EARTHWATCH

Climate Unit

Preparing For Drought:

A guidebook for developing countries

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UNEP (1992). Preparing for Drought: A guidebook for developing countries.
Prepared by Dr Donald A. Wilhite, University of Nebraska,
Lincoln, USA.
Nairobi: United Nations Environment Programme.

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"Droughts affect more people than any other environmental hazard . . . [and] drought is perhaps the most complex and least understood type of all environmental hazards. . . Africa has now emerged as the most drought prone continent. To many of the young African states this is a relatively new problem. They have had little training in coping with drought and famine, and foreign aid or advice have not always had a positive effect on them." (Hagman, Swedish Red Cross, 1984)

INTRODUCTION

Drought is an insidious hazard of nature. It originates from a deficiency of precipitation that results in a water shortage for some activity or some group. Although the continent of Africa has suffered the most dramatic impacts from drought during the past several decades, the vulnerability of all nations to extended periods of water shortage has been underscored again and again during this same time period. In the past decade alone, droughts have occurred with considerable frequency and severity in most of the developed and developing world. Brazil, Argentina, Uruguay, Australia, the United States, Canada, India, China, and most of the countries of Southeast Asia are just a few examples of the countries ravaged by drought.

Concern by members of the scientific and policy communities about the inability of governments to respond in an effective and timely manner to drought and its associated impacts exists worldwide. Numerous "calls for action" for improved drought planning and management have been issued by national governments, professional organizations, intergovernmental organizations, nongovernmental organizations, and others. However, the task of altering the perception of policy makers and scientists worldwide about drought and educating them about alternative management approaches is a formidable challenge. Governments typically treat drought as a rare and random event that is inherently unpredictable; they are unprepared to respond effectively when it occurs. Effective drought response requires long-range planning, a difficult assignment for most governments.

Many scientists and policy makers now have an improved understanding of drought and its economic, social, and environmental consequences. Although impediments to drought planning exist, recent progress has created a sense of cautious optimism that society is steadily moving toward a higher level of preparedness. Also, technologies and information are available that would enable countries to more effectively mitigate the effects of drought through the development of a more proactive and systematic risk management approach (Wilhite and Easterling, 1987a).

The occurrence of severe drought worldwide during and following the extreme El Niño/Southern Oscillation (ENSO) event of 1982-83 partially explains

governments' increased awareness and understanding of drought and interest in planning. These droughts have focused attention on the vulnerability and lack of coping capacity of all nations. It also appears that societal vulnerability to drought is increasing, largely because of population growth and society's increasing demand and competition for limited water resources. In addition, many governments now have a better appreciation of the costs associated with drought. These costs include not only the direct impacts of drought but also the indirect costs (i.e., personal hardship, relief costs, retardation of economic development, and accelerated environmental degradation). Nations can no longer afford to allocate scarce financial resources to often short-sighted response programs that do little to mitigate, and may in fact exacerbate, the effects of future drought.

In the public's mind, the subjects of drought and projected changes in climate caused by increasing concentrations of CO_2 and other atmospheric traces gases have become inextricably linked. For example, the 1988 drought in the United States was viewed by some scientists (and popularized by the media) as a forewarning of greenhouse warming. Others suggest that changes in climate will lead to an increased frequency and intensity of drought, although these predictions are highly speculative at present (Houghton et al., 1990). However, we do know that droughts are a normal part of climate in virtually all regions; their recurrence is inevitable, with or without changes in climate. From an institutional point of view, learning today to deal more effectively with extreme climatic events such as drought will serve us well in preparing proper response strategies to long-term climate-related issues.

The International Drought Information Center (IDIC) at the University of Nebraska-Lincoln was formed in 1988. The primary goal of the IDIC is to increase awareness and understanding of drought, ultimately leading to a reduction of societal vulnerability through the development and implementation of preparedness plans in all drought-prone nations of the world. One of the first steps taken by the IDIC was the conduct of training seminars on drought management and preparedness for developing regions.[1] This guidebook on drought preparedness is one of the outcomes of this seminar series.

The purpose of this guidebook is to describe those unique characteristics of drought that set it apart from other natural hazards (Chapter 1). The guidebook also describes the nature of impacts associated with drought. Chapter 2 illustrates, through several case studies, how some nations have coped with drought in the past and describes recent attempts to adopt a more proactive risk management approach. Chapter 3 proposes a methodology to assist developing countries in the preparation of drought plans, exemplifying many of the concepts now being incorporated in the national policies and plans discussed in Chapter 2. The final chapter summarizes

[1] To date, three seminars have been conducted. The first was held in Botswana in September 1989 for countries in the eastern and southern African regions. The second seminar was held in November 1989 in Brazil and focused on the drought-prone northeast region. The third seminar was held in Thailand in March 1991 for the Asian and Pacific Regions. A fourth seminar is scheduled for the Latin American region in early 1993.

the key features of the proposed planning methodology, including recommendations for governments and international organizations.

"We have no good definition of drought. We may say truthfully that we scarcely know a drought when we see one. We welcome the first clear day after a rainy spell. Rainless days continue for a time and we are pleased to have a long spell of such fine weather. It keeps on and we are a little worried. A few days more and we are really in trouble. The first rainless day in a spell of fine weather contributes as much to the drought as the last, but no one knows how serious it will be until the last dry day is gone and the rains have come again . . . we are not sure about it until the crops have withered and died." (Tannehill, 1947)

CHAPTER 1
DROUGHT: AN OVERVIEW

Drought as a Natural Hazard

Drought differs from other natural hazards (e.g., floods, tropical cyclones, and earthquakes) in several ways. First, since the effects of drought often accumulate slowly over a considerable period of time, and may linger for years after the termination of the event, a drought's onset and end are difficult to determine. Because of this, drought is often referred to as a "creeping phenomenon" (Tannehill, 1947). 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. Realistically, definitions of drought must be region and application (or impact) specific. This is one explanation for the scores of definitions that have been developed. Unfortunately, many of these definitions have done a less than adequate job of defining drought in meaningful terms for scientists and policy makers. This is the result, at least in part, of misunderstandings of the concept by those formulating definitions. Third, drought impacts are less obvious and are 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 are far more difficult tasks for drought than they are for other natural hazards. These characteristics have hindered the development of accurate, reliable, and timely estimates of drought severity and impacts.

Drought is a normal part of climate for virtually all climatic regimes. It occurs in high as well as low rainfall areas. Drought differs from aridity in that the latter is restricted to low rainfall regions and is a permanent feature of the climate. Many people associate the occurrence of drought with the Great Plains of North America, East Africa, West African Sahel, 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. For example, residents of many humid regions often refer to "green droughts" (i.e., droughts associated with apparent ample rainfall but reduced agricultural productivity because of poor timing of rains or ineffective precipitation). Thus, the

character of drought is distinctly regional, reflecting unique meteorological, hydrological, agricultural, and socioeconomic characteristics.

Drought is the consequence of a natural reduction in the amount of precipitation received over an extended period of time, usually a season or more in length, although other climatic factors (such as high temperatures, high winds, and low relative humidity) are often associated with it in many regions of the world and can significantly aggravate the severity of the event. Drought is also related to the timing (i.e., principal season of occurrence, delays in the start of the rainy season, occurrence of rains in relation to principal crop growth stages) and the effectiveness of the rains (i.e., rainfall intensity, number of rainfall events).

Drought severity is dependent not only on the duration, intensity, and geographical extent of a specific drought episode, but also on the demands made by human activities and vegetation on a region's water supplies. The characteristics of drought along with its far-reaching impacts make its effects on society, economy, and environment difficult, though not impossible, to identify and quantify. The significance of drought should not be divorced from its societal context. The impact of a drought depends largely on societal vulnerability at that particular moment. Subsequent droughts in the same region will have different effects, even if they are identical in intensity, duration, and spatial characteristics.

Drought Types and Definitions

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 developed and developing countries alike, the approaches taken to define it also reflect regional differences as well as differences in ideological perspectives. Impacts also differ spatially and temporally, depending on the societal context of drought. A universal definition of drought is an unrealistic expectation.

Definitions of drought can be categorized broadly as either conceptual or operational. Conceptual definitions are of the "dictionary" type, generally defining the boundaries of the concept of drought, and thus are generic in their description of the phenomenon. For example, the American Heritage Dictionary (1976) defines drought as "a long period with no rain, especially during a planting season." Operational definitions attempt to identify the onset, severity, continuation, and termination of drought episodes. Definitions of this type are often used in an "operational" mode. These definitions can also be used to analyze drought frequency, severity, and duration for a given historical period. An operational definition of agricultural drought might be one that compares daily precipitation to evapotranspiration (ET) rates to determine the rate of soil water depletion and then expresses these relationships in terms of drought effects on plant behavior at various stages of development. The effects of these meteorological conditions on plant growth would be reevaluated continuously by agricultural specialists as the growing season progresses.

Many disciplinary perspectives of drought exist. Each discipline incorporates different physical, biological, and/or socioeconomic factors in its definition of drought. Because of these numerous and diverse disciplinary views, considerable confusion often exists over exactly what constitutes a drought (Glantz and Katz, 1977). Research has shown that 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 (Wilhite et al., 1986). It must be accepted that the importance of drought lies in its impacts. Thus definitions should be region and impact or application specific in order to be used in an operational mode by decision makers. A comprehensive review of drought definitions and indices can be found in a technical note published by the World Meteorological Organization (WMO) (1975). Consult Subrahmanyam (1967), Glantz and Katz (1977), Sandford (1979), Dracup et al. (1980), and Wilhite and Glantz (1985) for a thorough discussion of the difficulties in defining drought.

Drought can be 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. For example, some definitions differentiate meteorological drought on the basis of the number of days with precipitation less than some specified threshold. Extended periods without rainfall are common for many regions; such a definition is unrealistic in these instances. Other definitions may relate actual precipitation departures to average amounts on monthly, seasonal, water year, or annual timescales. Definitions derived for application to one region usually are not transferrable to another since meteorological characteristics differ. Human perceptions of these conditions are equally variable. Both of these points must be taken into account in order to identify the characteristics of drought and make comparisons between regions.

Hydrological droughts are related more with the effects of periods of precipitation shortfall on surface or subsurface water supply (i.e., stream flow, reservoir and lake levels, groundwater) rather than precipitation shortfalls (Dracup et al., 1980; Klemes, 1987). Hydrological droughts are usually out of phase or lag the occurrence of meteorological and agricultural droughts. Meteorological droughts result from precipitation deficiencies; agricultural droughts are largely the result of soil moisture deficiencies. More time elapses before precipitation deficiencies show up in components of the hydrological system (e.g., reservoirs, groundwater). As a result, impacts are out of phase with those in other economic sectors. Also, water in hydrological storage systems (e.g., reservoirs, rivers) is often used for multiple and competing purposes (e.g., power generation, flood control, irrigation, recreation), 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.

The frequency and severity of hydrological drought is often defined on the basis of its influence on river basins. Whipple (1966) defined a drought year as one in which the aggregate runoff is less than the long-term average runoff. Low-flow frequencies have been determined for many streams. If the actual flow for a selected time period falls below a certain threshold, then hydrological drought is considered to be in progress. However, the number of days and the level of probability that must be exceeded to define a hydrological drought period is somewhat arbitrary. These criteria will vary between streams and river basins.

Agricultural drought links various characteristics of meteorological and hydrological drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, and so forth. A plant's demand for water is dependent on prevailing weather conditions, biological characteristics of the specific plant, its stage of growth, and the physical and biological properties of the soil. An operational definition of agricultural drought should account for the variable susceptibility of crops at different stages of crop development. For example, deficient subsoil moisture in an early growth stage will have little impact on final crop yield if topsoil moisture is sufficient to meet early growth requirements. However, if the deficiency of subsoil moisture continues, a substantial yield loss may result.

Finally, socioeconomic drought associates the supply and demand of some economic good or service with elements of meteorological, hydrological, and agricultural drought. Some scientists suggest that the time and space processes of supply and demand are the two basic processes that should be included in an objective definition of drought (Yevjevich, 1967). For example, the supply of some economic good (e.g., water, hay, electric power) is weather dependent. In most instances, the demand for that good 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 (Sandford, 1979). This concept of drought supports the strong symbiosis that exists between drought and human activities. Thus, the incidence of drought could increase because of a change in the frequency of the physical event, a change in societal vulnerability to water shortages, or both. For example, poor land use practices such as overgrazing can decrease animal carrying capacity and increase soil erosion, which exacerbates the impacts of and vulnerability to future droughts. This example is especially relevant in semiarid regions and in areas of hilly or sloping terrain (e.g., Lesotho).

Drought Characteristics and Severity

Droughts differ from one another in three essential characteristics--intensity, duration, and spatial coverage. Intensity refers to the degree of the precipitation shortfall and/or the severity of impacts associated with the shortfall. It is generally measured by the departure of some climatic index from normal and is closely linked to duration in the determination of impact. The simplest index in widespread use is the percent of normal precipitation. With this index, actual precipitation is

compared to "normal" or average precipitation for time periods ranging from one to twelve or more months. Actual precipitation departures are normally compared to expected or average amounts on a monthly, seasonal, annual, or water year (October-September) time period. One of the principal difficulties with this (or any) index is the choice of the threshold below which the deficiency of precipitation must fall (e.g., 75 percent of normal) to define the onset of drought. Thresholds are usually chosen arbitrarily. In reality, they should be linked to impact. Many indices of drought are in widespread use today, such as the decile approach (Gibbs, 1967; Lee, 1979; Coughlan, 1987) used in Australia, the Palmer Drought Severity Index and Crop Moisture Index (Palmer, 1965; 1968) in the United States, and the Yield Moisture Index (Jose et al., 1991) in the Philippines. For a comparison of several popular meteorological indices, see Olidapo (1985).

