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National Drought Policies: Addressing Impacts and Societal Vulnerability

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National Drought Policies: Addressing Impacts and Societal Vulnerability

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Abstract

Drought is a naturally occurring event that is associated with virtually all climatic regions. Given its slow onset and other characteristics, including its spatial dimensions and duration, impacts are difficult to assess and have been, historically, poorly documented. These impacts are strongly influenced by a society's exposure to the hazard and the vulnerability of that society to the hazard. This vulnerability is continually changing in response to increasing population, land use changes, technology, government policies, and many other factors. Therefore, each drought event is superimposed on a society with differing vulnerabilities than existed when the previous drought event occurred. Drought impacts are increasing worldwide, both as a result of these changing vulnerabilities and, perhaps, because of an increase in the frequency, severity, and duration of drought events. To lessen societal vulnerability, it is imperative for nations to move away from the crisis management approach to drought management and toward a more proactive, risk-based approach, including the adoption of national drought policies that reflect this new paradigm. Emphasis must be given to the development of improved drought monitoring and early warning systems and the delivery of this information to decision makers at all levels. It is also essential that vulnerability assessments be conducted in order to determine who and what is at risk and why. A final step is the identification and implementation of appropriate mitigation measures or actions that will reduce future impacts on economic sectors and population groups.

Introduction

Drought is a complex, pervasive natural hazard, often referred to as a 'creeping phenomena' (Tannehill, 1947). As a result of its complexity, literally hundreds of definitions of drought exist, reflecting different climatic characteristics from region to region and sector-specific impacts. Conceptually speaking, drought results from a deficiency of precipitation from expected or normal that, when this deficiency is extended over a season or longer period of time, is insufficient to meet the demands of human activities. Droughts are typically classified as meteorological, agricultural, hydrological, or socioeconomic (Wilhite and Glantz 1985; Dracup et al. 1980). However, all types of drought originate from a deficiency of precipitation resulting in water shortage for some activity or some group. Of course, the severity of drought in both a temporal and spatial sense can be exacerbated by other factors such as high temperatures, low relative humidity, and high winds. Drought must be considered a relative, rather than absolute, condition. The ultimate results of these precipitation deficiencies are, at times, enormous economic and environmental impacts as well as personal hardship. These impacts ripple through the economy and produce significant secondary and tertiary impacts as well.

Impacts of drought appear to be increasing in both developing and developed countries, a clear indication of nonsustainable development in many cases and, perhaps, providing an indication of changes in climate and its variability resulting from an enhanced greenhouse effect or global warming. Lessening the impacts of future drought events will require nations to pursue development of drought policies that emphasize a wide range of risk management techniques, including improved monitoring and early warning systems, preparedness plans, and appropriate mitigation actions and programs.

Drought Management: The Crisis Management Approach

The approach taken by essentially all governments at both the national and local level is to react to drought through what is commonly referred to as the hydro-illogical cycle (Figure 1). This approach is characterized by a growing level of concern as the severity of the drought increases over a period of several months or more. However, no drought management plan is in place that oversees government agency responses or the coordination of those responses. It is widely known that responding to crisis is largely ineffective, and the actions of the multiple government agencies with responsibilities for responding to the drought conditions are usually poorly coordinated. This type of response is largely directed at addressing the impacts that are occurring. These impacts are a reflection of societal vulnerability. This largely reactive approach actually leads to an increase in societal vulnerability since the recipients of drought relief or assistance programs become dependent on government programs to rescue them by providing resources to survive the crisis. This approach discourages the development of self-reliance and implementation of improved resource management practices.

All drought-prone regions have a 'reference' drought that has helped to focus attention on the devastating impacts that can be associated with a severe drought episode. For the United States, the reference drought for most parts of the country is the severe drought that began in 1931 and extended through 1939 for many parts of the country and is associated with the famous 'Dust Bowl' period in American history. This series of drought years was noteworthy for several reasons. First, the severity, duration, and spatial extent of the drought during a critical settlement period in the nation's history and the economic depression of the period resulted in substantial economic, environmental, and social impacts across the country, including the exodus of many people from the Great Plains to the far western states, especially California and Oregon. The peak drought year, in terms of areal coverage, was 1934, when 65% of the country experienced severe to extreme drought. Second, it was the first time the federal government had become actively engaged in drought relief programs. The federal government had largely relied on the efforts of private organizations, such as the Red Cross, and churches to provide relief to the victims of drought (Wilhite 1983; Wilhite et al. 1986). The government's engagement in drought relief included a combination of reactive programs and several more noteworthy mitigation-type measures directed at reducing the vulnerability of the Great Plains and other regions. Most noteworthy was the formation of the Soil Conservation Service within the U.S. Department of Agriculture. This agency's mission was to improve soil and water management and conservation practices throughout the country. Of course, during this period there was no drought early warning system in place, as government entities relied largely on precipitation departures from normal to make assessments of drought severity in the region.

