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## Responding to Drought: Common Threads from the Past, Visions for the Future

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### Abstract

A number of studies conducted since the late 1970s have evaluated state and federal responses to drought in the United States. Each of these studies identified a number of key issues and impediments that needed to be addressed to improve the nation's ability to cope with and prepare for future episodes of drought. A content analysis of these studies was performed to identify common threads in their recommendations. The premise of this analysis was that the series of drought years that occurred between 1986 and 1992 and recurred between 1994 and 1996 increased awareness of our nation's continuing and apparent growing vulnerability to drought. This awareness has led to greater consensus among principal constituents and stakeholders, and also a greater sense of urgency to implement actions now to lessen vulnerability. The results of this analysis revealed that several themes recur: create an integrated national drought policy and plan; develop an integrated national climate monitoring (drought watch) system; incorporate drought in FEMA's National Mitigation Strategy; conduct post-drought audits of response efforts; establish regional drought forums; and encourage development of state drought mitigation plans.

**Keywords:** drought planning, water resources planning, water policy, water management, social and political

## Introduction

Severe drought affected large portions of the United States during the winter, spring, and summer months of 1995–96. This event triggered a significant response effort by both state and federal government in the drought-stricken states of the Southwest and southern Great Plains. A federal interagency multistate drought task force was formed in late May. This task force, coordinated by the Federal Emergency Management Agency (FEMA), organized a workshop (FEMA, 1996a) in late June to evaluate and assess drought-relief programs available from federal, state, and local agencies for the states of Arizona, California, Colorado, Nevada, New Mexico, Oklahoma, and Texas. Other federal agencies participating in this task force included the Department of Agriculture, Corps of Engineers, Department of Interior, and Small Business Administration. The goal of this task force was to develop “an overall strategy to mitigate the effects of this devastating situation” (FEMA, 1996b). This strategy was intended to include both short- and long-term actions that could be applied in the drought region.

Simultaneously, the Western Governors’ Association (WGA) unanimously passed a resolution calling for the creation of a drought emergency response task force composed of the WGA staff council and state emergency managers “to coordinate a comprehensive, integrated, response effort” (WGA, 1996). This task force met in September and began preparing a document of recommended short- and long-term actions. These recommendations will lead to the development of an implementation/action plan.

Both of these activities epitomize the “crisis management” approach to dealing with severe drought, an approach that has characterized federal and state response in the United States since the 1930s. Under the crisis management approach, response measures are reactive; they are hastily prepared and executed during the peak of drought severity and usually do little to lessen impacts. Most of these response measures are in the form of post-impact government interventions (i.e., emergency assistance), which serves to reinforce existing, possibly nonsustainable, resource management practices. Relief is generally considered to be a disincentive to the adoption of management methods that are more resilient to drought and more economically and environmentally sustainable in the long term.

The response of state and federal government to the 1996 drought was fairly typical of previous response attempts. However, this response differed from earlier efforts in several critical ways. First, coordination and communication between state agencies and with appropriate federal agencies was improved in those states with drought plans in place. Unfortunately, Oklahoma, Texas, and New Mexico, all located in the core of the drought-affected area, did not have drought plans in place at the onset of drought. Those states were, in most cases, able to set up temporary response authorities using organizational and communication structures in place in other states as models. Second, the severity of the drought led the states mentioned above to reexamine the need for a more permanent structure or plan; these states have subsequently initiated a process to develop a drought plan. Third, the FEMA drought workshop was timely and proved to be worthwhile for both federal agencies and state governments. The workshop assembled all appropriate state and federal representatives and some representatives from regional organizations to

discuss the status of impacts, available assistance programs, and appropriate responses. This workshop also brought significant media attention to the impacts associated with drought and the importance of addressing this issue at the regional and national scale. Fourth, the decision of the FEMA task force and the WGA to include both short- and long-term measures in their recommendations to the president and the congressional leadership is a significant step forward. This decision reflects the higher profile now being given to mitigation when addressing natural hazards and disasters. The WGA's decision to fully incorporate ideas from all western states in the report formulation and recommendation process reflects one of the lessons learned by the western states in response to the 1977 drought: federal action is more timely and comprehensive when states speak with one rather than many voices (Crawford, 1978; Wilhite et al., 1986).