Another distinguishing feature of drought is its duration. Droughts usually require a minimum of two to three months to become established but then can continue for several consecutive years. The magnitude of drought impacts is closely related to the timing of the onset of the precipitation shortage, its intensity, and the duration of the event. The five-year (1979-83) drought in northeast Brazil is a good case in point. In this series of years, 1979 and 1980 were both drought years in the classic sense (i.e., a significant deficiency during the principal rainy reason). In 1981, the seasonal rainfall totals were slightly above normal but the temporal distribution resulted in agricultural drought. In 1982, the opposite pattern occurred (meteorological drought) and the results were less adverse for agriculture. These four "drought" years were followed by 1983, the most severe drought year of the previous 25 years (Magalhâes et al., 1988).

Droughts also differ in terms of their spatial characteristics. The areas affected by severe drought evolve gradually, and regions of maximum intensity shift from season to season. In larger countries, such as Brazil, China, India, the United States, or Australia, drought would rarely, if ever, affect the entire country. During the severe drought of the 1930s in the United States, for example, the area affected by severe drought never exceeded 65 percent of the country (see Figure 1). In India, the droughts of this century have rarely affected more than 50 percent of the country. An exception occurred in 1918-19, when 73 percent of the country was affected (Sinha et al., 1987). On the other hand, it is indeed rare for drought not to exist in a portion of these countries in every year. For example, Figure 1 illustrates that in the United States the percent area affected by drought is usually greater than 10 percent. Thus, the governments of these larger countries are more accustomed to dealing with water shortages and have established an infrastructure to respond, albeit reactively. For smaller countries, it is more likely that the entire country may be affected since droughts are usually regional phenomenon--they result from large-scale anomalies in atmospheric circulation patterns that become established and persist for periods of months, seasons, or longer.

From a planning perspective, the spatial characteristics of drought have serious implications. A large-scale regional drought may significantly influence a nation's ability to import food, a potential impact mitigation strategy, from neighboring countries that may be affected equally. Likewise, the occurrence of

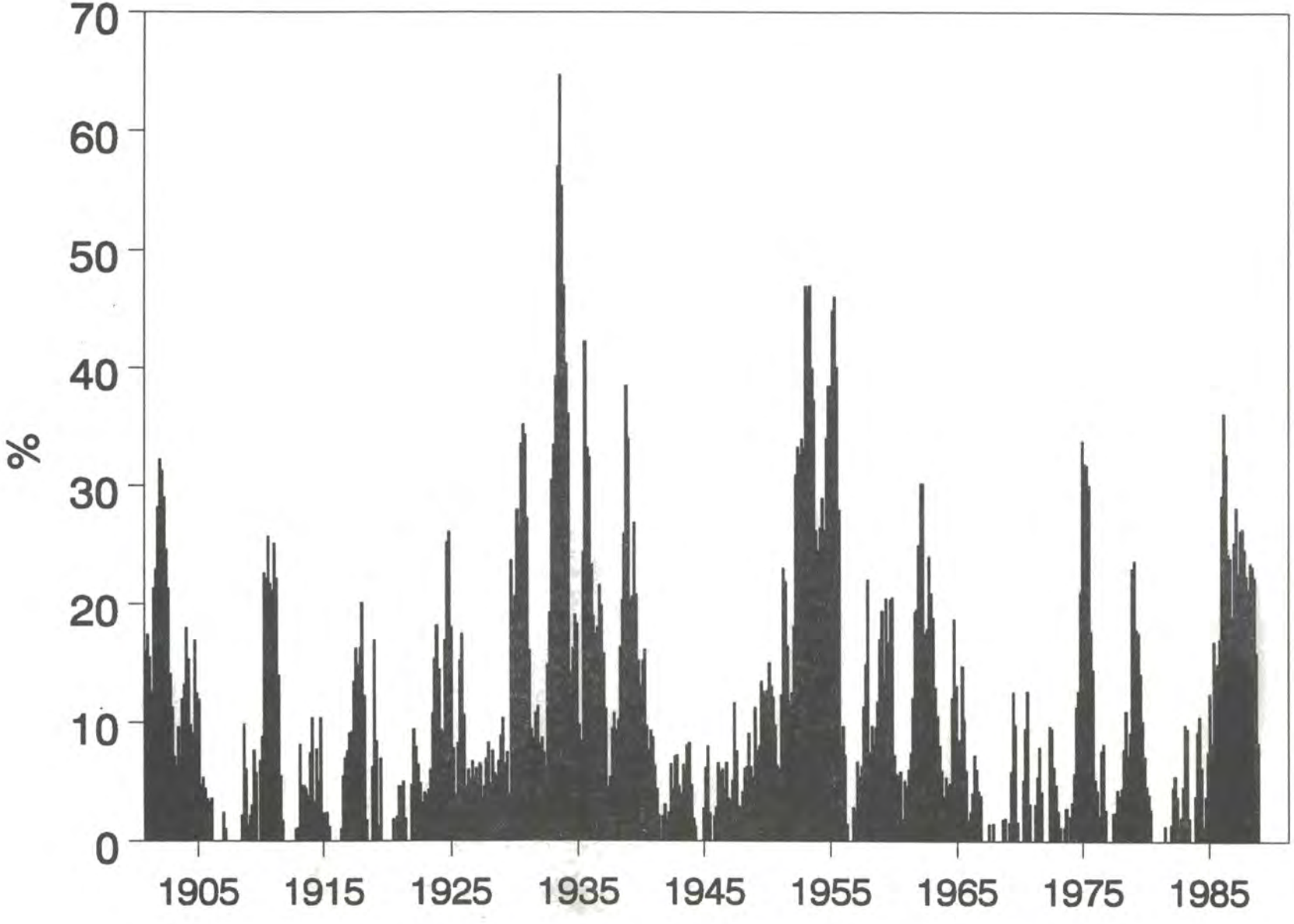

Figure 1. Percent area of the United States experiencing severe/extreme drought, 1895-1991 **(Heim, 1991).**

drought worldwide or in the principal grain exporting nations, such as during the ENSO event of 1982-83, may alter significantly a developing country's access to food from donor governments.

Impacts of Drought

The impacts of drought are diverse and often ripple through the economy. Thus, impacts are often referred to as direct or indirect, or they are assigned an order of propagation (i.e., first-, second-, or third-order) (Kates, 1985). Conceptually speaking, the more removed the impact from the cause, the more complex its link to the cause. In other words, a loss of yield resulting from drought is a direct or first-order impact of drought. However, the consequences of that impact (e.g., loss of income, farm foreclosures, outmigration, government relief programs) are secondary or tertiary impacts. First-order impacts are usually of a biophysical nature while higher-order impacts are usually associated with socioeconomic valuation, adjustment responses, and long-term "change." Asfaw (1989) succinctly summarized drought impacts as "direct or indirect, either singular or cumulative, immediate or delayed."

Because of the number of affected groups and sectors associated with drought, the geographic size of the area affected, and the difficulties connected with quantifying environmental damages and personal hardships, the precise determination of the financial costs of drought is an arduous task. Average annual estimates of the direct losses attributable to drought are misleading. Although some drought-related costs and losses may occur each year in some countries, in most instances they tend to occur in clusters around major single or multiple year events. Therefore, direct and indirect losses may be extremely large for one or two consecutive years and then negligible for several years. This clustering of drought-related costs and losses is repeated over and over again. For example, northeast Brazil experienced a severe drought from 1979 to 1983 that was preceded and followed by a series of favorable or wet years. The same can be said for Kenya, 1983-84 (Downing et al., 1987); Zimbabwe, 1981-84 (Makarau and Marume, 1989); Botswana, 1979-80 (Moremi, 1987); and India, 1980-82 (Sinha et al., 1987) and 1988-89 (Venkateswalu, 1992). The ebb and flow of dry and wet years (and thus the drought-related costs and losses) hinders the preparedness process in all countries. Human nature is to assume that next year will be a "good" year.

The impacts of drought can be classified into three principal sectors: economic, environmental, and social. Table 1 illustrates the principal impacts associated with each of these sectors. The economic impacts of drought are numerous, ranging from direct losses in the broad agricultural and agriculturally related sectors, including forestry and fishing, to losses in recreation, transportation, banking, and energy. Other economic impacts would include added unemployment, increases in food prices and overall disruption of food supply, strain on financial institutions because of farm foreclosures, increased costs of new or supplemental water resource development, and loss of revenue to local, state, and federal government. Environmental losses are the result of damages to plant and animal

TABLE 1. Classification of drought-related impacts (modified from Wilhite, 1992b).

Problem Sectors	Impacts
Economic	• loss from crop production annual and perennial crop losses; damage to crop quality reduced productivity of cropland (wind erosion, etc.) insect infestation plant disease wildlife damage to crops • loss from dairy and livestock production reduced productivity of rangeland forced reduction of foundation stock closure/limitation of public lands to grazing high cost/unavailability of water for livestock high cost/unavailability of feed for livestock high livestock mortality rates increased predation range fires • loss from timber production forest fires tree disease insect infestation impaired productivity of forest land • loss from fishery production damage to fish habitat loss of young fish due to decreased flows • loss of national economic growth, retardation of economic development • income loss for farmers and others directly affected • loss from recreational businesses • loss to manufacturers and sellers of recreational equipment • increased energy demand and reduced supply because of drought-related power curtailments • costs to energy industry and consumers associated with substituting more expensive fuels (oil) for hydroelectric power • loss to industries directly dependent on agricultural production (e.g., machinery and fertilizer manufacturers, food processors, etc.) • decline in food production/disrupted food supply increase in food prices increased importation of food (higher costs) • unemployment from drought-related production declines • strain on financial institutions (foreclosures, greater credit risks, capital shortfalls, etc.) • revenue losses to federal, state, and local governments (from reduced tax base) • revenues to water supply firms revenue shortfalls windfall profits • loss from impaired navigability of streams, rivers and canals • cost of water transport or transfer • cost of new or supplemental water resource development
Environmental	• damage to animal species wildlife habitat lack of feed and drinking water disease increased vulnerability to predation (e.g., from species concentration near water) • wind and water erosion of soils • damage to fish species • damage to plant species • water quality effects (e.g., salt concentration) • air quality effects (dust, pollutants) • visual and landscape quality (dust, vegetative cover, etc.)

Problem Sectors	Impacts
Social	• food shortages (decreased nutritional level, malnutrition, famine) • loss of human life (e.g., food shortages, heat) • public safety from forest and range fires • conflicts between water users • health-related low flow problems (e.g., diminished sewage flows, increased pollutant concentrations, etc.) • inequity in the distribution of drought impacts/relief • decreased living conditions in rural areas • increased poverty • reduced quality of life • social unrest, civil strife • population migration (rural to urban areas)

species, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; and soil erosion. These losses are difficult to quantify, but growing public awareness and concern for environmental quality has forced public officials to focus greater attention on these effects. Increasing levels of environmental regulation (e.g., water quality, preservation of wildlife habitat) have imposed a new layer of constraints on water managers during water-short periods. This trend is likely to continue. Social impacts mainly involve public safety, health, conflicts between water users, inequities in the distribution of impacts and disaster relief programs, loss of life, increased social unrest, depopulation of rural areas, and reduced quality of life.

Summary

Drought is, indeed, a complex and poorly understood natural hazard. Impacts are far-reaching and may linger for months or even years beyond the termination of the event. The impacts of drought result from complex interactions between physical and social systems. An understanding of the characteristics of drought and an appreciation of the magnitude of economic, social, and environmental impacts must precede the establishment of a viable assessment and response strategy that will lead to a reduction of societal vulnerability. This has been and continues to be a difficult assignment, but progress is being made. Chapter 2 will document, through case studies, the approach being taken in several drought-prone countries. The experiences of these countries can provide valuable lessons for other governments.

"Judging from past experience it would be unwise for the Botswana Government to perpetuate the type of ad hoc action which was characteristic of the pre-independence era. Planning must apply across the board [for all] natural disasters, including drought. There is no doubt that Government is fully aware of the need for and prepared to develop a long-term strategy to relieve the effects of drought in a coordinated and systematic manner. Government . . . facilitates development planning, implementation and the creation of the necessary institutional network alleviating drought." (Molosi, 1979)

CHAPTER 2
RESPONDING TO DROUGHT: CASE STUDIES

With the occurrence of any natural disaster come appeals for assistance from the affected area. Drought is no exception, but the characteristics of drought described in Chapter 1 of this guidebook make the provision of timely, effective, and coordinated response efforts a difficult assignment for most nations. This problem is especially evident in much of the developing world, where drought may occur in close association with economic stagnation, high population growth, declining food production, land degradation, and civil strife.

Historically, a wide range of response actions has been used by governments and international organizations to deal with the impacts of water shortages on people and various economic sectors. Parry and Carter (1987) have classified these policy responses of governments to climatic variations into three broad types: pre-impact programs for impact mitigation; post-impact government interventions; and contingency arrangements. Pre-impact government programs are defined as those that attempt to mitigate the future effects of climatic variations. Examples would include the Famine Commission of India and large-scale irrigation schemes. Post-impact government interventions refer to those reactive programs or tactics implemented by government when severe drought occurs. The implementation of these programs, which includes a variety of emergency relief programs, is largely the result of pressure by the public and the media on political officials. Many scientists, government officials, and recipients of relief have long criticized this approach as inefficient and ineffective. Examples of pre-impact programs and post-impact government interventions will be discussed in greater detail for selected countries in the next section of this chapter. Chapter 3 will present a methodology for drought planning that falls into Parry and Carter's third category, contingency arrangements.

