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Quick Response Report #136

South Carolina Drought Mitigation and Response Assessment: 1998-2000 Drought

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Executive Summary

Introduction

South Carolina is blessed with an abundance of water, although its distribution is uneven across the state and from season to season (SCDNR, 1998). These disparities were made especially clear during a once-in-a-hundred-year drought lasting from June 1998 through December 2000, and still continuing in 2001. This study was undertaken to provide a current "snapshot" of the state's primary drought concerns, impacts, and mitigation and response measures. The study included field and phone interviews with forty South Carolina citizens and government representatives.

Summarized Findings and Recommendations

- **State Drought Program Coordinator:** The study revealed a common consensus on one point in particular: the unanimous approval of the state drought coordinator position. This role should be maintained, or even strengthened if possible, with additional staff and resources to play an enhanced role in drought planning, mitigation, and response.
- **Drought Response Committees (DRCs):** The DRCs were viewed as a success story in that they are aimed at being non-adversarial; providing an avenue for compromise, communication, and coordination; and helping to establish an atmosphere of "trust, credibility, and reliance" between DRC members.
- **Drought Planning Education and Mitigation:** Detailed drought planning education should be continued throughout the state. Enhanced communication and cooperation are seen as key issues in these efforts by planners. Drought education and planning should focus on short- and long-term mitigation actions to foster sustainable water development. South Carolina should investigate the possibility of developing drought impact committees to continually work on drought impact assessment and mitigation activities, or mandate that these activities be carried out by the DRCs. Mitigation concepts should also be enhanced within the state's Drought Response Plan structure. Vulnerability modeling has been shown as one mitigative action that is especially useful for targeting high priority regions. Climate forecasts are another mitigation tool that has been under-used in the private and public sector. Research on vulnerability and climate forecast application has been initiated through the University of South Carolina and should be expanded.
- **Inclusive Participation:** The state should encourage more cooperation between differing interests in order to develop innovative solutions to drought impacts. Increased cooperation between the Department of Natural Resources (DNR) and Department of Health and Environmental Control (DHEC) was noted as especially important. In terms of the public, participation may need to be solicited or mandated in some cases. Resources may need to be provided to allow some minority interests to participate effectively.
- **Financial Assistance:** The state should research possible local and state drought mitigation and response financial assistance. Additional incentive and cost-share programs should be investigated and promoted to encourage drought mitigation.
- **Legislative Action:** Citizens continually expressed frustration over the slow progress of legislative action, especially in terms of environmental issues and innovative water management techniques. Many noted the willingness of state agencies to elicit public input and develop innovative proposals, but that new ideas were continually "bogged down" by the legislative process. Perhaps some discretionary actions could be placed

under the authority of the DRCs or a water management council as authorized by the South Carolina Drought Response Act to enhance the responsiveness of drought planning proposals.

Drought Response Committee (DRC) Recommendations

- **Drought Management Areas and Authority:** It is recommended that the state finish the appointment of all representatives and take steps to ensure that representation be continuous. In addition, water suppliers are very concerned about basin-wide or county-wide mandatory water restrictions when they still have sufficient water reserves. This legitimate concern should be addressed by local DRCs.
- **DRC Representatives:** Parks and Recreation representatives are not legal members of the DRCs. Given the importance of tourism and recreation within the state, and the impacts of drought on this sector, representatives of these interests should be considered as permanent members on the DRCs.
- **Administrative Jurisdiction:** The state needs to clarify the responsibilities of the DRCs and the Governor's State Emergency Response Team so that the transition between the two is smooth and effective when the Governor's Team is established.
- **Water Conflicts:** The DRCs must understand and promote their role in water use conflicts, thus addressing the central issue of water rights and questions involving priorities and the essential uses of water. The Drought Act states the responsibility of the DRCs and the Department of Natural Resources in water conflict resolution (negotiation/mediation), but these avenues have not yet been utilized. Additionally, water suppliers recommend that state water laws be revised so that emergency water supplies for a community could be obtained in cases involving public safety issues.
- **Regulation Enforcement:** Some water suppliers expressed concern over the lack of enforcement in regards to water ordinances. Some entities have complied while others have not, creating resentment. The question of whether the DNR or DRCs should take on more responsibility for compliance with local drought response ordinances should be investigated.
- **Assistance to Rural Areas:** The DRCs need to better address the assistance available to meet the water needs of individual landowners/homeowners, particularly in the rural areas of northern South Carolina. More cooperation between the state, the DRCs, and the South Carolina Rural Water Association may be useful in these efforts.