The purpose of this paper is to review the recommendations that have emanated from several key evaluations of state and federal responses to recent episodes of severe drought in the United States. These evaluations were selected for review because each identified a number of key issues and impediments that needed to be addressed to improve the nation's ability to cope with and prepare for future drought episodes. The goal of this analysis is to identify those fundamental issues common to all the evaluations. The premise of this paper is that the series of drought years that occurred between 1986 and 1992 and recurred between 1994 and 1996 increased awareness of our nation's continuing and apparent growing vulnerability to drought. This increased awareness has led to greater consensus among the principal constituents and stakeholders, and also a greater sense of urgency to implement these actions now to lessen future vulnerability to drought.

### **Responding to Drought: Common Threads from the Past**

In the United States, the federal government became the principal player in the provision of drought relief during the 1930s in response to a drought that was nearly nationwide in extent and coexisted with severe economic conditions (Wilhite, 1983). Before the 1930s, assistance was provided primarily by the private sector (e.g., churches, Red Cross) but the level of assistance required during the 1930s far exceeded the response capacity of this sector. The federal government has continued to be the principal provider of drought assistance during subsequent drought events, most notably the 1950s in the Southwest, southern Great Plains, and Midwestern states; the 1960s in the Northeast; the mid-1970s in the Midwest and western states; and the recent series of drought years beginning in 1986. More than \$7 billion in drought relief was provided by the federal government during the period from 1974 to 1977 (Wilhite et al., 1986); nearly \$5 billion was provided in 1988 (Riebsame et al., 1990). Until recently, state government assumed a relatively passive role in drought management. States have now assumed a greater responsibility for drought planning, but drought relief remains largely a federal responsibility.

Post-drought evaluations or audits are not routinely completed in the United States. However, following the severe droughts of 1976–77 and the demonstrated inability of federal government to adequately cope with the problems that emerged, scientists and policy makers expressed considerable concern about the inefficiencies of this effort and repeat-

edly issued “calls for action” for the development of drought plans, including the development of a national drought policy and plan. These calls include recommendations from the Western Governors’ Policy Office (1978), General Accounting Office (1979), National Academy of Sciences (1986), Great Lakes Commission (1990), American Meteorological Society (Orville, 1990), and Interstate Council on Water Policy (1987; 1991). In light of a possible increase in the frequency and severity of extreme events in association with changes in climate, an Environmental Protection Agency report (Smith and Tirpak, 1989) called for the development of a national drought policy to coordinate federal response to drought.

In addition to these “calls for action,” several studies completed in the late 1970s, 1980s, and 1990s evaluated specific response efforts and offered recommendations for improving future drought management in the United States. These recommendations placed greater emphasis on federal response initiatives to address many of the problems and issues identified, but the role of state government, regional organizations, and the private sector was not ignored. A content analysis of each of the following studies was completed for this paper: General Accounting Office (GAO) (1979), Wilhite et al. (1986), Grigg and Vlachos (1989), Riebsame et al. (1990), Wilhite (1993), Office of Technology Assessment (U.S. Congress, OTA, 1993), Wilhite and Wood (1994), and the Federal Emergency Management Agency (FEMA, 1996a).