During the twentieth century, governments in developed and developing countries have typically responded to drought by providing (or requesting from donor organizations) emergency assistance to distressed economic and social sectors (i.e., post-impact government intervention). Research has demonstrated that this

reaction to crisis often results in the implementation of hastily prepared assessment and response procedures that lead to ineffective, poorly coordinated, and untimely response. This approach is well illustrated by the "hydro-illogical cycle" shown in Figure 2. As this cycle illustrates, drought is followed by a sequence of stages from "awareness" to "concern" to "panic." An alternative approach (and what is proposed in this guidebook) is to initiate planning between periods of drought (i.e., before the "apathy" stage in Figure 2), thus developing coordinated assessment and response programs that more effectively address longer-term issues and specific problem areas and eliminate the "panic" stage. This alternative would allow governments to allocate their limited resources for drought mitigation in a more beneficial manner. But, because drought is not as well understood as other natural disasters and its impacts are nonstructural and less quantifiable, governments have been less inclined to invest resources to develop well-conceived mitigation programs and contingency plans.

Deficiencies or inadequacies in previous governmental drought assessment and response efforts were highlighted by participants of the drought management and preparedness training seminars referred to in the introduction. Deficiencies were noted in the following areas:

- monitoring or early warning systems, including the lack of appropriate indices;
- data bases for assessing water shortages and potential impacts;
- impact assessment methodologies, leading to untimely and unreliable estimations of effects;
- data and information flow on drought severity, impacts, and appropriate policy responses between and within levels of government and to the private sector;
- implementation of drought assistance;
- targeting drought assistance to vulnerable population groups and economic sectors;
- allocation of scarce financial and human resources;
- emphasis on post-impact government interventions (i.e., short-term emergency programs) rather than more proactive (pre-impact) programs aimed at reducing societal vulnerability;
- institutional and other contingency arrangements directed toward mitigating drought impacts and conflicts between water users;

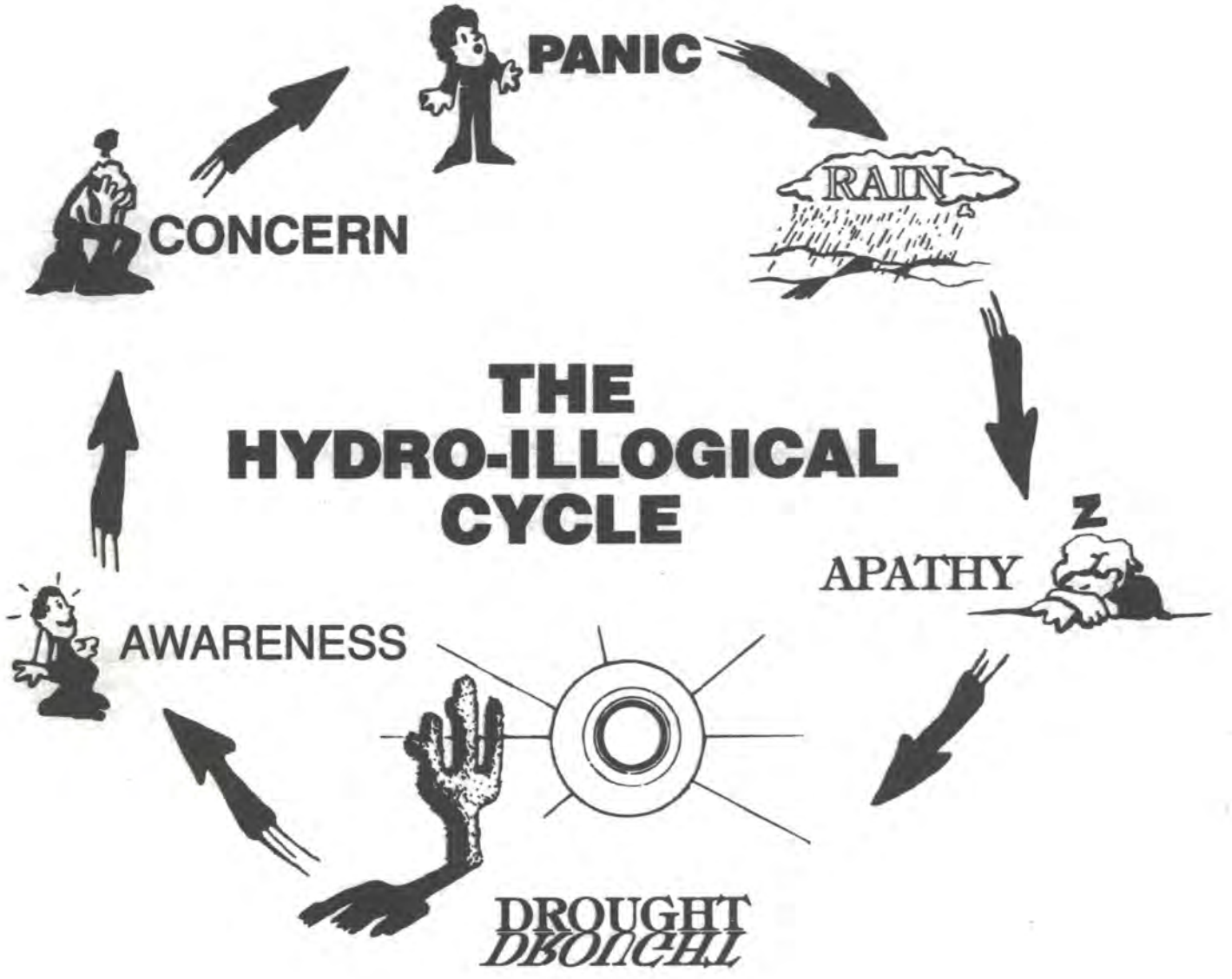

Figure 2. The hydro-illogical cycle illustrates the typical approach used by governments to respond to drought, crisis management (Wilhite, 1990).

- coordination of the drought policy and plan objectives with other governmental policies and programs (e.g., long-term development goals) and emergency drought relief.

This list of deficiencies is not intended to be comprehensive, but rather is given to illustrate some of the problems that have characterized previous attempts by government to assess and respond to drought. The discussion below provides a more complete view of these deficiencies in specific settings.

Government Drought Assessment and Response Efforts: Case Studies

Recurring drought has resulted in the piecemeal development of assessment and response programs in many countries. The principal features of these programs can be grouped into three categories: *organizational, response, and evaluation* (Table 2). These categories were used to compare drought policy in the United States and Australia (Wilhite, 1986) to learn more about how these two drought-prone nations have coped with the effects of drought. *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 and are operational in many countries. *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 3 lists the federal assistance programs used during the 1976-77 drought, a major event that affected a significant portion of the country (see Figure 1). Until recently, relief arrangements in Australia were included, for the most part, under the Natural Disaster Relief Arrangement (NDRA) agreements. Drought is no longer included under these agreements; instead a new national drought policy (which will be discussed in a later section of this chapter) has been instituted. Relief measures, by state, used during the 1982-83 severe drought in Australia are illustrated in Table 4. Tables 3 and 4 are intended to depict the wide range of assistance measures that have been employed historically in both countries. The types of assistance programs used in response to drought in Zimbabwe, the Philippines, Brazil, India, South Africa, the United States, and Australia are discussed in the next section of this chapter.

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 performed by a nongovernment organization, such as a university or private research group, that will be unbiased in their assessment. In

Features	United States	Australia
ORGANIZATION:		
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

Table 2. Comparison of Drought Policy Features: United States and Australia--Status as of 1984.

TABLE 3. Drought-related federal assistance programs used to respond to the 1976-77 drought in the United States, by Agency (Wilhite, 1986).

Agency	Program Name
Department of Agriculture	
Farmers Home Administration (FmHA)	Emergency Loans*
	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*
	Disaster Payments
Federal Crop Insurance Corp (FCIC)	Federal Crop Insurance*
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
Department of the Interior	
Bureau of Reclamation (BuRec)	Emergency Fund
	Drought Emergency*
	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*
Economic Development Administration (EDA), Department of Commerce	Community Emergency Drought Relief
	Economic Adjustment
	Public Works Impact Projects
Small Business Administration (SBA)	Emergency Drought Disaster Loans*
	Physical Disaster Loans
	Economic Injury Disaster Loans
Federal Disaster Assistance Administration (FDAA), Department of Housing and Urban Development	Disaster Assistance (Hay Transportation, Cattle Transportation, Emergency Livestock Feed, Forest Fire Suppression)
Federal Power Commission/Federal Energy Administration (FPC/FEA)	Drought-Related Services and Activities
Employment and Training Administration (ETA), Department of Labor	Unemployment Insurance Grants to States
	Farm Workers
	Comprehensive Employment and Training Programs (CETA)
	Employment Services
General Services Administration (GSA)	Donation of Federal Surplus Personal Property
	Sale of Federal Surplus Personal Property
Defense Civil Preparedness Agency (DCPA), Department of Defense	Civil Defense-Federal Surplus Personal Property Donation

TABLE 4. **Drought relief measures available in Australia under the Natural Disaster Relief Arrangements, by state, as of March 1983 (Wilhite, 1986).**

Measure	New South Wales	Victoria	Queensland	South Australia	Western Australia	Tasmania	Northern Territory
Concessional Loans							
Carry-On Loans to Primary Producers	*	*	*	*	*	*	*
	(Maximum amount ranges from $20,000-$40,000, with interest at 4%. Repayment period generally 7 years with discretional 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-$30,000; repayable over 7-10 years, at 4-5% interest rate.)						
Loans for Purchases 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
Freight Concessions							
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.)						
Other Subsidies							
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 for 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

* - Included in core measures
NA - Not available.
(1) - Included in carry-on loans.
(2) - Available but not part of core measures.

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 1976-77 drought were evaluated by the General Accounting Office (1979) and Wilhite et al. (1986). A partial examination of public and private sector response to the 1987-89 droughts was completed recently by Riebsame et al. (1990). Post-drought audits have been used effectively by some of the countries discussed in this chapter.

The approaches and types of programs implemented in response to drought in Zimbabwe, the Philippines, Brazil, India, and South Africa are discussed here and depict a reactive or crisis management approach in most instances. These examples are extracted from case studies presented at the training seminars and from the literature. Case studies of recent trends in preparedness in the United States and Australia, two drought-prone countries with a long history of government interventions, will be presented to further illustrate the traditional reactive approach. All of these examples, however, portray an emerging trend toward drought preparedness. The principal components of drought policy presented above should be considered when reviewing these case studies.

Zimbabwe

The drought of 1981-82 through 1983-84 was the most severe on record in Zimbabwe. Although droughts are not an uncommon occurrence, never before in the historical record had the country experienced three consecutive years of rainfall deficiencies of such magnitude. Because of the duration and intensity of the drought, it tore at the social, economic, political, and environmental fabric of the country. The greatest impacts were in the agricultural sector, on which 80 percent of the population depends for survival (Makarau and Marume, 1989). The livestock industry was the first to be affected because it is the predominant economic activity in the most drought-prone portion of the country. As the precipitation deficiencies continued, virtually all agricultural crops were affected, particularly during the 1982 and 1983 harvest seasons. Recent trends toward substituting less drought- resistant crops such as maize for mhunga, rapoko, and sorghum aggravated the situation.

Clearly the nation was not prepared to respond to drought at its onset. The first indication of impending problems came in 1981, when the Crop Forecasting Committee warned that food shortages would occur. The infrastructure and actions that followed were a reaction to that forecast. The Cabinet Committee on Drought Relief was established and included representatives of nine ministries (Makarau and Marume, 1989). This committee was charged with the task of formulating policies and recommending ways of providing emergency relief to those areas in the country that experienced problems. The administrative structure that resulted extended from the cabinet to the village level; drought relief efforts at the provincial level were coordinated by provincial administrators (Figure 3). The primary instruments of

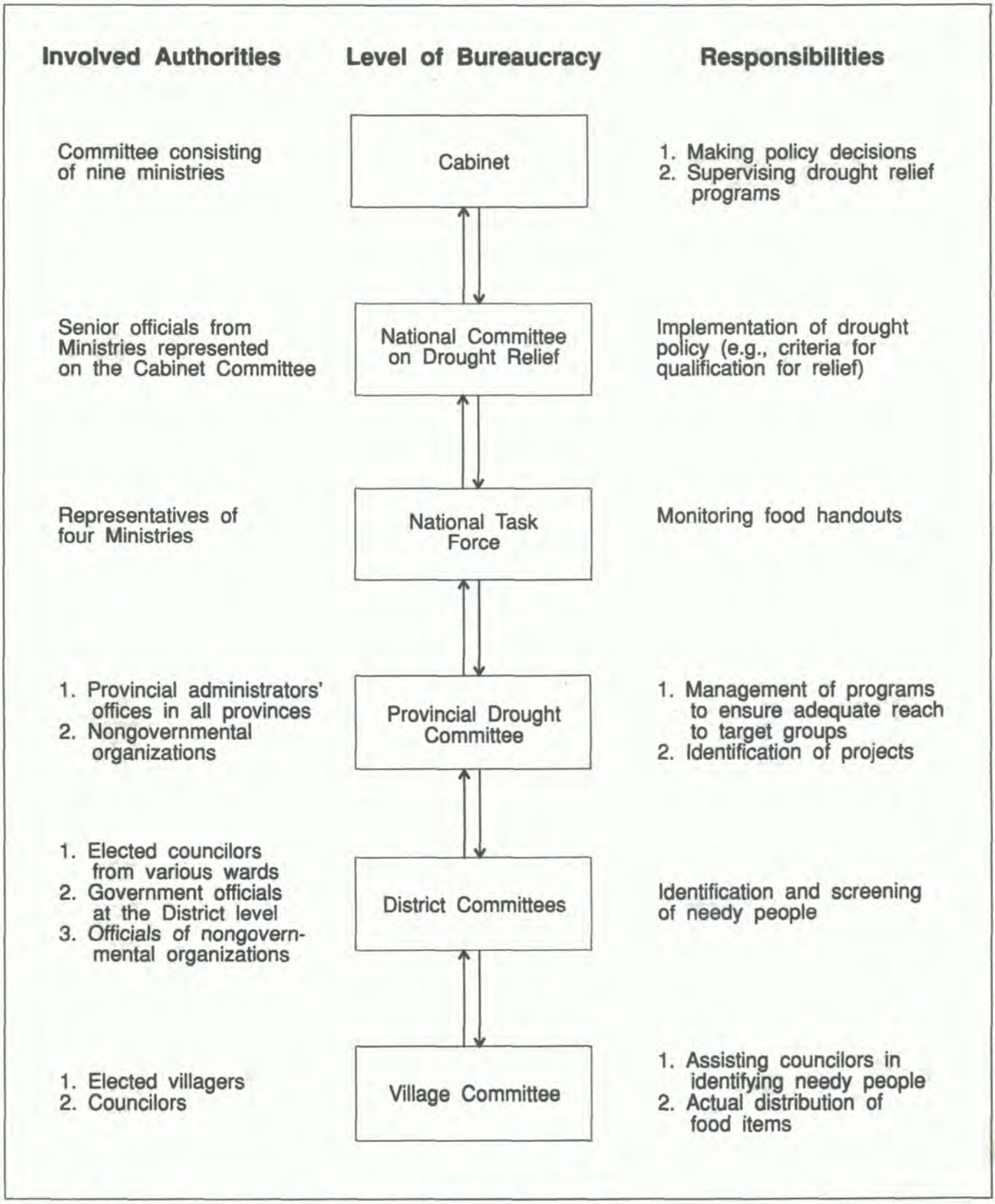

Figure 3. The administrative structure developed in Zimbabwe in response to the 1981-84 drought (Makarau and Marume, 1989).