The impacts of drought are much more complex today, a trend that will continue. Once largely characterized as a problem for the agricultural sector, the impacts of drought have now escalated and cascaded into many other sectors such as energy, transportation, recreation and tourism, urban water supply, and water quality. The environmental and social impacts are also more dramatic, resulting in significant conflicts between water users. These impacts cascade as drought conditions evolve from a short-term precipitation deficiency, commonly referred to as meteorological drought, to a longer-term period of precipitation deficiency leading to agricultural and hydrological drought, as illustrated in Figure 2. Agricultural drought is associated with deficiencies in soil moisture, which, in turn, affects agricultural production. As precipitation deficiencies continue, shortages in hydrological systems (i.e., reservoirs and lakes, streamflow, ground water levels) begin to emerge, resulting in significant impacts in the other sectors mentioned above.

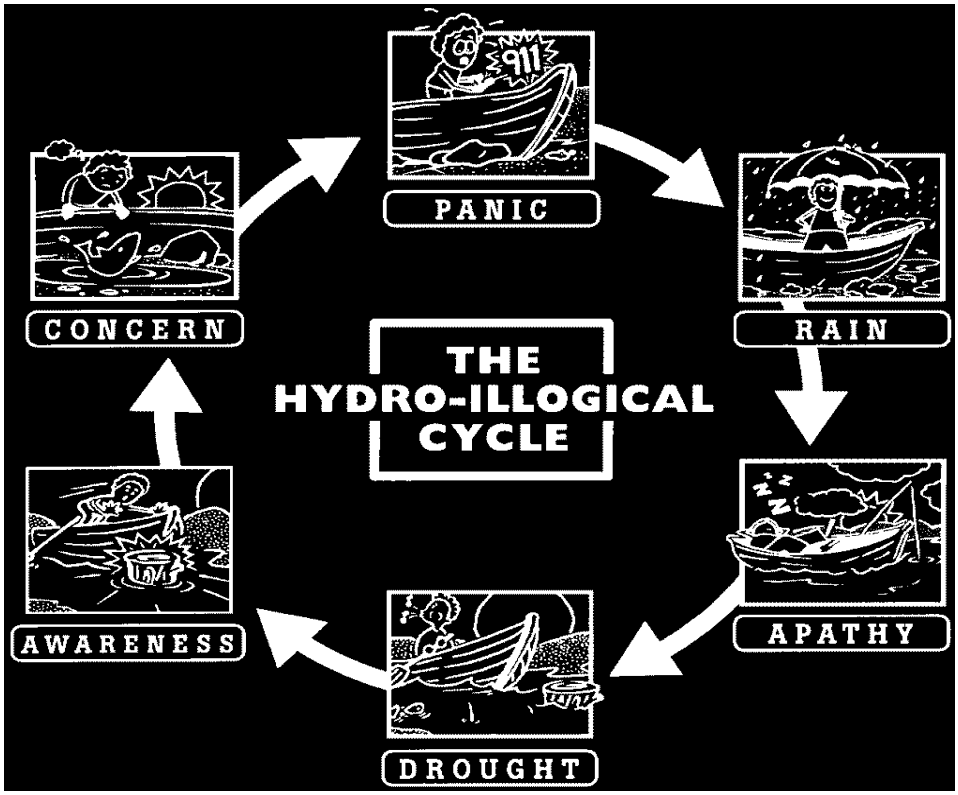

Figure 1.The hydro-illogical cycle (Source: NDMC website, http://drought.unl.edu/Planning/HydroillogicalCycle.aspx).