### **General Accounting Office**

#### *Federal Response to the 1976–77 Drought: What Should be Done Next?*

GAO (1979) characterized the response programs implemented in 1976–77 as largely untimely, poorly coordinated, and inequitable. The GAO found that assistance provided by federal agencies to farmers, communities, businesses, and water user organizations was available too late to lessen the effects of drought. GAO recommended that Congress direct the four principal agencies responsible for administering relief programs in 1976–77 (Departments of Agriculture, Interior, and Commerce, and the Small Business Administration) to consider the problems identified and formulate a national plan to provide future assistance in a more “timely, consistent, and equitable manner.” Issues to be addressed in the development of the plan included the identification of the respective roles of each agency in order to reduce duplication and overlap, legislation needed to more clearly define those roles, and standby legislation that might be necessary to allow for more timely response to problems associated with drought. GAO suggested that effectively implementing a national plan required establishing uniform criteria for determining “priorities for the type of projects to be constructed; eligibility of applicants; and interest rates, terms, and repayment requirements for loans.” No action was taken on these recommendations.

### **Wilhite, Rosenberg, and Glantz**

#### *Government Response to Drought in the United States: Lessons from the Mid-1970s*

Wilhite et al. (1986) confirmed the GAO findings and also concluded that the decision-making process for determining eligibility for drought assistance was seriously flawed.

For example, the designation and revocation process for determining eligibility for the more than \$5 billion of disaster relief expended in 1976–77 was confusing and was not based on consistent, established criteria. In total, 16 federal agencies administered 40 separate assistance programs in 1976–77. Wilhite et al. (1986) concluded, based on lessons learned during the 1976–77 response effort, that a more effective federal response effort must address four basic issues. First, information on drought severity must be provided to decision makers and other users in a more timely manner. This requires better coordination of data collection efforts between federal agencies, information sharing between and within levels of government, and improved delivery systems. Second, impact assessment procedures must be more reliable and timely. Better indices are required to capture the severity of drought, particularly in the spring planting period. Improved estimates of drought impact on yield would help trigger assistance to the stricken area, and improved impact estimates are also important in other sectors such as fire protection, transportation, energy, and recreation and tourism. Third, objective and timely designation (and revocation) procedures are necessary to target assistance to drought areas. Decisions on drought disaster designations during 1977 were based largely on the Palmer Drought Severity Index (Palmer, 1965), an index that often does not accurately reflect the severity of the drought, particularly in its early stages (Alley, 1984; Wilhite et al., 1986). Fourth, disaster programs must be more efficiently administered and programs must match specific regional needs. In other words, the “one size fits all” of federal drought assistance was not considered effective in addressing the needs of regions with different resource management issues. It was concluded that a national drought plan would help coordinate the activities of federal government in responding to the effects of future droughts. It was also suggested that state governments and regional organizations should play a more active role in drought management and that their activities be coordinated between levels of government. The growth in the number of states with drought response plans (Wilhite, 1991a) has been a positive sign and an indication of greater awareness for drought planning and the resources available to facilitate that process (Western States Water Council, 1987; Wilhite, 1991b; Wilhite, 1996).

### **Grigg and Vlachos**

#### ***Drought Water Management: Preparing and Responding to Drought***

Grigg and Viachos (1989) analyzed local, state, regional (i.e., river basin), and federal responses to the droughts of 1986 and 1988 and derived a series of “next steps” to improve future response efforts. These steps expressed the importance of learning from previous experiences and treating drought management as a process rather than a discrete event. They emphasized the critical role of state government in drought management and recommended that states evaluate existing plans and their effectiveness in responding to recent droughts. It was suggested that federal government improve the analysis and integration of drought-related data and information and how this information is presented to various audiences. Grigg and Viachos recommended that existing administrative structures be streamlined and communication between organizations improved. This could be accom-

plished by a vertical restructuring between levels of government and a horizontal restructuring within levels of government to achieve greater integration in water management. Better information on the origins and patterns of drought, the interrelationships of natural and human-induced water shortages, and the implications of climate change for drought frequency and severity were considered necessary to improve understanding and decision making. Grigg and Vlachos stressed the importance of contingency planning and the use of monitoring techniques to improve drought management to sustain the natural resource base. The challenge, in their view, was to make planning and management more effective within the current administrative and governmental system.