relief were food distribution programs, drilling of wells, construction of dams, cattle rescue operations, and public works programs. Free food programs were used initially but were discovered to have a deleterious impact by creating dependency on the government; thus these were soon replaced with food-for-work programs. The government also established a pricing program for small grain crops that provided incentives for farmers to produce drought-resistant crops (and therefore a disincentive for maize production). Other programs used included supplementary feeding programs for children and the provision of seeds, fertilizer, and draught power to farmers. Drought relief programs were financed by a tax levied by the government.

The government's reaction to drought revealed several serious problems (Makarau and Marume, 1989). First, government officials lacked the training necessary to successfully manage the drought response program, particularly since no advance planning had been completed. The response program was also highly politicized and corrupt. Second, weather information was not used in the decision-making process for calculating food supply forecasts and food importation needs because this information was unavailable to decision makers. Third, as the drought persisted, obstacles to the effective operation of the relief program became obvious. For example, communal farmers wanted to maintain large cattle herds on farms, which in turn led to the deterioration of the range. The vehicle fleet and the road network were inadequate to distribute food to those in need in a timely manner. Food storage facilities were located in larger cities, further aggravating the distribution problem. The government also had problems in determining who needed food aid and in maintaining a balanced food nutrition program for those receiving assistance.

Makarau and Marume (1989) noted a wide range of lessons learned as a result of Zimbabwe's recent experience with drought. These lessons were:

- Government must be prepared to deal with future episodes of drought. It should begin by educating the nation about drought and its impacts;
- Incentives are an effective way of encouraging specific actions by farmers such as the production of drought-resistant crops;
- Grain storage facilities should be located in each district to reduce distribution problems and transport costs;
- An administrative structure that extends from the cabinet level to the village must be maintained and must incorporate resources of governmental and nongovernmental organizations;
- Public works projects are an effective method of improving communities, thus avoiding overdependence on the government;

- Surface and subsurface water supplies must be developed to provide resilience during drought-related water shortages;

- An integrated approach to development must be initiated from the rural communities upward;

- The value of climate information for use in rural and urban planning, rural resettlement, drought relief, irrigation and water resources development, and agricultural land use has been accepted by the government;

- The rational use of natural resources, preserving them for future generations, has been reinforced.

The Zimbabwe government can build on these experiences to prepare for future episodes of drought. However, institutional memory is short and interest in drought planning quickly wanes following the return of normal rainfall. An important lesson for all governments is to should proceed swiftly to develop a drought plan before the attention of political officials and other policy makers is diverted to other issues. If this occurs, the onset of the next drought will find the country once again ill-prepared to respond effectively.

Philippines

In the Philippines, drought usually begins in the southern portion of the country. Its occurrence is associated with the El Niño phenomenon, an event that has occurred five times in the past two decades. The drought of 1987-88 was quite serious; 46 of the country's 78 provinces were proclaimed by presidential declaration to be in calamity, compared with only 16 and 5 in 1989-90 and 1991, respectively. Drought severely affects agriculture, particularly the planted acreage and yields of paddy rice, corn, and sugar. It also has a significant impact on rice stocks (Lalap, 1991).

Although drought occurrence is not unusual in the Philippines, governmental efforts to mitigate its effects are relatively new. Most of the mitigation efforts have been directed toward the agricultural sector since farmers represent the most vulnerable population group. The government has also increased these efforts by providing early warning of drought conditions and the potential impacts of water shortages on agriculture (Jose, 1991a; Jose et al., 1991).

An institutional structure was developed in 1987-88 in the Philippines under the leadership of the National Disaster Coordinating Council (NDCC). Based on the recommendation of the chairman of this council, the president of the Philippines is responsible for declaring a State of Calamity in the affected areas (Lalap, 1991). This proclamation enables the government to provide assistance to those affected by drought by controlling overpricing and preventing hoarding of prime commodities, delaying payment of taxes and amortizations owed to the government, and the

release of monies in the Calamity Fund. The Department of Agriculture is responsible for administering the rehabilitation program. Through this program, farmers are given resource inputs such as seeds and fertilizers.

The NDCC is chaired by the secretary of defense and is composed of senior policy officials of 18 government agencies and the Philippine Red Cross. This council coordinates the mitigation efforts of government and related preparedness activities (Lalap, 1991). The concept of the NDCC is duplicated at the regional and provincial levels.

The Inter-Agency Committee on Water Crisis Management is charged with the responsibility of water management during drought periods, including the setting of priorities on water use. This committee was created in 1987 and meets regularly during periods of crisis to monitor water supply and set priorities. Reports issued routinely on water supply or forecasts by existing federal agencies, such as the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), are forwarded to this committee for consideration. Recommendations are transmitted to the NDCC for further action. Each of the states and the public are kept well informed of the potential impacts of drought through advisories issued by government agencies. The media are also key components of the government's public awareness program.

Other actions or programs implemented by the Philippine government in response to drought include crop insurance, cloud seeding, irrigation development, and watershed management and erosion control through agroforestry projects. The government has also undertaken specific policy reforms that include stiff penalties for hoarding rice during periods of rising prices due to shortages. Importation of rice and corn is used to help control prices and to increase buffer stocks (Lalap, 1991).

In the future, the Philippine government hopes to improve mitigation efforts through the following actions (Lalap, 1991):

- Improve the data base for agricultural statistics at the provincial rather than regional level;
- Expand funding for the cloud seeding program and improve estimation of the effectiveness of these operations;
- Improve crop programming (i.e., crop selection by region, strategic crop planning strategies during drought periods) as an aspect of disaster planning through better integration of information on drought and typhoon occurrence;
- Improve assessment of farmers at risk to assist in the disbursement of drought assistance:

- Implement comprehensive public awareness programs on irrigation management and water and energy conservation.

In May 1991, with support from the World Meteorological Organization and other groups, the Philippine government organized the National Workshop on Drought Planning and Management (Jose, 1991b). The objectives of the workshop were to:

(1) evaluate government responses to past drought;

(2) identify information needs and opportunities that can be used in improving the national ability to assess and respond to droughts;

(3) determine the need for developing more effective drought monitoring and mitigation strategies and define ways of promoting the formulation of strategies;

(4) review policies, approaches, and actions effectively used by other nations to mitigate drought and reduce impacts; and

(5) initiate the formulation of a national drought policy and plans.

At the conclusion of the workshop, members of principal government agencies were selected and charged with the task of preparing a resolution on the development of a national drought policy. On completion, this resolution was presented to the Department of Agriculture for consideration and implementation.

Brazil

The northeast region of Brazil is often referred to as the drought polygon, a vast region of semiarid climate located between two humid zones. Governmental attempts to alleviate drought have been an important part of the history of this region, dating back to 1877-79, when the Imperial Inquiry Commission was created to respond to staggering social and economic impacts (Pessoa, 1987). Drought policy has evolved through six phases since the formation of this commission, becoming more complex and integrated with each new phase (Magalhâes et al., 1992). The six phases were (1) study phase, 1877-1906; (2) engineering and water resources phase, 1906-45; (3) ecological phase, 1945-50; (4) economic development phase, 1950-70; (5) socioeconomic development phase, 1970-90; and (6) sustainable development phase, 1990-present.

The evolution of drought policy in the northeast region began (Phase 1) with the construction of reservoirs and canals, well drilling, and the creation of ports and roads. A few attempts to provide food supplies for residents had little success. An institution created in 1909 (National Department for Drought Relief Works, DNOCS) was given the responsibility to develop a water supply infrastructure for the region (Phase 2). Today, reservoirs in the region have a total storage capacity

of more than 22 billion cubic meters. These reservoirs provide water for various farm activities, including irrigation. DNOCS still exists and continues its mission to develop the region's water resource. The ecological phase (3) began in 1945 in an attempt to implement strategies to make farm production more resilient during drought through the introduction of more resistant crops. During the 1950s, an attempt was made to couple industrial development with regional agricultural development (Phase 4). The substance of this plan was contained in a plan of action that promoted industrialization, agricultural production, and land settlement. This plan created several new organizations, including the Sao Francisco River Power Company, Sao Francisco Valley Development Company (CODEVASF), Bank of the Northeast of Brazil (BNB), and Superintendency for the Development of the Northeast (SUDENE). During the 1960s, SUDENE was responsible for expanding existing monitoring networks, conducting hydrogeological research and integrated studies of potential natural resources, and mapping soil and mineral resources (Pessoa, 1987). SUDENE continued to be one of the region's primary development agencies until 1964, when a change in federal policy reduced its authority. At that time, a greater emphasis on the development of the Amazon region detracted from the development of the northeast. The eradication of poverty became the thrust of Phase 5 during the early 1970s. This phase was associated with the establishment of rural development strategies such as Project Northeast. Phase 6 began around 1990 and emphasizes development that is both ecologically and socioeconomically sustainable. The belief is that this approach, ultimately, will reduce vulnerability to drought in the region. The program thrusts of each of these phases have been implemented to reduce the devastation that drought inflicts on residents of the region. Although each has been important to the development of the northeast, these approaches have not solved the drought-related problems that exist.

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). Government response to this drought resulted in the rebirth of what has been commonly referred to as the "drought industry" of the region, essentially the abuse and corruption associated with emergency intervention programs. In 1985 the Civil Defense Plan was developed under the regional leadership of SUDENE to address both drought and flood problems. The purpose of the plan was to reduce the risks and impacts and provide aid as necessary. The plan also triggers a drought watch system that produces more detailed climatological analyses and advisories.

Under the National Civil Defense System, the primary emphasis was to provide jobs (Magalhães et al., 1992). 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.

One of the goals of the public works programs is to reduce the drought-related migration of people from rural to urban areas within and outside the region and to interior locations. This has been one of the most serious impacts of previous droughts in the northeast.

After more than a century of drought policy development in the northeast, the intermingling of emergency and permanent action projects has often resulted in conflict and competition for the same human and financial resources (Magalhâes et al., 1992). It is now realized that emergency programs must be integrated with permanent, long-term programs. This approach will not only reduce competition for human and financial resources between the two types of programs, but emergency programs can be used to foster the objectives of long-term development programs (Magalhâes et al., 1988).

The recurrence of drought in 1987 provided an opportunity for government to apply these lessons. The state of Ceará designed and implemented a response plan that incorporated the following elements (Magalhâes et al., 1992):

- emphasis on projects that would provide immediate public benefits, chosen by communities but in harmony with long-range plans and programs;
- provisions targeting vulnerable population groups in need of development aid;
- emphasis on emergency programs that would foster achievement of state development plan objectives;
- programs or projects that avoided remanifestation of "drought industry" and political manipulation;
- ensured community participation in work project selection;
- payment of fair market wage to labor for public works projects.

All state government agencies participated fully in program planning and implementation. An interagency coordinating group was created to ensure technical coordination. The result of this response was successful, avoiding increased migration rates while maintaining health and nutrition indicators. The two main problems that emerged were funding and institutional deficiencies.

Largely as a result of these continuing problems, several institutions organized a drought management and preparedness training seminar in 1989 in conjunction with the University of Nebraska's International Drought Information Center.[2] The following conclusions were reached by participants of this regional seminar regarding previous response efforts and current vulnerability to drought (Banco do Nordeste, 1991).

- Drought unveils preexisting poverty conditions confirming that the benefits of economic progress have been withheld for the majority of the population;
- Economic, social, and environmental impacts of drought emphasize the necessity of a permanent drought policy to reduce these impacts;
- The most vulnerable persons to drought in the northeast region are small farmers and rural workers, representing the majority of the population;
- Previous actions in response to drought emergencies have reduced impacts but have not reduced vulnerability;
- Previous attempts to manage drought have had both successes and failures. However, the lack of continuity of programs, institutional deficiencies, lack of integration between levels of government, and lack of regional cooperation and coordination have been the major factors hindering the effectiveness of previous response activities;
- Deficiencies of data collection networks for hydrometeorological and upper air variables and the lack of adequate information delivery systems continue to exist;
- Drought research programs are poorly organized and coordinated;
- Emergency response actions for drought are in conflict with long-term regional economic development plans.