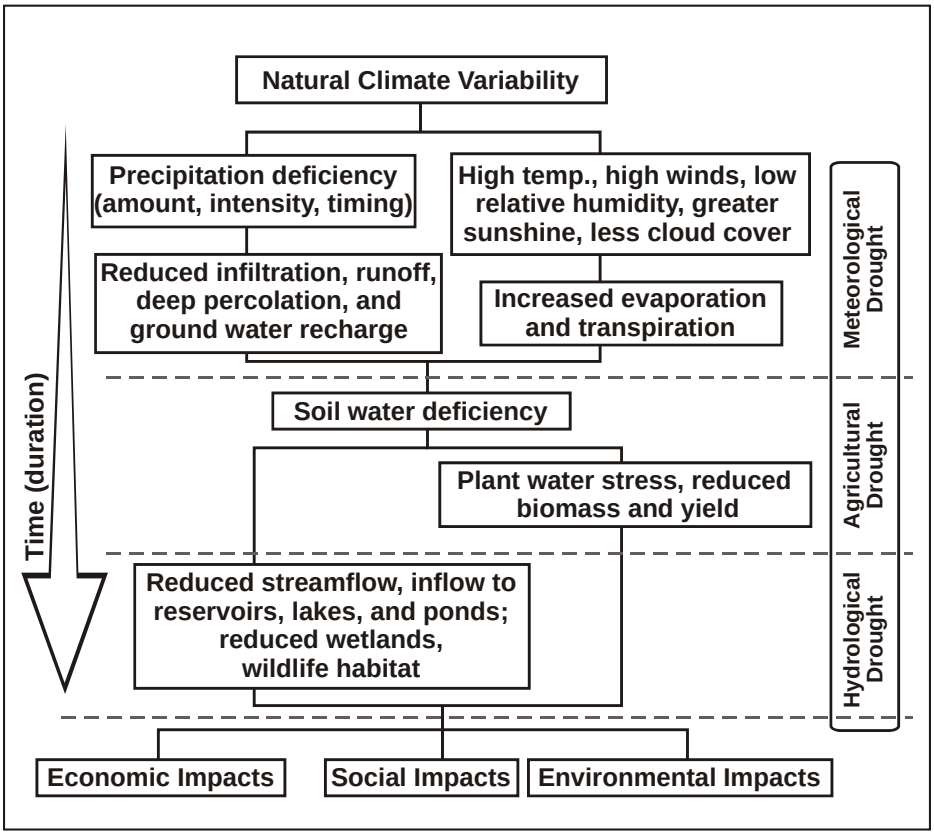

Figure 2. The evolution of drought types and impacts (Source: National Drought Mitigation Center, University of Nebraska–Lincoln).

Figure 3 represents the historical occurrence of drought in the United States for the period of 1895 to 2011, expressed as the percent area of the country experiencing severe to extreme drought. Several important features of drought are illustrated in this figure during the period of record. First, drought affects a portion of the country each year, ranging from less than 10% in some years and reaching levels of more than 40% in several major drought episodes. Second, the percent area affected is highly variable during this period of record, but drought events tend to cluster, such as during the 1930s, 1950s, 1960s, and so forth. The recent series of drought years have been rather dramatic in terms of duration, intensity, and spatial extent, beginning in the late 1990s and continuing to present. The major drought events illustrated in this figure are also important for another reason—each one represents a 'window of opportunity' for improved drought management and planning. Referring once again to Figure 1, each major drought episode captures the attention of the public, natural resource managers, and policy makers by highlighting the complex series of impacts associated with these events and the need for a more proactive, risk-based management approach.