### **Riebsame, Changnon, and Karl**

#### ***Drought and Natural Resources Management in the United States: Impacts and Implications of the 1987–89 Drought***

Riebsame et al. (1990) reviewed the climatology of the 1987–89 drought and evaluated the impacts and responses to this event. They concluded that the response effort was seriously deficient. Most of these deficiencies had been observed in previous droughts. Several critical issues were identified and recommendations were proposed to address these problem areas: (1) conduct a post-drought evaluation of the 1987–89 experiences; (2) develop an improved drought watch system, linking federal, state, and local agencies; (3) evaluate the reliability of indices in detecting emerging drought; (4) develop an integrated impact assessment program for all primary sectors; (5) increase drought contingency planning to provide greater guidance to resource managers and others in response to extreme events; (6) develop improved record keeping on heat mortality and morbidity and conduct studies of the impact of drought on mental health; and (7) improve the delivery of information on drought and its impacts to users, especially in the business sector. Riebsame et al. (1990) suggested that since many of these recommendations were embodied in the National Climate Program Act of 1978, this legislation, if fully implemented, could serve as a vehicle to address many of these issues.

### **Wilhite**

#### ***Drought Mitigation Technologies in the United States: With Future Policy Recommendations***

Wilhite (1993) reviewed drought mitigation technologies recently implemented in the United States in response to the series of severe drought years between 1986 and 1992. The primary goal of this study was to review and evaluate ongoing and developing federal, interstate, and state drought mitigation technologies, programs, and policies to determine ways to improve the effectiveness of future Natural Resources Conservation Service (NRCS, formerly the Soil Conservation Service) drought mitigation initiatives. Although this study was initially focused on NRCS programming, the scope extended to all federal agencies and other levels of government in an attempt to identify initiatives that would improve the nation's ability to manage droughts through a more integrated approach

within and between levels of government, involving regional organizations and the private sector where appropriate. Feedback from federal and state government and regional organizations was obtained from a series of survey instruments.

Six recommendations were forthcoming from this study. First, it was recommended that a national drought policy and plan be developed to improve the effectiveness of future response efforts and the efficiency of resource allocation during times of water shortage. This action is intended to improve coordination by integrating planning activities within and between levels of government and to reduce duplication between federal agencies. Second, development of a national drought watch system was recommended to achieve a more comprehensive assessment of drought and other extreme climatic conditions. This system would support and reinforce the tenets of a national policy and plan. Third, it was recommended that a national drought mitigation center be created to assist state and other levels of government in the development of appropriate mitigation technologies. The center would also be responsible for establishing a clearinghouse that would serve as a resource for government, regional organizations, and the private sector for a broad range of drought-related information. Fourth, the study recommended that all federal drought relief programs be reviewed to ensure consistency with national drought policy. The goal of this action is to redefine emergency assistance available during periods of drought to guarantee that it provides adequate incentives for the adoption of proactive management and planning strategies that minimize risks associated with drought. Fifth, postdrought audits of previous response efforts must be conducted to identify the successes and failures of recent efforts and provide a rational basis for recommending the continuation or discontinuation of assistance programs. Sixth, educational programs and training workshops that promote water conservation and management should be developed for all age groups and the media.

### **Office of Technology Assessment**

#### *Preparing for an Uncertain Climate*

The Office of Technology Assessment conducted a study (U.S. Congress, OTA, 1993) at the request of Congress to address how the United States can cope with projected changes in climate, given the high level of uncertainty about what the future climate is likely to be. This study sought to identify natural and managed natural resource systems at risk from climate change, how to incorporate the uncertainty of climate change into planning decisions, and whether the U.S. Global Change Research Program will provide information to decision makers in a timely manner. OTA based its assessment on six systems: coastal areas, water resources, agriculture, wetlands, federally protected natural areas, and forests. The water section of this study specifically addresses the issue of drought management and federal initiatives that would improve future response and preparedness.