Overcoming the problem of drought in the northeast region of Brazil will continue to be a problem for years to come. The past century has been filled with both successes and failures. However, the institutions responsible for solving these problems now understand more fully the magnitude of the problems they face, the deficiencies of previous response efforts, and the changes that must ensue if

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[2] This seminar was sponsored by the Banco do Nordeste do Brasil, DNOCS, SUDENE, Governo do Estado do Ceará, and FUNCEME (Meteorological Foundation of the State of Ceará). The U.S. National Oceanic and Atmospheric Administration (NOAA) and the University of Nebraska-Lincoln also provided funding for this seminar.

vulnerability to drought is to be lessened. It appears that these institutions are now poised to pursue solutions to these problems in a more coordinated fashion.

India

The policies and programs in place to mitigate the effects of drought in India have evolved over more than a century. The initial emphasis of these programs was the preservation of life and prevention of death (Pant, 1991). Famine codes date back to 1883, when several provincial governments adopted them in response to drought and famine conditions (Sinha et al., 1987). In 1975, the "Drought Code" and "Good Weather 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 nonirrigated areas, and building up seed and fertilizer buffers to implement the drought coping strategy. The Good Weather Code provides a framework for the scientific, administrative, and planning steps needed to take full advantage of a good monsoon season to increase production of food grains. The Drought Watch group, made up of representatives of the Ministry of Agriculture, Meteorology Department, Indian Council of Agricultural Research, and Ministry of Information and Broadcasting exists at the national level to monitor weather conditions throughout the country. This group receives regular reports from similar groups at the state and district levels (Sinha et al., 1987).

The strategies being used by the Indian government to reduce vulnerability to drought are a combination of emergency and long-term measures. These tactics include early monsoon forecasts; improved communication systems; provision of resources such as credit, fertilizers, and pesticides for increasing production; assistance to farmers in poor monsoon years; maintenance of adequate prices; improved transportation systems; and maintenance of reasonable buffer stocks of food grains in strategic locations (Sinha et al., 1987). Relatively recent innovations in India's food production systems have improved the resiliency of these systems through impressive increases in production (Venkateswarlu, 1992).

Each state in India also manages its own Calamity Relief Fund (CRF) to assist in rehabilitation and reconstruction after the occurrence of natural disasters (Pant, 1991). The CRF is a cost-sharing arrangement between the central and state governments on a 3:1 basis. The level of funding provided to the fund by the national government is determined on the basis of the demonstrated vulnerability of the state to natural disasters during the preceding five years. The states have autonomy in deciding how and when these resources are used. The concept of the CRF is quite similar to the NDRA agreements implemented in Australia in 1971 (discussed later in this chapter).

As a result of severe deficiencies in rainfall in more than half of the country's meteorological subdivisions, a drought response plan was drawn up in

1987 (Venkateswarlu, 1992). This plan was operated under the leadership of the Ministries of Energy, Water Resources, Petroleum, Food and Civil Supplies, Rural Development, Health and Family Welfare, Women and Child Development, and Commerce. These ministries work together in developing contingency crop plans, organizing compensatory programs in the post-monsoon period, and creating employment at the rural level. An important part of the drought relief program was organized through nongovernmental organizations (NGOs). NGOs were instrumental in organizing cattle camps, water supply for humans and cattle, feeding camps for humans, and health care. India's Department of Rural Development, through the Council for Advancement of People's Action and Rural Technology, provided funds to the NGOs for natural resources works such as afforestation and soil conservation.

The Indian government has also undertaken the establishment of a nationwide satellite monitoring program to complement the nation's current drought management capability. The purpose of this system is to predict and objectively assess the potential impacts of drought on agricultural production. It provides a standard view of drought conditions, thus enabling state and national governments to reconcile their different perceptions of necessary drought management measures (Thiruvengadachari, 1991). The remote sensing information collected through this system is supplemented with ground observations of socioeconomic variables. The system is complemented by the work of the Agro-Meteorology Service of India. This unit 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 droughts (Sinha et al., 1987).

Evidence would seem to indicate that the drought-prone areas of India are less vulnerable today than they were several decades ago because of the country's maintenance of buffer stocks of food for distribution during times of shortage (personal communication with A.R. Subbiah, 1991). These and other accomplishments in drought and famine mitigation have been achieved largely through a coordinated effort between agencies of government. Although a comprehensive drought preparedness plan has not been fully implemented by the Indian government, much of the infrastructure necessary to support such a strategy is in place.

South Africa

Actions taken by the South African government in response to droughts typically have been poorly coordinated, and assistance programs have been largely ineffective (personal communication from C.R. Baard, 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 has been that 85 percent 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 percent of South Africa receives precipitation in excess of 500 mm per year. A serious drought that began in 1978 and affected, to varying degrees, 75 percent of South Africa resulted in significant expenditures by the government for drought relief. For example, during the 1984-85 fiscal year, the government spent approximately R447 million in support of various relief programs (personal communication from Baard, 1985). During the years 1987-89 the government allocated R1,300 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. Actions taken recently by the government are aimed at reversing the negative aspects of this response program.

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.[3] 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 vs. 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 includes the 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, 1990). 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 Department of Agriculture and Water Supply.

Based on experiences with the new drought policy during the 1980s, the government 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

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[3] Grazing capacity is defined as the number of hectares per livestock unit that 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.

(1990), "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.

United States

In the past decade, droughts have been a prevalent feature of the American landscape (see Figure 1). These droughts have resulted in significant impacts in a myriad of economic sectors, including agriculture, transportation, energy, recreation, and health; they have also had adverse environmental consequences. In recent years, attempts to cope with the effects of these extended periods of water shortage have reconfirmed the inadequacy of federal and state contingency planning efforts. Our inability 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 governments.

The U.S. scientific and policy communities have expressed considerable concern about the continuing inability of governments to respond to drought in an effective and timely manner. This concern has resulted in "calls for action" by regional and scientific organizations (Western Governors' Policy Office, 1978; Great Lakes Commission, 1990; Interstate Conference on Water Policy, 1987; National Academy of Sciences, 1986; Orville, 1990) and government (General Accounting Office, 1979; Brown, 1989). In light of a possible increase in the frequency and severity of extreme events in association with changes in climate, a recent Environmental Protection Agency report (Smith and Tirpak, 1989) has called for the development of a national drought policy to coordinate federal response to drought.

States are now taking the lead in raising the level of drought preparedness in the United States (Wilhite, 1991b). Historically, state governments have played a passive role in governmental efforts to assess and respond to drought. During the widespread and severe drought of 1976-77, 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. The federal government provided nearly $8 billion in relief as a result of the sequence of drought years in the mid-1970s (Wilhite et al., 1986); federal assistance efforts totaled more than $6 billion in response to the 1988-89 droughts (Riebsame, et al., 1990).

The increasing awareness of inefficient past response efforts, "calls for action," and the impacts of the droughts of the late 1980s have generated considerable momentum at the state level for the establishment of contingency plans. A survey conducted in the fall of 1991 indicates that twenty-six states have now developed drought plans, with three states in the process of developing a plan (Wilhite, 1992a). The pattern of state drought contingency planning is illustrated in Figure 4. In addition, action on the development of a plan is pending in several states.

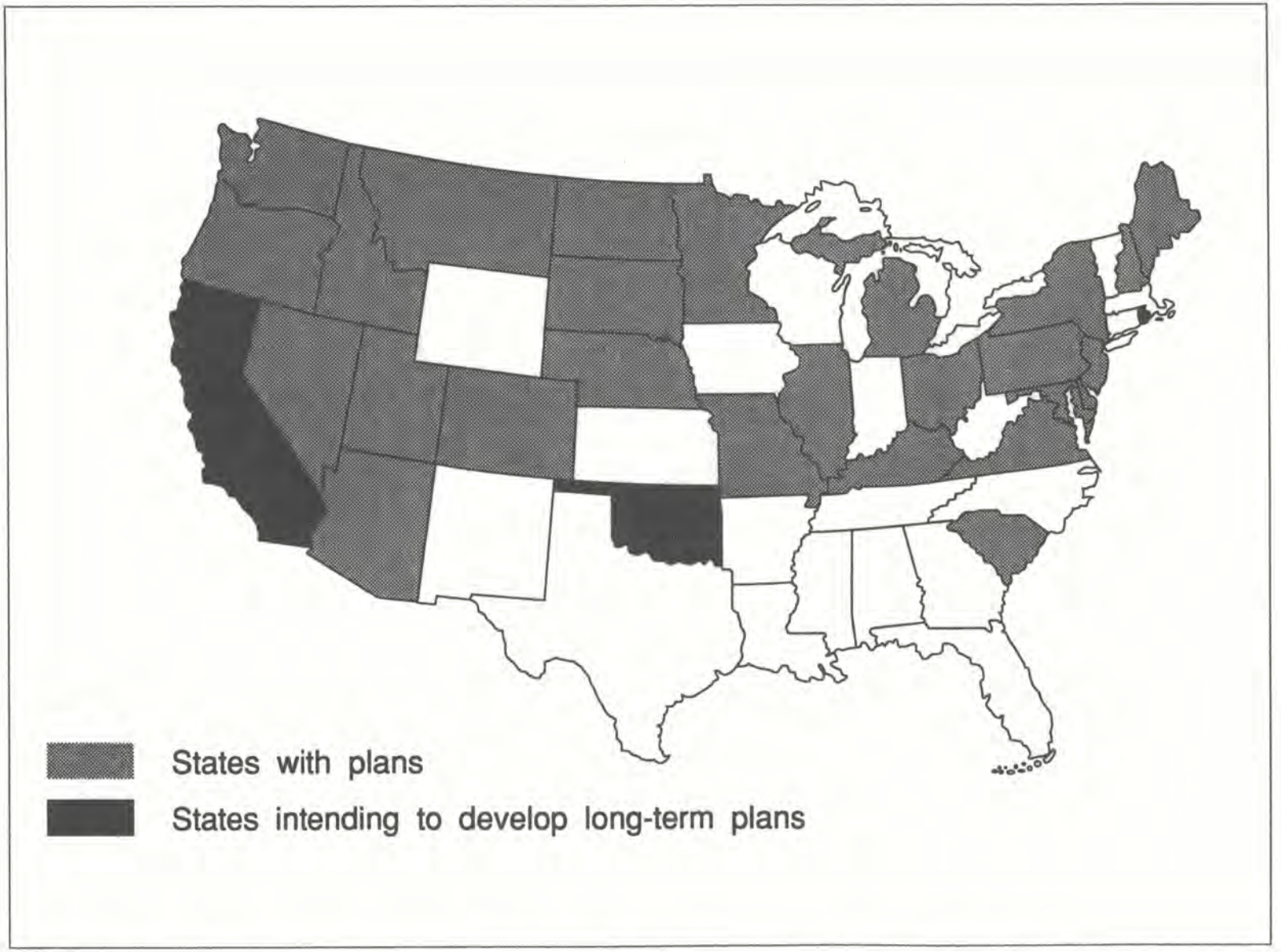

Figure 4. Status of drought planning in the United States, 1992 (updated from Wilhite, 1991b).

have developed plans, planning efforts have often been conducted in conjunction with an overall water management planning initiative. Clearly, states can now be labeled policy innovators in drought planning. 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 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 plan. It is unclear at present, however, which federal agency would be the most logical choice to lead this interagency effort. In the final analysis, it may take an executive order to initiate the process at this level. In the meantime, the federal government continues to contemplate the need for a national policy and plan.

An examination of existing state drought plans reveals that they have certain key elements in common (Wilhite, 1991b). 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 is established to continuously monitor water conditions and prepare outlooks a month or season in advance. Since most of the information necessary to comprehensively monitor water conditions (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 usually exists to consider current and potential impacts and recommend 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 contingency 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 hardship associated with drought. State-level plans will need to be integrated with plans at other levels as they develop.

From the progress that has been achieved in drought planning by state government in the past five years, it seems clear that some valuable lessons have

been learned about the need for preparedness. The key question that has yet to be answered is whether these lessons will be forgotten when the rains return. Or will states continue to strive to lessen vulnerability to future episodes of drought? One can argue that although some degree of apathy is unavoidable, continuing drought, recent "calls for action" for the development of contingency plans, and existing plans give us reason to be optimistic that the issue of drought planning will remain an important agenda item for state governments in the United States. The future commitment of the federal government is far less certain.

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 on a 1:1 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 bushfires. 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 arrangements, 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 thirty 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.

State and federal expenditures for drought aid from 1970-71 to 1983-84 under the NDRA were considerable. The magnitude of expenditures for all states was just over A$570 million (National Drought Consultative Committee, 1984). Of this total, approximately A$180 million was expended during 1982-83 and A$120 million was spent during 1983-84. Federal expenditures to the states for drought aid under the NDRA arrangements 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 1982-83 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 1982-83 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 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 1982-83 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 nonfarm income was able to recover more quickly than after previous episodes of severe drought. LGPA estimated that, had government not intervened in 1982-83, some 15 to 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 five-year period (Anonymous, 1983). However, the Working Group for the Standing Committee of 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, 1983; South Australian Department of Agriculture, 1983; Stott, 1983), each providing recommendations for future drought policy. The 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 management 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 that have now been implemented following a period of review by states.