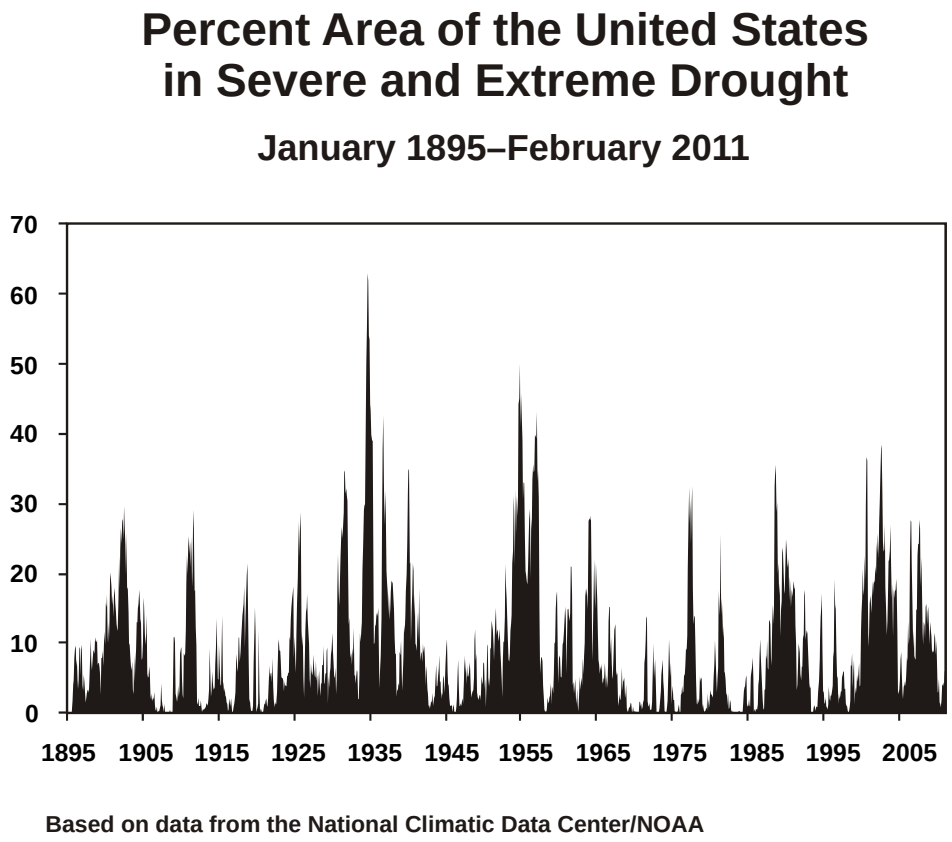

Figure 3. Percent area of the United States in severe and extreme drought, 1895–2011 (Source: Compiled from data from NOAA's National Climatic Data Center).

Current and Future Droughts: Key Observations

It is clear from the recent occurrences of drought in the United States that there is a growing need to enhance planning and policy efforts to deal with the expanding drought impacts and their complexities. Several key points are to be noted. First, the impacts from recent droughts have led to greater sectoral impacts and reflect the increasing vulnerability of much of the country to periods of severe and extended water shortages. Second, there is a significant migration of population in the United States to more water-short areas in the southwest, south-central, and far western states, as well as a

significant shift in population to the southeastern states, particularly Georgia and Florida. This shift in population was noteworthy between 1990 and 2000, and the latest census information through 2010 indicates that it is continuing. Percentage increases during the 1990s ranged from 30% to more than 60% in the states of Arizona, Colorado, Utah, and Nevada. These already water-short states in the western United States are now being further water-stressed as population increases dramatically and water seems to be more limited as a result of warmer winters, declining snowpack and runoff, and higher rates of evapotranspiration. Third, water demand is increasing rapidly in many parts of the country in association with expanding populations. Thus, conflicts between water use sectors are increasingly leading to greater transboundary issues between states and with Mexico and Canada. Fourth, many river basins in the country are currently fully or over-appropriated. The ability of states to manage water supplies with an expanding population under various climate change scenarios is an important area of concern for many decision makers. Finally, many feel that current water laws and institutions are outmoded and unable to deal with these expanding pressures of a growing population and changing vulnerabilities to increased climate variability and changes in climate state.

Projections of an increased frequency and severity of drought conditions from the most recent IPCC report (2007) provide further cause for concern (Figure 4). Using the output from the A1B scenario, a significant increase in drought is expected for Central America, the southwestern United States, the Amazon Basin, southern Africa, the Mediterranean Basin, Australia, and Indonesia. Some of these regions are currently significantly water-stressed, so a trend toward increased drought is cause for significant concern.