OTA noted that a first step to improved water management would be improved management of extreme climatic events such as floods and droughts. One institutional recommendation to improve drought management was to create an interagency task force to develop a national drought policy and plan. Other actions recommended to improve water management were to provide the Bureau of Reclamation and the Corps of Engineers with

greater administrative flexibility to manage reservoirs on a basin wide level and to promote water marketing as a means of facilitating water transfers. The use of new analytical tools for water modeling and forecasting, as well as demand management were also recommended. OTA also recommended that the scope of the Western Water Policy Review Commission (P.L. 102-575) be expanded to include a wide range of issues that are relevant to drought management. OTA further recommended that the nature of the Commission's review be expanded to address national water policy issues.

More specific to the issue of drought management, OTA suggested that a national drought policy and plan be created under Executive Order 12656, created to guide emergency water planning and management responsibilities of federal agencies. The national drought policy and plan would be developed under the leadership of the interagency drought task force mentioned previously. OTA recommended that a national drought policy and plan identify "specific, action-oriented response objectives" and an implementation plan. Given the numerous federal agencies with drought and water management responsibilities, a lead agency or the Office of the President would need to be appointed to direct this process. Federal agencies would be expected to review, as part of this policy and plan formulation process, all drought assistance programs, the identification of eligibility requirements for these programs, and the programs' overlapping responsibilities. The distribution of financial resources to relief recipients and the timing and effectiveness of relief should also be included in this review process.

OTA also recommended that three additional components be part of a national drought policy and plan. These were the adoption of risk management practices to promote self-reliance and protect the natural and agricultural resource base, the conduct of postdrought audits to evaluate the effectiveness of these efforts, and the development of a national drought watch system in support of a more proactive, anticipatory approach to drought management.

## **Wilhite and Wood**

### ***Drought Management in a Changing West: New Directions for Water Policy***

In 1994, a conference was held to examine the future of western water and natural resources management and the region's growing vulnerability to extended periods of water shortages because of the sequence of drought years that occurred between 1987 and 1992 (Wilhite and Wood, 1994). Participants of this conference offered a series of recommendations to improve drought management and reduce vulnerability to future drought episodes. First, participants recommended that a national drought policy or framework be adopted that integrates actions and responsibilities between levels of government and promotes preparedness and mitigation. This policy should include actions that promote development of utility and locally based drought plans. Second, funds currently expended on drought relief should be reallocated to preparedness and mitigation programs. Third, region-specific drought policies should be developed and the missions of federal agencies modified as necessary to implement these policies. Fourth, FEMA should be encouraged to include drought planning and preparedness as a part of overall hazard planning at the state and local level. Fifth, human and technological resources should be redistributed

within and between state and federal agencies to promote collaborative institutional relationships that improve productivity and eliminate redundancy on drought and water policy and management issues. Sixth, an integrated climate monitoring system should be created to better detect emerging drought and other climate-related extreme events. Seventh, seasonal forecast skill for drought and water supply should be improved through increased support for research.

## FEMA

### *Drought of 1996: Multi-State Task Force Findings*

In 1996, FEMA was asked to chair the Multi-State Drought Task Force to address the drought situation in the Southwest and southern Great Plains states. The purpose of the task force was to coordinate the federal response to drought-related problems in the stricken region by identifying needs, applicable programs, and program barriers. The task force was also directed to suggest ways to improve drought management through both short- and long-term national actions. To accomplish these objectives, a workshop was held in June 1996 that included representatives from many federal agencies, the drought-affected states, regional organizations, universities, and the Navajo Nation. The final report of this workshop (FEMA, 1996a) divided short- and long-term recommendations and issues into three categories: policy, legislative, and executive branch. These recommendations are the product of intensive discussions and represent the opinions of all participating parties.