This redirection of drought policy stemmed from a fundamental philosophical change in how the Australian government views climatic variability and drought (Drought Policy Review Task Force, 1990). Instead of considering drought as a physical phenomenon and a specifically defined event denoted by a period of rainfall deficiency or reduced productivity, the task force recognized the following features of drought. First, no objective physical criteria at present can identify the existence of drought. It was felt that defining the concept in these terms encouraged the artificial designation of drought or nondrought periods or levels of drought severity (i.e., extreme, severe, moderate). Second, drought is a relative concept, dependent on the type of agricultural system in practice in a particular region and whether that system is in harmony or equilibrium with climate constraints. Rather, the task force chose to view drought (and climatic variability) as one of several factors affecting land productivity. For example, inappropriate management practices can induce drought-like effects or exacerbate existing drought conditions. The key, in the view of the task force, is to manage the land appropriately, taking into account the risks associated with operating an agricultural business, given the variability of climate. In other words, drought is considered one of many risks that farmers must consider in the operation of their business. The task force summarized their findings as follows:

"In a risk context, therefore, drought is synonymous with climatic variability. Recognition of this supply side risk is a significant departure from traditional perspectives on drought, but one we believe is critical to effective implementation of a national drought policy.

To achieve more sustainable agricultural production systems, both industry and government must accept the variability of climate. There is no such thing as a normal or average season. Managing for climate and income variability must become the norm, instead of what has amounted in the past to attempted income and climate stabilisation measures.

The need to manage for variable climatic conditions puts an onus on producers to adopt more flexible farming and management strategies.

Equally, producers must be given the opportunity to manage for the risks involved. Government policies need to recognize these risks and to provide appropriate encouragement to producers to manage for them as part of their ongoing business activities.

The need for more flexible and sustainable production systems puts greater onus on governments to reconsider their traditional approaches to industry support and assistance.

Assistance arrangements must be consistent with this self-reliant approach and apply when the risks involved begin to exceed those that can reasonably be addressed on a sound commercial basis."

Under the new national drought policy, the Australian government will provide financial assistance to farmers through the Rural Adjustment Scheme, a responsibility of the Commonwealth government (Kerin, 1991). Thus, under this policy, more responsibility for drought assistance will be transferred to federal government. Under the NDRA agreements, states carried a larger share of this responsibility.

The changes in drought policy recently implemented by the Australian government are dramatic and underscore a growing discontent with traditional response approaches. Although it will take some time before the results of this policy experiment are known, this innovative approach is one that should be studied by other governments for possible implementation, with appropriate modifications.

Summary

Drought is a natural hazard that plagues, in varying degrees, virtually all nations. The trend toward improved preparedness depicted in this chapter illustrates a wide range of government perspectives on drought management. Some of the

cases presented were selected because they portray examples of significant progress, while others simply show how the problem is being approached in various settings.

Like the occurrence of drought, the trend toward improving the level of preparedness is clearly a global phenomenon. It is not restricted to a particular continent, climatic regime, political system, or level of development. Many governments now view drought as a recurring physical event that results in complex direct and indirect economic, social, and environmental impacts that may linger for years beyond the termination of the event itself. Thus governments have begun to develop improved monitoring or early warning capability and an infrastructure to more effectively respond to water shortages when they occur. Governments are only now beginning to understand the symbiotic relationship between drought and human activities and the need for a national drought policy that integrates emergency programs and long-term development objectives. Chapter 3 presents a methodology that countries should consider as they move to develop a national drought policy and preparedness strategy.

"One logical approach, even in the face of great uncertainty about future climate, is to improve our ability to manage current climate extremes. Unlike global control of greenhouse gas emissions, international cooperation is not needed for many such adjustments to succeed; thus nations or regions that instigate them will be rewarded unilaterally." (Roberts, 1990)

CHAPTER 3
ADVANCING DROUGHT PREPAREDNESS IN THE 1990s

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 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, ultimately internal support must be present for the process to move ahead. The response efforts of many nations to date have had little, if any, effect on reducing vulnerability. In fact, vulnerability may have increased because of the 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 serve as a strong 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 and, 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.

Constraints to Drought Planning

Institutional, political, budgetary, and human resource constraints often make drought planning difficult (Wilhite and Easterling, 1987b). 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 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 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 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 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 some impacts while reducing physical and emotional hardship. Planning is a dynamic process that must incorporate new 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, the effects on 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. These features of assessment and response efforts were illustrated by the case studies in Chapter 2. 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 R 2.5 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. Congressman George E. Brown, Jr., of California recently suggested that perhaps using as little as one-tenth of one percent of U.S. federal drought relief dollars for preventative measures might lower the costs of future drought relief measures by tens, if not hundreds of millions of dollars (Brown, 1989). Although this example is from the United States, the principal applies to other political settings. Thus, 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.

Developing a National Drought Policy and 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, 1990; 1991a). This process has been evolving since 1987, when it was first conceived to synthesize the discussions and recommendations from participants of an international symposium and workshop on drought (Wilhite and Easterling, 1987c; 1989). This process was further modified as a result of direct interaction

between foreign governments and the author. The framework described below presents ten steps considered essential in the planning process (Figure 5). The first four steps actually involve appraising the resources available to support plan development and designing tactics to gain public support for the process. However, the process is intended to be flexible (i.e., governments can add, delete, or modify steps as necessary). For modifications in the planning process recommended by participants of the Drought Management and Preparedness Training Seminar for the Asian and Pacific Regions held in Bangkok, Thailand, in March 1991, see the final resolution (Figure 6).

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 task force) will vary from region to region; some examples are given in the case studies provided in Chapter 2. The NDC has two purposes. First, during plan development, the NDC 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 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 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 representative of the media or a public information specialist is to guarantee that attention is given by the NDC to promoting the public's awareness of drought and associated water issues and the mitigative actions that might be required of government during times of shortage. The actual make-up of this committee would be highly variable from one country to another, reflecting different political infrastructures and the unique combination of economic, social, and environmental impacts associated with drought. Care must be taken to keep the commission membership relatively small so that size does not become in itself a constraint or impediment to the completion of the planning process.

At the time of the appointment of the commission, two pivotal decisions rest with the head of state or other political official(s) with responsibility for this

Appointment of
National Drought Commission
(Step 1)

Statement of Drought Policy
and Plan Objectives
(Step 2)

Avoiding and Resolving Conflict
between Environmental and Economic Sectors
(Step 3)

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

Development of Drought Plan
(Step 5)

Identification of Research Needs
and Institutional Gaps
(Step 6)

Synthesis of Scientific
and Policy Issues
(Step 7)

Implementation of Drought Plan
(Step 8)

Development of Multilevel Educational
and Training Programs
(Step 9)

Development of Drought Plan
Evaluation Procedures
(Step 10)

Figure 5. The ten-step methodology proposed for the development of a national drought plan (Wilhite, 1990).

Final Resolution

The participants of the Drought Management and Preparedness Training Seminar for Asia and Pacific Regions, 25-29 March 1991, held in Bangkok with the financial support of UNEP, WMO, NOAA, and the University of Nebraska are:

·*Concerned* by the magnitude of the sufferings caused by the frequent recurrence of drought over large parts of the world, including Asia and Pacific Region and its effect on the sustainability of the natural resource base and environment;

·*Aware* of the need to improve global and regional response to this creeping disaster;

·*Observing* the inadequacy of current [assessment and] response [efforts] at governmental and other levels;

·*Noting* the concern expressed at the Second World Climate Conference and other recent international conferences, particularly in view of the implications of future climate change that is likely to influence the frequency, severity, duration, and location of drought episodes.

Recommends that governments and regional bodies urgently consider the following actions aimed at enhancing preparedness and limiting future drought impacts:

1. Formulate drought policy and planning objectives;
2. Establish national/state coordinating mechanisms for drought management;
3. Develop drought mitigation plans with special reference to:
   - Compiling an inventory of natural and human resources and identifying financial and legal constraints;
   - Identifying research needs and measures to bridge institutional gaps;
   - Synthesizing science and policy issues;
   - Recommend solutions to assist in the resolution of conflict between economic and environmental issues;
4. Develop multilevel public information, education, and training programs;
5. Ensure timely implementation of drought mitigation strategies;
6. Cooperate in establishing global response mechanisms for drought under the auspices of the United Nations.

The participants of the Training Seminar further request that UNEP take the following actions:

1. Transmittal of the above recommendations to governments in order to foster the philosophy of drought preparedness to other international and regional government organizations;
2. Provide financial and technical assistance in support of:
   - the development and distribution of a technical training manual on drought management and preparedness by the International Drought Information Center at the University of Nebraska-Lincoln;
   - the conduct of regional training seminars for developing countries in drought-prone regions;
   - the establishment of national and regional climate networks.

Figure 6. Final Resolution of the Drought Management and Preparedness Training Seminar for Asia and the Pacific Regions (Wilhite and Easterling, 1991).

planning process. First, who will provide the leadership for the activity? The person chosen must coordinate the development and implementation of the plan and be someone in whom the head of state has complete confidence; in particular, the chairperson should have a demonstrated ability to coordinate complex activities in an unbiased manner. The chairperson must also have a thorough understanding of those drought-related issues that must be addressed as part of the planning process so that all components of the plan receive adequate attention in their proper sequence.

Second, what agency will assume the primary responsibility for the administration of the plan after implementation? Often, the agency that the chairperson represents will assume responsibility for the administration of the plan once it has been produced. However, the authority for administering a drought preparedness plan may reside with any one of several agencies and should be determined on a case-by-case basis, depending on the existing organizational structure of governmental agencies, economic sectors affected by severe drought, and the types of water-related and/or environmental problems that exist. The decision on the question of agency leadership could be deferred until well into the plan development process. At this juncture, the choice may become more obvious.

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, as the hydro-illogical cycle illustrates (see Figure 2). 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. In the United States, several states have formalized their plan through the legislative process (e.g., South Carolina). Other states have chosen to make it an addendum to their emergency management plan, a comprehensive plan that addresses a variety of natural and human-induced disasters.

Step 2. Statement of Drought Policy and Planning Objectives.

As their first official action, the NDC 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* will be broadly stated and should express 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, Wilhite (1986) proposed three objectives of a national policy. 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 alleviate the effects of drought. Relief measures relied on in Australia, the United States, and other countries have discouraged self-reliance by encouraging the adoption of management practices that are 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. Assistance can be provided in many forms or as 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 not inconsistent 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 assessing and responding to drought?
- What should be the scope of the plan (i.e., will it concentrate primarily on agricultural issues or will it be 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 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 in this guidebook 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, 1991a). To be successful, drought planning must be integrated between levels of government, involving the private sector, where appropriate, early in the planning process. From previous discussion we have seen that a more proactive approach to drought management is now being taken by some governments. 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 drought conditions. Drought plan objectives will, of course, vary between countries and should reflect unique physical, environmental, socioeconomic, and political characteristics. 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 and responding to 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 each country consider these objectives and add to, delete, or modify them as appropriate.

Step 3. 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 NDC 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[4] must be considered in the drought planning process at an early stage. Although the level of involvement of these groups will no doubt vary

[4] These terms are defined according to their meaning in the United States. Other terms may apply in other political settings. The primary difference between special and public interest groups is who and what they represent. Where drought is concerned, special interest groups seek to influence policy to benefit their specific economic interests. For example, industry will want to assure sufficient water for corporate operations, and producers of agricultural goods want adequate water supplies for crops and livestock. Public interest groups represent the diverse values of the public domain. During drought, those groups representing natural resources or wildlife interests may be most prominent. Conservation and environmental groups may seek to prevent pollution or disruption of ecosystems. Economic self-interest is not the driving force for these groups. Economics, though, are generally used to define damages resulting from inadequate, inequitable, or inappropriate drought policies. Special and public interest groups may find themselves at odds during a drought crisis. Every effort should be made to incorporate nonlitigious conflict resolution throughout the drought planning process.

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 these concerns.

If it is determined that the public should be involved in drought planning, then that involvement should commence early in the planning process. A drought advisory council (DAC) should be established by the NDC to facilitate this involvement. The DAC should be a permanent feature of the drought plan, assisting the NDC in the flow of information and the resolution of conflicts between water users during severe drought periods.

Public interests and environmental concerns are best addressed early and often in the drought planning process. It is highly desirable to enhance communication between the public and the government at all levels in a drought situation (i.e., assessment, policy formulation, and response effort). The communication networks of public interest and environmental groups can greatly assist government in both dissemination of information and creation of and feedback on mitigation attempts.

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 NDC. In most cases, much information already exists concerning available resources, particularly in the natural and biological resource areas. 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 hay, 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 hay, 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 the 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 7.

The organizational components shown in Figure 7 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 (Figure 7), but would include the basic components and responsibilities given in Figure 3 for the Zimbabwe drought relief committee. South Africa has a similar vertical structure, as discussed in Chapter 2. Thus, each of the committees shown in Figure 7 would likely have a counterpart at the provincial and local level with well established linkages to the national committees. These provincial and local committees will not only facilitate data collection and feedback on programs and policies, but also the dissemination of informational products and advisories as well as the implementation of policies.