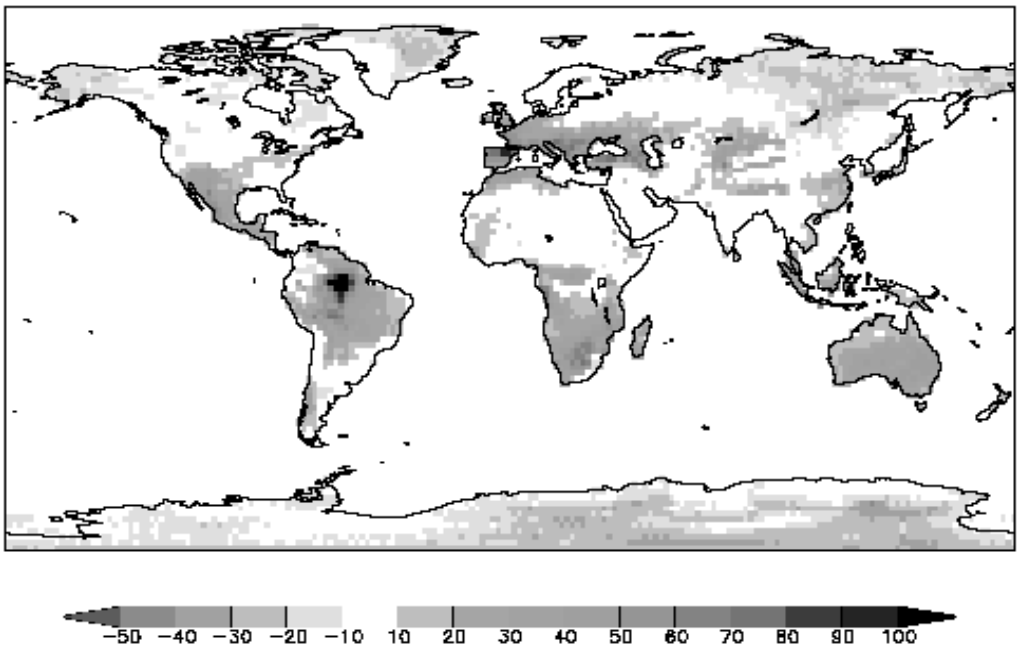

Figure 4.Projected drought according to the A1B model. Percentage change in average duration of longest dry period 30-year average for 2071–2100 compared to that for 1961–1990 (Source: IPCC, 2007).

The pattern of drought in the United States over the past decade is also of concern and illustrates several key points with regard to drought occurrence and patterns. As noted in Figure 3, the spatial extent of drought has been quite variable in terms of area affected over this period, with portions of the western and southeastern United States experiencing severe drought conditions in most of these years. A representative sample of the U.S. Drought Monitor maps from the period from 2000 to 2010 is provided in Figure 5. The U.S. Drought Monitor map is compiled weekly by the National Drought Mitigation Center (NDMC), the U.S. Department of Agriculture (USDA), and the National Oceanic and Atmospheric Administration (NOAA). Figure 5 illustrates the spatial dimensions of drought and its

severity in four years of the past decade to illustrate the point that drought is a national issue in the United States, thus requiring a national approach or policy that reinforces the need for a more consistent proactive approach for drought management. The series of weekly U.S. Drought Monitor maps from 1999 to current is available on the website of the National Drought Mitigation Center (http://droughtmonitor.unl.edu). Viewing these maps over any sequence of months during this period illustrates another important point regarding drought occurrence: the shifting epicenter of drought from month to month and from year to year for persistent droughts. Because of the long duration of drought events, the areas of greatest severity are continuously changing from month to month and year to year. Also of note from Figure 3 is that only one year (2010) in the sequence from 2000 to 2010 experienced minimal drought occurrence in the country. However, drought returned in 2011 (Figure 6) and affected most of the southern United States, stretching from Arizona to Florida, with the hardest-hit areas being Texas, Oklahoma, New Mexico, and Arizona.

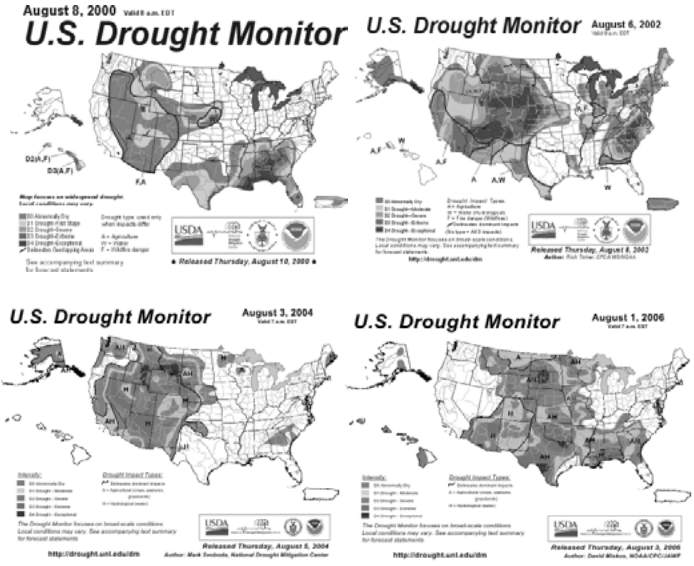

Figure 5. Weekly U.S. Drought Monitor maps for 2000, 2002, 2004, and 2006 (Source: U.S. Drought Monitor; http://droughtmonitor.unl.edu).