This discussion of the FEMA report will present only long-term issues and recommendations. First, participants recommended the development of a national drought policy based on the philosophy of cooperation with state and local stakeholders. They emphasized that this policy should be developed now even though "regional interests and states' rights advocates may occasionally throw up roadblocks." Participants emphasized the need for a contingency plan to help apply lessons from the past to future drought events. This policy should include a national climate/drought monitoring system to provide early warning of the onset and severity of drought to federal, state, and local officials. This policy would also include an institutionalized organizational structure to address the issue of drought on a national scale. Second, it was suggested that a regional forum be created to assess regional needs and resources, identify critical areas and interests, provide reliable and timely information, and coordinate state actions. It was suggested that multistate and impact-specific working groups be established under this forum to identify critical needs. Third, FEMA was asked to include drought as one of the natural hazards addressed in the National Mitigation Strategy (FEMA, 1995), given the substantial costs associated with its occurrence and the numerous opportunities available to mitigate its effects. Fourth, states strongly requested that a single federal agency be appointed to coordinate preparedness and response to droughts. The states recommended that FEMA be given this responsibility; FEMA suggested that USDA should be the agency in charge given its program responsibilities in agriculture, often the first sector affected.

In summary, these eight studies are in general agreement on the primary challenges and opportunities that lie ahead if we are to achieve a higher level of preparedness and a more

effective response to drought in the United States. In other words, there seems to have been a convergence of ideas on how to improve the management of drought. The next section of this paper will synthesize these themes into some specific recommendations for improved drought management and preparedness.

### **Responding to Drought: Visions for the Future**

What common threads or recommendations from the studies discussed above could define a new direction for drought management and preparedness in the United States? Several recurring themes emerged from this analysis.

#### ***Create a National Drought Policy and Plan***

An interagency task force should be established to develop an integrated national drought policy and plan that emphasizes a preventive, anticipatory (i.e., risk management) approach to drought management and promotes self-reliance. The Australian National Drought Policy could be used as a model for the United States (White et al., 1993). The interagency drought task force would coordinate the activities of the federal government in responding to and mitigating the effects of drought. A lead federal agency would need to be appointed to direct this effort.

The interagency task force should identify ways to streamline current administrative structures between levels of government (i.e., vertical) to improve communication and information flow and within levels of government (i.e., horizontal) to achieve a more integrated approach to water management (e.g., reservoir management on a basin wide scale).

The national policy or framework would integrate actions and responsibilities between all levels of government and would be developed through a participatory process. This policy and plan should lead to a more coordinated and timely response while concurrently promoting self-reliance. A national plan would include an institutionalized organizational structure to address drought on a national scale with mitigation and response programs that are regionally appropriate.

Most funds expended on drought relief should be redirected to programs that encourage planning and mitigation or to provide more timely and reliable information to decision makers.

This task force should conduct a review of all federal drought assistance programs to ensure that they are consistent with national policy.

#### ***Develop a Comprehensive, Integrated National Climate Monitoring System***

Develop a comprehensive, integrated climate monitoring system to provide early warning of emerging drought and other climate-related (e.g., floods) extreme events. This system would be an invaluable resource for planners, managers, and policy makers nationwide in preparing for and responding to a broad range of climatic events that occur simultaneously each year. This system would be an integral part of the national drought plan.

The goal of this system would be to integrate data from federal and state collection networks. It would include the following parameters: precipitation and temperature, stream flow, reservoir and lake levels, ground water levels, snowpack, and soil moisture. Satellite

remotely-sensed data (e.g., Advanced Very High Resolution Radiometer–AVHRR) should be used to monitor vegetation stress to help derive early estimates of impacts.

***Incorporate Drought in the National Mitigation Strategy***

The National Mitigation Strategy (FEMA, 1995) includes all major natural hazards, except drought. Steps should be taken, in conjunction with formulation of a national drought policy and plan, to incorporate drought in this strategy.

***Conduct Post-Drought Audits of Federal/State Response Efforts***

Post-drought audits of federal and state drought response efforts should be conducted to determine successes and failures, and recommendations from these studies should be incorporated into national and state-level policies and plans.

***Establish Regional Drought Forums***

Regional forums or councils should be established to consider drought-related issues on an ongoing basis to keep policies and plans current, share lessons learned, and avoid a return to the reactive approach to drought management. This is an especially relevant issue in the drought-prone western states.