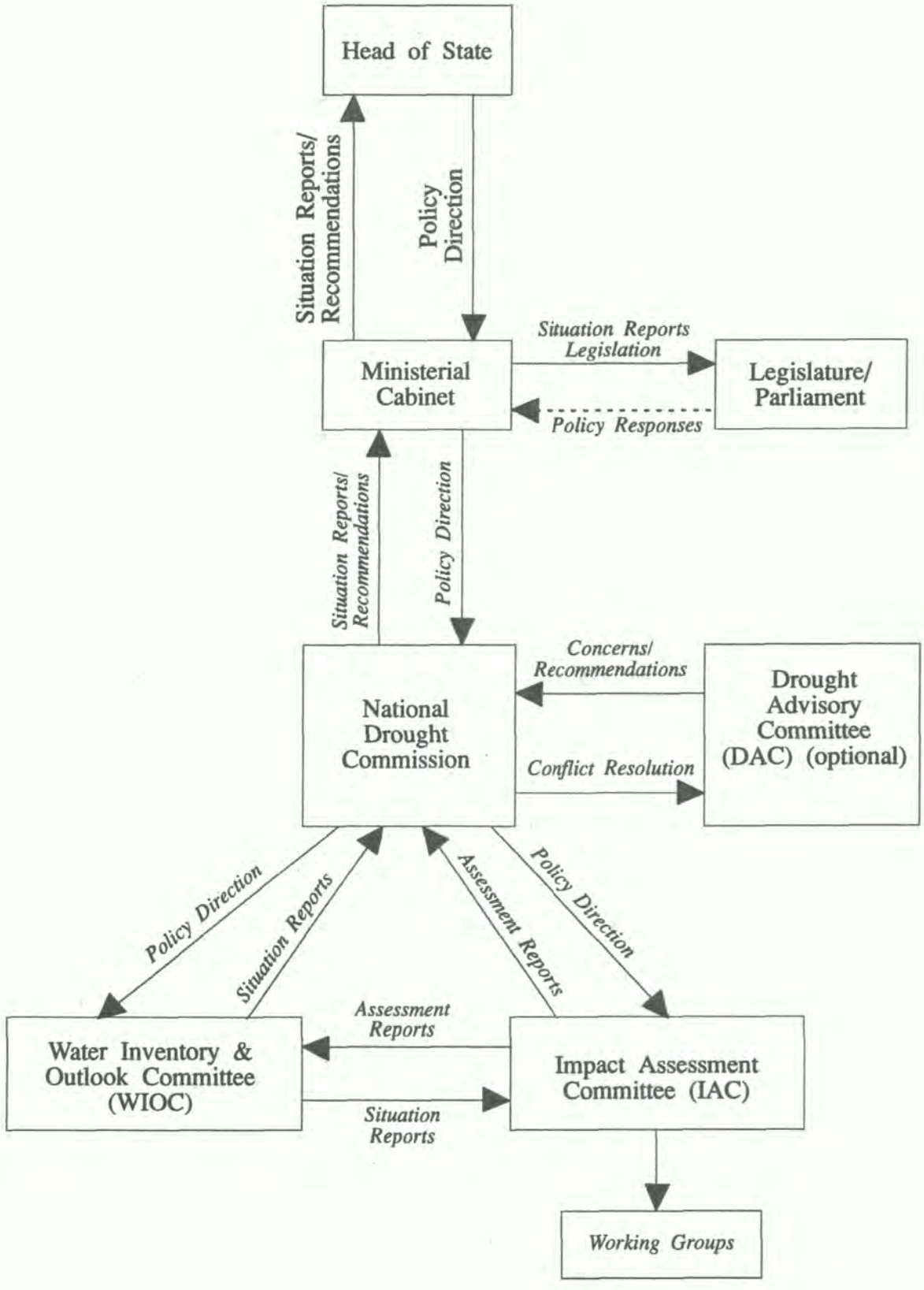

Figure 7. Linkages and suggested organizational components of the drought plan proposed under the ten-step process (adapted from Wilhite, 1990; 1991a).

Monitoring Component: The Water Inventory and Outlook Committee (WIOC).

A Water Inventory and Outlook Committee (WIOC) 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 WIOC would have four 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 triggers and an early warning system;

4. 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, groundwater, and streamflow). In some instances, many agencies at the 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. The number of agencies responsible for collecting, analyzing, and disseminating data and information on each of these indicators will vary by country.

It is important for the WIOC 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. At times, shortage and surplus situations may exist simultaneously within the country. The frequency of WIOC meetings should be increased if conditions warrant.

It is preferable for members of the WIOC to meet face to face to encourage interaction and ensure the correct interpretation of data and information before it is disseminated. The experience of governments that follow this procedure indicates that this exercise is a valuable learning experience for all those involved. Not only do members of the committee become more aware of the data collection systems operating within the country, but each person also receives a first-hand briefing on water availability for each component of water supply. As a result, all members of

the committee have a more comprehensive and accurate assessment of the situation, leading to greater consistency in water status reports provided to the media.[5]

It must be emphasized that an accurate assessment of water availability and its outlook (not a meteorological forecast) for both the near and long term is valuable information in both dry and wet periods. During drought periods, however, the value of this information increases markedly. Following each meeting, the NDC should brief the president or appropriate political official about the contents of the report, including any recommendations for specific actions that would require his/her decision. The WIOC should also prepare a report for dissemination to government and nongovernment agencies and the media, as deemed appropriate by the NDC. It is vital for the public to receive a balanced interpretation of changing conditions as expressed by the media.

(1) Inventory data availability and current observation networks. The WIOC must inventory current observational networks (e.g., meteorological, hydrological) operated by governmental agencies and nongovernmental organizations and protect and enhance those networks where necessary. Maintaining or enhancing existing networks and/or establishing new data collection networks can be costly, but this is essential to a dependable monitoring system. The inventory may identify areas of data deficiency (quantity or quality) that must be addressed. Meteorological data represent an important part of any drought monitoring system, but they are only one component of a complete system. To reflect the impact of weather events on agriculture, domestic and industrial water use, and so forth, other physical indicators of water availability must be included as part of the monitoring system. For example, increased development and use of groundwater resources in many areas has not been accompanied by the establishment of adequate monitoring systems or regulation authority.

The WIOC must ensure that conventional surface observation stations in national and state measurement networks are protected from being downgraded or eliminated. These networks provide essential benchmark data and time series needed for improved monitoring of the climate and hydrologic system. Data must be collected at a sufficient spatial density to adequately represent impending drought conditions to many user groups, and of sufficient quality to ensure accurate assessments. Currently, many observational networks, especially in developing countries, and reports emanating from the data collected by those networks do not provide sufficient information for some user applications. Reporting networks may also need to be upgraded by adding automated stations to provide more timely reporting of data and/or data from remote locations. Automated networks have been established and are operating on a routine basis in many developed and developing nations.

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[5] Representatives of the media will often follow up on official reports by contacting individual members of the committee for more detailed and personal interpretations of water status and problems being experienced in particular locations or by specific population groups. Conflicting reports on the severity of the drought situation can be devastating to the credibility of the WIOC and its member agencies.

The WIOC should also consider the use of Advanced Very High Resolution Radiometer (AVHRR) digital data from the GOES satellite (operated by NOAA) (Tucker and Goward, 1987). These data are transmitted by the satellite in five discrete bands of the electromagnetic spectrum, two of which are useful for land-resource investigations. These data can be used to depict changes in the photosynthetic activity of vegetation and thus are useful in early detection of the onset and spread of drought conditions. These data are used routinely as part of the Famine Early Warning System (FEWS) in Africa and the National Agricultural Drought Surveillance System in India (Thiruvengadachari, 1991); many other nations also use the data.

(2) Determine primary user needs and develop and/or modify current data and information delivery systems. For monitoring systems to be successful in both the short and long run, network designers must consider user needs from the outset. Often informational products are developed with little, if any, input from users regarding their primary data/informational needs, critical decisions that require timely information, or the format of the data products.

If new data networks are to be established, such as automated weather stations, user needs should be considered from the initial design phase through the development of information delivery systems. This concept has been defined by Wilhite (1990) as the data/information continuum (Figure 8). This continuum expresses the development of weather products for users as an interactive process between the developers and users of those products. Primary target groups for informational products must first be determined. The continuum stresses the importance of interaction between the developers and product users and includes educating primary product users on the application of these products to specific problems. According to the continuum, communication channels between suppliers and users of information must always be open to spontaneous feedback. Agencies and organizations responsible for maintaining drought monitoring or early warning systems must receive and use feedback from users in the modification of system operations and products. System managers must also formally solicit the opinions and suggestions of users on a periodic basis. These solicitations should include requests for opinions about and experiences related to the use of existing products and practices as well as ideas for product development.

Information on the onset, severity, spatial extent, and probable impacts of drought is not always disseminated to users in a timely manner. To be timely, information should reach the user in time to be incorporated in the decision process. Therefore, it is imperative that the timing of critical decisions by primary users be determined along with user data/information needs. Once the information reaches the user or decision maker, it may, for a number of reasons, be applied ineffectively. For example, the user may be unfamiliar with techniques to incorporate this information into a decision strategy, or the product may be poorly designed to convey information. Referring again to Figure 8, it is essential that data and information delivery systems be developed in concert with user needs and that educational programs be available to primary users to train them in product application.

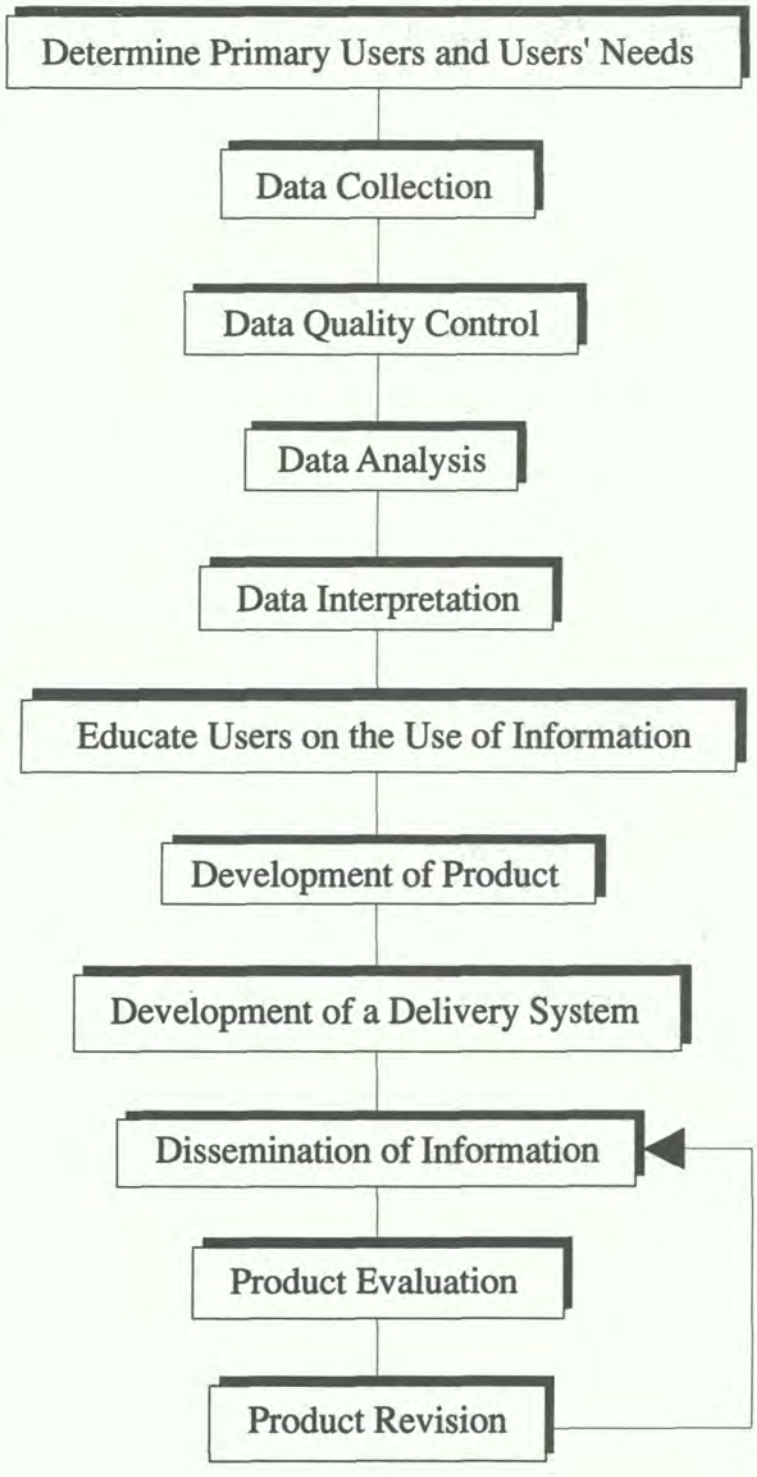

Figure 8. The data/information continuum for the development of weather/climate data-based products (Wilhite, 1990).

(3) Define drought and develop triggers and an early warning system. Countries must develop or select an index or combination of indices that can be used to trigger specific and timely actions by government. What is envisioned is a stepwise or phased approach as water conditions deteriorate and more stringent actions become necessary. Given this approach, thresholds must be established such that when they are exceeded, certain actions are triggered within government and other organizations, as defined by the structure of the drought plan. Definitions of drought were discussed earlier in this guidebook. As a first step, the WIOC should inventory and evaluate indices that may be applicable to their country, providing comprehensive and reliable quantitative measures of drought severity. If necessary, international organizations such as the WMO and the Food and Agricultural Organization (FAO) may be able to assist in this evaluation process.

It is recommended that a number of indicators be used in combination to evaluate the status of water conditions since no single index can properly integrate and evaluate all of the important meteorological, climatological, hydrological, and agricultural components. It is the role of the WIOC to review these indicators on a regular basis and interpret trends and anticipate problem areas.

The WIOC, with significant input from the National Drought Commission (NDC), may want to consider a phase-in system that is dependent on supply source or application. Drought severity is a function of supply and demand, which may vary significantly for different water use sectors within the same geographic area. For example, there can be considerable disparity in the vulnerability of municipalities to drought. One municipality may have a more than adequate supply because of a particularly reliable source or as a result of recent expansion of the water supply system, but a nearby community may be extremely vulnerable. Farmers growing crops under irrigation might also be affected differently--for example, those relying on surface water from streams or reservoirs may experience significant shortages in available water while those irrigating from groundwater may not be affected. Requiring conservation or rationing measures within a particular water use sector without regard to differences in vulnerability can be a very unpopular decision, penalizing those that have invested time and resources in supply augmentation or other vulnerability-reducing tactics.

At the outset it is important for the WIOC to distinguish between early warning systems designed for drought and those designed for famine. Drought early warning systems concentrate primarily on assessments based on the most important components of the water balance (as noted earlier). Famine early warning systems should incorporate many, if not all, of these elements and also include information

on a wide range of other social indicators.[6] The monitoring system described here is intended only for drought. If drought and famine conditions often coexist, the WIOC should broaden its scope and pursue development of a famine early warning system. For a discussion of famine early warning systems, the reader should consult Walker (1989).