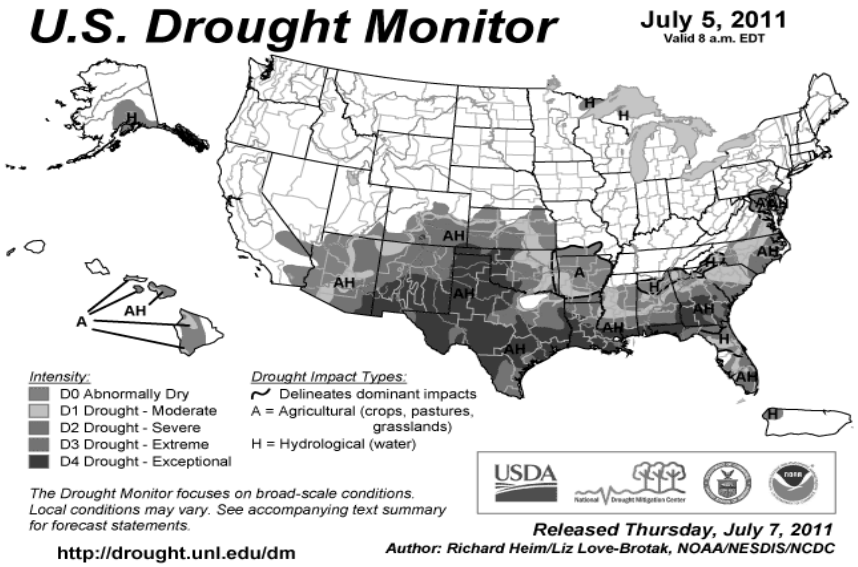

Figure 6. U.S. Drought Monitor for July 5, 2011 (Source: U.S. Drought Monitor; http://droughtmonitor.unl.edu).

Drought Risk Reduction

To reduce the impacts of drought there is an urgent need to focus attention on the identification of the most vulnerable sectors, population groups, or regions. A risk assessment of the historical and most recent impacts associated with drought allows us to quickly highlight these areas and implement mitigation measures that will improve the coping capacity (i.e., resilience) of these sectors, groups, and regions. This risk-based management approach is illustrated in Figure 7, the Cycle of Disaster Management, which is composed of the crisis management elements and the risk management elements. To build greater societal resilience, it is critically important for more emphasis to be directed at the risk management portion of this cycle.

The risk associated with drought (and other natural hazards) is a reflection of both a region's exposure to drought conditions and its vulnerability. Exposure is defined by the frequency and severity of historical drought occurrences and current trends. Vulnerability is defined by a long series of social factors, including population growth and migration patterns, land use changes, technology, urbanization, environmental degradation, water use trends, government policies, and environmental awareness of the population, to name a few. It is difficult to assess how trends in each of these and other factors affect vulnerability, but it is clear that each drought event overlays a society with vulnerabilities that are different from the previous event. Tracking these changes/trends is critically important as part of a drought planning and mitigation strategy.