***Encourage Development of State Drought Mitigation Plans***

States should evaluate existing drought response plans and revise them to place greater emphasis on mitigation. States without drought plans should develop plans. The federal government could provide incentives to states to develop plans.

**Conclusions and Recommendations**

During the past decade in the United States, widespread and severe drought has resulted in an increased awareness of the nation's continuing vulnerability to this creeping natural hazard. This experience has resulted in numerous initiatives by state and federal government to improve the timeliness and effectiveness of response efforts. Although some progress has been made, much remains to be done. For the most part, government continues to deal with drought in a reactive, rather than proactive, mode. The dilemma facing government, particularly federal government, is whether to continue with the approach of the past (i.e., crisis management) or to seek a new direction. Given that previous attempts to mitigate drought in the United States have been largely unsuccessful, it seems clear that fundamental and sweeping program and policy changes must occur in order for the nation to more adequately address existing drought management problems. As a nation we can no longer afford to tinker with a system that is seriously flawed. For this transition to a more proactive, risk management approach to be successful, the deficiencies of previous drought response attempts must be addressed in a systematic way.

A review and synthesis of studies that have evaluated recent drought response efforts shows that there is broad agreement on the need for an integrated national drought policy and plan. The first step in this process would be the establishment of a federal interagency

task force with the authority to develop and implement the plan. The task force must develop the objectives of a national policy in concert with extensive public involvement. This policy should promote the concept of risk management, although it cannot ignore the need for government assistance for some sectors during extended periods of severe drought. The policy should promote self-reliance while at the same time protecting the natural and agricultural resource base. The interagency task force should coordinate the drought-related activities of the federal government (i.e., forecasting, monitoring, impact assessment, response and recovery, and planning). The national policy should also include incentives for all drought-prone states to develop plans that promote a more proactive, anticipatory approach to drought management. Lessons learned from previous drought response attempts need to be documented through post-drought audits and shared with all levels of government. Regional drought councils could be used as a forum for keeping policies and plans current and sharing lessons learned.

In support of the national drought policy and plan, it is recommended that a comprehensive, integrated national climate monitoring system be established to provide early warning of emerging drought and other extreme climate events. This system would integrate data from federal and state collection networks, including information on precipitation and temperature, stream flow, reservoir and lake levels, ground water levels, snowpack, and soil moisture.

Drought inflicts considerable pain and hardship on society. The impacts of contemporary droughts have demonstrated this fact again and again over the past several decades. Drought illustrates in innumerable ways the vulnerability of economic, social, political, Wilhite and environmental systems to a variable climate. It also illustrates the dependencies that exist between systems, reinforcing the need for improved coordination within and between levels of government.

Extended periods of normal or benign weather conceal the vulnerability of societies to climate variability, while drought exposes these sensitivities. Projected changes in climate because of increased concentrations of CO<sub>2</sub> and other atmospheric trace gases suggest a possible increase in the frequency and intensity of severe drought in the future. Any increase in the incidence of drought will aggravate drought management problems further. Coupled with increasing population and the associated rise in demand for water and other shared natural resources, there is a sense of urgency for reducing the personal hardships and economic and environmental impacts of drought.

### Literature Cited

- Alley, W. M. 1984. The Palmer Drought Severity Index: Limitations and Assumptions. *Jour. of Climate and Appl. Meteorol.* 23:1100–1109.
- Crawford, A. B. 1978. State and Federal Responses to the 1977 Drought. In: *North American Droughts*, N. J. Rosenberg (Editor). AAAS Selected Symposium. Westview Press, Boulder, Colorado.
- FEMA. 1995. *National Mitigation Strategy: Partnerships for Building Safer Communities*. Washington, D.C.
- FEMA. 1996a. *Drought of 1996: Multi-State Drought Task Force Findings*. Report of a Workshop, Washington, D.C.