Most countries already have in place some of the components of a drought early warning system. A problem specific to many developing countries is the inadequacy of monitoring networks for detecting water shortages and interpreting these shortages in a historical and probabilistic sense. Many national meteorological services have little experience with early warning systems and may need assistance from other nations, regional drought monitoring centers such as those that have been established in Africa, or international organizations such as WMO.

The challenge facing the WIOC is to coordinate and integrate current data collection and information systems into a comprehensive monitoring system that will provide timely and reliable information to key government decision makers. The selected indices should accurately depict current water conditions and water outlook. Another challenge for the WIOC is to identify deficiencies that may exist in various data networks or in the availability of informational products, and supplement these as needed. These initiatives were discussed under previous duties of the committee.

(4) Identify drought management areas. In many instances it may be worthwhile to identify drought management areas (DMAs) as a mechanism for focusing the resources of government and the attention of the media on the geographic areas most affected. DMAs may be defined on the basis of political boundaries, river basins, or agricultural zones. In essence, DMAs facilitate targeting of relief; these areas can be designated or undesignated as drought conditions intensify or moderate. Eligibility for relief can still be determined on a case-by-cases basis within the DMA.

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 (see Chapter 1). 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

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[6] The types of data that would be used as part of a food and nutritional surveillance program can be divided into two classes (Walker, 1989): process indicators and status indicators. Process indicators include measures such as the prevalence of breast-feeding, immunization coverage, access to clean water, and use of health services. These are indicators of gradual, long-term trends describing vulnerability of the system in question. Status indicators are intended to measure the individual's ability to cope within the system. The three indicators recommended by UNICEF for famine or nutritional surveillance include birth weight, weight for age of children under age five, and height of school entrants. The FEWS operated by USAID is an example of one system. It has been operating since 1985 in eight countries, mostly in East Africa and the Sahel. For an example of an integrated drought and famine early warning system operating in the Turkana District of Kenya, consult Swift (1989).

to include university scientists 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 businesses are largely ignored. Because of the obvious dependency of the IAC on the Water Inventory and Outlook Committee (WIOC), frequent communication between the two is essential.

Two models are proposed to assess the magnitude and diversity of impacts that are likely to result from drought. The first model will be appropriate in some cases. In this instance, the IAC is responsible for determining impacts, drawing information from all available and reliable sources. The advantage of this approach is its simplicity, involving only a select group of agency heads or representatives. This approach will likely be successful in those countries where impacts are concentrated in a relatively few economic sectors (e.g., agriculture). The disadvantage of this approach is that unless an adequate reporting structure is in place to ensure that all impacts are identified and evaluated correctly, indirect effects may go undetected.

The second model establishes a series of working groups responsible for anticipating and identifying drought-related impacts in all economic sectors deemed to be important. As previously discussed, the assessment (and quantification) of drought impacts is complicated and their detection is most difficult without a team of experts from each impact sector working in concert. Members of the IAC may not have the expertise necessary to identify the range of impacts that occur. Working groups would be composed of specialists for each impact sector. The leader of each working group would be a member of the IAC and would report directly to the IAC. With this model, the responsibility of the IAC is to coordinate the activities of each of the working groups and make recommendations to the NDC.

The number of impact sectors or working groups will vary considerably between countries. Working groups used by some states in the United States include municipal water use, wildfire protection, agriculture, industry, commerce, tourism, wildlife, energy, and health. A working group on environmental problems should be considered in most, if not all, instances.

A major point of concern here is that the IAC must give significant attention to the full range of impacts associated with drought and also must 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. The IAC must work closely with both the WIOC and the NDC (see next section, the response component) to ensure that this does not occur.

Response Component: National Drought Commission. The third and final element of a drought plan is the response component. The purpose of this component is to act on the information and recommendations of the IAC and evaluate the range of

assistance from government and other sources to assist agricultural producers, municipalities, and others during times of emergency. Because this is a policy-making body, it would be composed of senior-level policy officials, precisely the same make-up as the NDC. Therefore, in addition to overseeing the plan development process, the NDC should assume this 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 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 NDC may want to consider transferring this task to the IAC. The NDC (or IAC) should also recommend other forms of assistance that could be developed. During drought the NDC will make recommendations to the president or appropriate presidential 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 the occurrence of 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 most rational forms of assistance needed by the various impact sectors.

With regard to assistance programs, societal vulnerability to drought may be influenced substantially by non-drought-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 (see Chapter 2). 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 WIOC 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.

Institutional deficiencies should 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 for responding to drought impacts. A panel of researchers and policy experts recently 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, all or a portion of the system should be tested under simulated drought conditions before it is implemented. 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 that 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 plan once it is activated, but also those at the provincial and local levels of government that will provide valuable input into the decision-making process. The individuals that constitute 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) and should be no different in this case. Changes in political leadership, retirements, promotions, and transfers to other positions all can disrupt the integrity of the plan.

Step 9: Development of Multilevel Education 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 that 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 review team should address the following questions as a part of the process:

- Was the drought plan followed? If not, why not?

- Were the actions taken and measures implemented effective in mitigating the impact of drought? Which actions and relief measures were effective and which were not?

- Should the plan have included other actions or assistance measures?
- Did aid reach all groups in the stricken area? If not, why not? How were the target groups for aid identified?
- Were the measures timely in relation to the events of the drought period?
- Was it possible to correct errors during the emergency?
- What financial and human resources were allocated to the relief effort? Where did the resources come from and how were they controlled?
- How efficient was the logistical support and the available infrastructure? What obstacles (if any) were encountered that reduced the efficiency of the response?
- How effective was the coordination of response efforts between government, NGOs, and other organizations? How did this cooperation affect the flow of information or assistance?
- Was media coverage accurate and realistic in providing details of the event? What kinds of media were involved? What role did they play in the emergency?

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. 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.

Planning for Drought and Climate Change

Debate on ozone depletion, drought, climate change, deforestation, biological diversity, and desertification has been raging within the scientific community and between the scientific and policy communities for a decade or more (for example, see Schneider [1990] for a discussion of the debate on climate change). The public has observed this debate largely through the eyes of the media. Central to the debate have been issues of cause and effect, linkages between issues, and preventative, adaptive, and mitigative actions that could be implemented to reduce or lessen impacts. However, because of the uncertainties associated with these issues, often it has been difficult to separate fact from fiction.

Working Group I of the Intergovernmental Panel on Climate Change (IPCC) recently issued their scientific assessment of climate change (Houghton et al., 1990). In that report the Working Group concluded with certainty that the earth's natural greenhouse effect will be enhanced by increasing atmospheric concentrations of greenhouse gases that will in turn result in a warming of the earth's surface. The working group further reports that on the basis of a "Business-as-Usual" scenario, the rate of increase in global mean temperature (GMT) during the next century will be about 0.3°C per decade, with a range of uncertainty of 0.2°C to 0.5°C per decade. They also concluded that the rise will not be a gradual one. Other scenarios tested by the working group represented increasing levels of emission controls. These scenarios indicated that these controls could retard the rate of increase considerably, but some increase in GMT would be unavoidable.

Regional changes in climate are expected to be different from the global mean, but confidence in these predictions is low because of the limitations of current climate models. These predictions pertain not only to the regional patterns of climate change but also to the timing and magnitude of these changes. The working group noted that this uncertainty is largely due to of an incomplete understanding of the sources and sinks of greenhouse gases, clouds, oceans, and polar ice sheets. Although there is no evidence to suggest that weather has become more variable in the past decade (IPCC, 1990), a key question that has yet to be answered is how future climate variability will be affected by changes in climate (Rind et al., 1989; Mearns et al., 1990; Rind, 1991). The IPCC did note, however, that the frequency of high temperature periods is expected to increase while the frequency of cold temperature periods is expected to decrease. Clearly, changes in temperature will alter rates of evapotranspiration and soil moisture depletion. Uncertainties regarding changes in precipitation amounts and seasonal distribution make it difficult to approximate the future incidence of drought.

The advantages of preparing for drought, a climatic certainty, through the development and implementation of a comprehensive drought plan have been discussed in this report. These advantages exist whether or not projected anthropogenically-related changes in climate occur (i.e., a "no-regrets" action of government). However, planning for drought and climate change should not be considered as separate issues. Governmental efforts to prepare for severe drought

today will place those that take this course of action in a better position to develop strategies for coping with projected changes in climate.

Drought planners must incorporate the best scientific judgments of climate change into the planning process. This should not be a particularly difficult assignment since the planning process is intended to be dynamic, incorporating economic, social, technological, and political changes as they occur. As part of the ten-step planning process described above, the NDC should designate the WIOC, IAC, and other key institutions to examine the sensitivity of managed and unmanaged systems to changes in climate, using scenarios that seem to be regionally appropriate. Based on the results of this analysis, these groups can postulate alternative response options and incorporate them in the plan.

Summary

A methodology was presented to facilitate the development of a drought plan. This ten-step planning process presents the principal ingredients that should be considered by governments that desire to adopt a more proactive approach to drought management in order to provide a more effective, efficient, and timely response effort in the short term and reduce societal vulnerability in the long term. 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.

"Drought-prone countries should develop drought response plans for drought monitoring, establishment of selected indices for the identification of thresholds for onset and cessation of drought and for following the impact of drought in all areas of the economy especially in agriculture, water supply, energy and industry" (Obasi, 1986).

"Even if we cannot stop drought from occurring or cannot fulfill occasional political or scientific promises to drought-proof an area, there are ways either to protect more vulnerable countries or to prepare them to be better able to cope when such situations recur. These countries . . . need . . . drought preparedness training, drought-technology and transfer of drought-coping mechanisms" (Glantz and Degefu, 1990).

"A national drought policy is strongly needed to coordinate federal response to the possibility of increased frequency and duration of future droughts due to climate change. Even without climate change, such a policy is needed not only for the agricultural sector but also for other sectors" (Smith and Tirpak, 1989).

CHAPTER 4
SUMMARY AND RECOMMENDATIONS

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. These deficiencies were illustrated in this guidebook through case studies of Zimbabwe, the Philippines, Brazil, India, South Africa, the United States, and Australia. The magnitude of economic, social, and environmental losses in the past decade or so in these and many other countries has pointed out the vulnerability of all nations to extended episodes of severe drought. Increased awareness and understanding of drought has led many governments to take a more proactive approach toward 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.

This guidebook documents some of the recent progress made in developing and developed countries in preparing for drought. Each of the case studies exhibited an evolving, yet substantive, philosophical change by government in their approach to drought management. The development of drought policies that promote risk management and the preparation of contingency plans exemplify these changes and represent a positive step toward risk minimization and vulnerability reduction. Drought contingency plans promote greater coordination within and between levels

of government; improved procedures for monitoring, assessing, and responding to 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 plans. The essential elements to consider in the formulation of these plans were presented in a ten-step process. The first step in the proposed planning process is the appointment of a national drought commission (NDC) to supervise and coordinate the development of the plan. Although the make-up of the NDC would vary considerably from country to country, it should include representatives from the most relevant mission agencies. The leadership of the NDC is critical since this group oversees all aspects of plan development.

The NDC, as their first official action, will proceed to formulate a national drought policy and the purpose and objectives of the plan (Step 2). In most settings the commission will also need to include a formal mechanism to reduce conflict between environmental and economic sectors during periods of shortage (Step 3). In order to ensure that the views of citizens, public, and environmental interest groups are considered in the planning process, it may be helpful to form drought advisory committees to incorporate their concerns and ensure their participation and support in the process. The NDC will also need to undertake an inventory of natural, biological, and human resources available and determine financial and legal constraints that may exist with regard to plan formulation and implementation (Step 4).

The actual development of the plan begins with Step 5. A drought plan possesses three essential elements: monitoring, impact assessment, and response. These elements are the basis for three committees: (1) Water Inventory and Outlook Committee; (2) Impact Assessment Committee; and (3) National Drought Commission. The organizational and operational responsibilities of these committees were specified in considerable detail. During plan development, the NDC should identify research needs and institutional gaps to strengthen the plan (Step 6). The NDC must also synthesize the scientific and policy issues (Step 7) to determine what is feasible, given the broad range of options and resources available. The culmination of the planning process is the implementation of the drought plan (Step 8). At this point, an organizational structure is in place to address the issues critical to the management of water during periods of shortage. The implementation of the plan should coincide with the peak demand or most drought-sensitive season to take advantage of inherent public interest. The development of multilevel educational and training programs (Step 9) is a long-term effort and will be an ongoing process after the implementation of the plan. Educational programs for all age groups should focus on the full spectrum of water management and conservation issues during drought and nondrought periods. A media awareness program is an important part of this educational process.

The development of drought plan evaluation procedures (Step 10) is the critical final step in the planning process. A drought plan is not a static document,

but one that must evolve continuously to meet the needs of a changing society. Two modes of evaluation were recommended. First, an ongoing or operational evaluation program was recommended that considers how new technology, legislation, changes in political leadership, and so forth may affect the operation of the plan and the need to revise operating procedures. The second recommendation calls for a post-drought evaluation program that documents and critically analyzes the assessment and response actions of government and recommends actions for improving the plan. This post-drought evaluation program attempts to build on the successes of the past while eliminating the failures. The post-drought evaluation process should be initiated soon after the drought has ended to take advantage of and preserve institutional memory.

Drought is a normal part of climate. Planning for drought represents prudent action by governments. Learning to anticipate the occurrence of and respond more effectively to drought will benefit all nations, whether or not projected changes in climate occur in the future. Intergovernmental organizations, international organizations, donor governments, and NGOs are urged to encourage and assist governments in the formulation of drought plans.

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