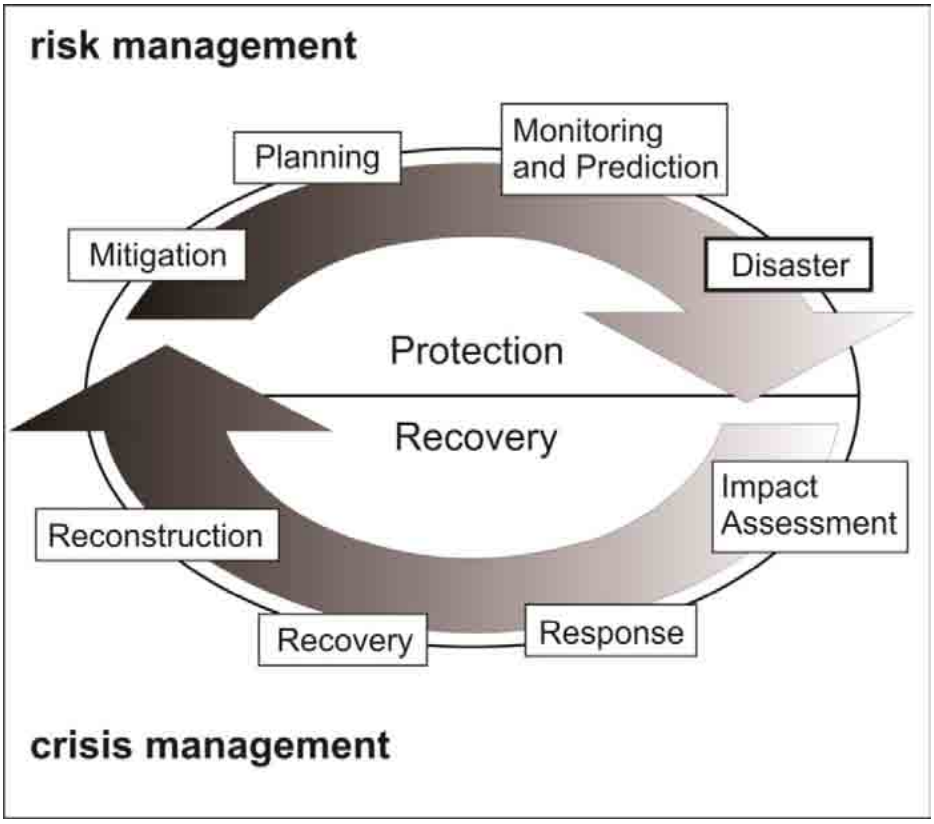

Figure 7. The cycle of disaster management reflects two components, crisis management and risk management. (Source: National Drought Mitigation Center).

Referring again to the types of drought in the context of drought risk reduction, as meteorological drought continues and begins to cause impacts in the agricultural sector and in water management (i.e., hydrological drought), there is less emphasis on the actual departure of precipitation from normal or expected and more emphasis on management practices that may increase the resilience of society to water shortages as manifested in the impacts that occur. For example, impacts on agriculture can

be substantially influenced by cultivation practices, crop type, irrigation efficiency, and so forth. Likewise, hydrological drought is affected by management practices that are associated with reservoir management and the management of other ground and surface water resources. Mitigating the impacts of drought is related to the proper management of resources in these sectors.

Status of Drought Planning in the United States

Drought planning can and should occur at all levels, from local to regional to national. Significant progress has been made in drought planning at the state level from the early 1980s, when there were only 3 states with drought plans, to today. At present, 47 states have drought plans, and 11 of those states are increasingly emphasizing mitigation as a key component of their plans (Figure 8). States in the southwestern and south-central portions of the country have made the greatest progress. Many other states have plans in place, but the emphasis of these plans is directed more toward response, i.e., reacting to crisis. As states move along the continuum from response to mitigation planning, there is an increasing need to deliver better and more timely information on drought status and early warning, including improved seasonal forecasts, to decision makers and other users. It is also important for these users or stakeholders to be involved in the development of products or decision support tools to ensure that their needs are being met.