- FEMA. 1996b. "FEMA Region Six Director Appointed to Chair Drought Task Force." Press Release, Washington, D.C.
- General Accounting Office. 1979. *Federal Response to the 1976–77 Drought: What Should Be Done Next?* Report to the Comptroller General, Washington, D.C., 29 pp.
- Great Lakes Commission. 1990. *A Guidebook to Drought Planning, Management and Water Level Changes in the Great Lakes*. Great Lakes Commission, Ann Arbor, Michigan, 61 pp.
- Grigg, N. S., and E. C. Vlachos. 1989. *Drought Water Management: Preparing and Responding to Drought*. International School for Water Resources, Colorado State University, Ft. Collins, Colorado.
- Interstate Council on Water Policy. 1987. *Statement of Policy 1986–87*. Interstate Conference on Water Policy, Washington, D.C., 39 pp.
- Interstate Council on Water Policy. 1991. *Statement of Policy 1991–92*. Interstate Conference on Water Policy, Washington, D.C., 39 pp.
- National Academy of Sciences. 1986. *The National Climate Program: Early Achievements and Future Directions*. Washington, D.C., 55 pp.
- Orville, H. D. 1990. AMS Statement on Meteorological Drought. *Bull. of the Amer. Meteorol. Soc.* 71:1021–23.
- Palmer, W. C. 1965. *Meteorological Drought*. Research Paper No. 45, U.S. Weather Bureau, Washington, D.C.
- Riebsame, W. E., S. A. Changnon, Jr., and T. R. Karl. 1990. *Drought and Natural Resources Management in the United States: Impacts and Implications of the 1987–89 Drought*. Westview Press, Boulder, Colorado, 174 pp.
- Smith, J. B., and D. Tirpak (Editors). 1989. *The Potential Effects of Global Climate Change on the United States*. Environmental Protection Agency (EPA-230-05-89-050), 411 pp.
- U.S. Congress, Office of Technology Assessment. 1993. *Preparing for an Uncertain Climate, Volume 1*. OTA-O-567, U.S. Government Printing Office, Washington D.C.
- Western Governors' Association (WGA). 1996. *Draft Strategy for Development of Western Drought Policies and Regional Response Plans*. Denver, Colorado.
- Western Governors' Policy Office (WESTPO). 1978. *Managing Resource Scarcity: Lessons from the Mid-Seventies Drought*. Institute for Policy Research, Denver, Colorado, 78 pp.
- Western States Water Council. 1987. *A Model for Western State Drought Response and Planning*. Midvale, Utah.
- White, D. H., D. Collins, and M. Howden, 1993. Drought in Australia: Prediction, Monitoring, Management, and Policy. In: *Drought Assessment, Management, and Planning: Theory and Case Studies*, D. A. Wilhite (Editor). Kluwer Academic Publishers, Boston, Massachusetts, 320 pp.
- Wilhite, D. A. 1983. Government Response to Drought in the United States: With Particular Reference to the Great Plains. *J. of Climate Appl. Meteor.* 22:40–50.
- Wilhite, D. A. 1991a. Drought Planning and State Government: Current Status. *Bull. of the Amer. Meteorol. Soc.* 72:1531–1536.
- Wilhite, D. A. 1991b. Drought Planning: A Process for State Government. *Water Resources Bulletin* 27:29–38.
- Wilhite, D. A. 1993. *An Assessment of Drought Mitigation Technologies in the United States*. Final Report to the Soil Conservation Service/USDA, IDIC Technical Report 93-1.
- Wilhite, D. A. 1996. A Methodology for Drought Preparedness. *Natural Hazards* 13:229–252.

- Wilhite, D. A., N. J. Rosenberg, and M. H. Glantz. 1986. Improving Federal Response to Drought. *J. of Climate Appl. Meteor.* 25: 332-342.
- Wilhite, D. A., and D. A. Wood. 1994. *Drought Management in a Changing West: New Directions for Water Policy* (Proceedings of a Conference). IDIC Technical Report 94-1, University of Nebraska, Lincoln, Nebraska, 239 pp.