The purpose of this step is to identify research needed in support of the objectives of the drought plan and to recommend research necessary to remove deficiencies that may exist. The research needs and institutional gaps will be identified by the monitoring, impact assessment and response committees. These committees will make recommendations to the national/state drought committee for further action.

Step 7. Synthesis of scientific and policy issues

Direct and extensive contact is required between scientists and policy makers to distinguish what is feasible from what is desirable. Typically little contact occurs between these two groups. The purpose of this step is to identify ways to break down the barriers that exist between disciplines and between scientists and policy makers.

Step 8. Implementation of the drought plan

The drought plan should be implemented by the DTF to give maximum visibility to the program and credit to the agencies and organizations that have a leadership or supporting role in its operation. The plan should be tested under simulated drought conditions before it is implemented, and simulation

exercises should be carried out periodically following implementation. It is also suggested that announcement and implementation occur just before the most drought-sensitive season to take advantage of inherent public interest.

Step 9. Development of multilevel educational and training programs

Educational and training programs must be long term in design, concentrating on a broad audience ranging from policy makers to extension personnel to individual citizens.

Educational and training programs should emphasize 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, industry and government can help to mitigate impacts in the short run. This educational process might begin with the development of a media awareness program. Second, the DTF should initiate an information program aimed at educating the general population about drought and drought 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 elementary school children. If such programs are not developed, governmental and public interest in and support for drought planning will wane during periods of non-drought conditions.

Step 10. Development of drought plan evaluation procedures

The drought plan must be evaluated and revised periodically to remain responsive to the needs of each country. Two modes of evaluation are recommended. The first is a continuous (every 1–2 years) evaluation and revision to adjust the plan in light of political, economic, technological and social changes. This mode of evaluation is intended to express drought planning as a dynamic process, rather than a discrete event. The evaluation process is proposed to keep the drought assessment and response system current and responsive to the needs of society. 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.

The second mode of evaluation follows an episode of severe drought in which the plan was activated. A post-drought evaluation of the plan should be undertaken by a non-governmental organization to assure an unbiased appraisal of the assessment and response actions. 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.

CONCLUSION

Post-drought audits of government response to drought have demonstrated that the reactive or crisis management approach has led to ineffective, poorly coordinated and untimely responses. Also, the magnitude of economic, social and environmental losses in recent years has illustrated the vulnerability of all nations, developed and developing, to extended episodes of severe drought. Increased awareness and understanding of drought have led many governments to take a more proactive approach toward drought management, thus attempting to reduce impacts in the short term and vulnerability in the long term. This approach promotes the concept of increased harmony between government policy, land management practices and environmental constraints, leading to more sustainable agricultural production.

This chapter documents some of the recent progress that has been made in the United States, South Africa and Australia in drought mitigation. In each case, this progress is the direct result of a fundamental philosophical change by government. The development of drought policies that promote risk management rather than crisis management and the preparation of contingency plans represent a proactive step toward risk minimization and vulnerability reduction. Drought contingency plans promote greater coordination within and between levels of government, improve procedures for monitoring, assessing and responding to severe water shortages, and facilitate more efficient utilization of natural, financial and human resources.

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