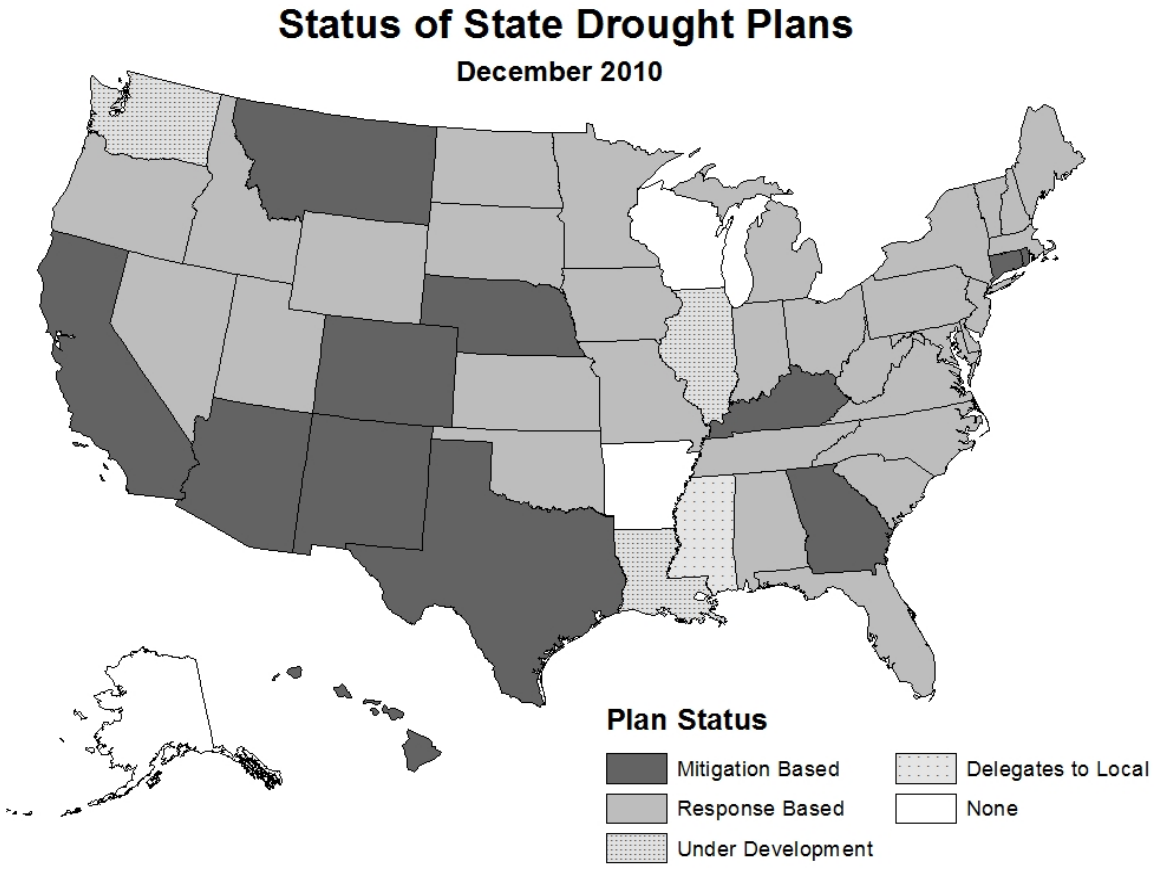

Figure 8. Status of drought planning in the United States, 2010 (Source: NDMC website, http://drought.unl.edu/Planning/PlanningInfobyState.aspx).

The NDMC has been working with states to stress the importance of developing a mitigation plan in order to be better prepared for future drought episodes. Most states have incorporated, in some form, a 10-Step Planning Process that was originally developed in 1991 (Wilhite 1991) and has been modified several times (Wilhite et al. 2000; Wilhite 2000; Wilhite et al. 2005) since its introduction in order to incorporate greater emphasis on risk-based management and mitigation planning. This model has been used by most U.S. states in the development of a drought mitigation plan. The key elements of a drought mitigation plan are:

(1) Monitoring, early warning, and information delivery systems, including integrated monitoring of key indicators, the use of appropriate indicators and indices, and the development of decision support tools;
(2) Risk and impact assessment, including conduct of vulnerability assessment and the monitoring and archiving of drought impacts;
(3) Mitigation and response measures to increase coping capacity.

Because of the increasing emphasis on drought risk management at the state level in the United States, there has been increasing pressure on the federal government to devote more attention to this approach as well. This bottom-up approach has been quite effective in initiating several bills introduced in Congress, including the National Drought Policy Act of 1998, which created a National Drought Policy Commission charged with making recommendations to the U.S. Congress on future approaches to drought management and the National Drought Preparedness Act, introduced in Congress in 2001, 2003, and 2005. Although this bill did not pass and become law, it did generate another bill, the National Integrated Drought Information System Act, which passed Congress in 2006 and was signed by the president later that year. This system (NIDIS) is currently being implemented throughout the country by NOAA with partners from other federal agencies, state and regional organizations, and universities.

Summary and Conclusions

The top ten challenges for progress in drought risk management were identified as follows.

(1) Drought is the 'Rodney Dangerfield' of natural hazards—i.e., it doesn't get respect because of the lack of structural impacts and the fact that loss of life is nonexistent or minimal in most instances.

(2) Drought monitoring/early warning is complex, requiring data from all elements of the hydrological system and the blending of this information for assessing the severity of drought and its potential impacts.

(3) Drought predictability is low in most cases, especially on a seasonal or longer basis, except where strong teleconnections exist to ocean sea surface anomalies.

(4) Decision-support tools and delivery systems are generally not available in many countries, and those that are available must be improved and tailored to the needs of users.

(5) Impacts are poorly understood and documented in almost all cases, further reducing understanding of the effects of drought on society and how investments in mitigation measures are justified as cost-effective.

(6) Drought relief discourages a risk-based management approach because it reduces self-reliance and increases reliance on government.

(7) Institutional inertia constrains change from crisis to risk management because federal and other agencies and ministries repeat the same practices and policies with each subsequent drought episode. Drought assistance programs are ingrained in the institutional structure of government.

(8) The effect of societal changes on vulnerability is poorly understood because of the lack of research on this critical element of risk-based management.

(9) Drought mitigation actions are less obvious to most decision makers because these measures are usually non-structural in nature.

(10) Political will for a national drought policy and drought risk management is weak at all levels of government because drought relief is often a pathway to re-election for officials and there is poor understanding of drought impacts and the proven cost-effectiveness of mitigation over relief.

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