Tourism and Recreation

- **Business Assistance Programs:** South Carolina has no business assistance programs available at the state level for addressing the economic impacts resulting from tourism- and recreation-related drought losses. This is especially important given that the Small Business Administration (SBA) does not consider drought losses. The state needs to address this issue given the seriousness of economic losses in 2000 and the potential for increased losses in 2001.
- **Water-Shortage Contingency Plan:** The DNR, in the South Carolina Water Plan (SCDNR, 1998), suggests that "A water-shortage contingency plan should be developed for lakes and approved by DHEC in coordination with DNR." All lakes/reservoirs have

not developed these contingency plans resulting in devastating impacts to some lake users. It is recommended that these efforts be pushed forward through cooperative agreements with not only dam operators and state agencies, but also through the active participation of relevant cities, homeowners, and recreational service providers. A positive example is the work being done between the Committee for the Preservation of Lake Marion and Lake Moultrie, the Santee Cooper company, and the Department of Natural Resources.

- **"Safety Net" Proposals:** The state must play a more dominant role in recognizing and assisting the drought impacts on tourism and recreation. The state can provide important technical and organizational assistance and should consider economic "safety net" proposals during exceptional drought situations. Assistance is especially needed for newer operators that do not have drought experience and lack resources to buffer against multi-year droughts. The state should also help coordinate cooperation among utility interests to ensure appropriate lake-level maintenance.

Agricultural Production

Agricultural producers and state planners continuously express frustration over their lack of control in determining current national farming policies. Drought losses place an additional strain on their limited resources. However, there are many drought mitigation actions that planners can undertake that will also assist the agricultural community in general, such as:

- **Enhanced Communication and Cooperation:** Although many producers would make some modifications to their operations prior to drought, many are hesitant to commit fully to mitigation efforts because of the their uncertainty in long-term weather forecasts (Knutson et al., 2001). In many cases, resistance is also caused by lending requirements and the high human and monetary costs of modification. Enhanced three-way communication between producers, financial lenders, and drought forecasters or their representatives may allow for a broader understanding of forecast benefits and limitations and "get everyone on the same page" in terms of needs and expectations. Additional or more identifiable state, federal, and private incentives and assistance programs may also be needed to help operators implement capital-intensive mitigation measures, as well as participate in other drought assistance programs.
- **Agricultural Marketing:** There is a realization that many agricultural issues are decided at the federal level, but it was suggested that state and local planners can help ensure local markets, provide incentives, and increase their voice at the national level.
- **Insurance Research:** Insurance issues were also brought up by a number of South Carolina producers. They felt that their payments were not in line with their received benefits. This was especially troublesome during multi-year droughts when debts become cumulative.
- **Flexible Rental Agreements:** Landlords and tenants should work together to develop flexible arrangements that increase the viability of the land and operation prior to and during drought. "Floating" rate structures on leases are particularly useful agreements to reduce drought risk.
- **Community and Informal Support Networks:** Family, community, and church support is seen as essential in sustaining producers through periods of drought. Family counseling

specialists and members of the clergy should be included in state and local drought planning and response efforts. Farm crisis and mental-health "hotlines" and videos have been shown to be especially useful.
- **Extension Services:** The state needs to work more closely with the extension services operating both at Clemson University and at South Carolina State University to promote and develop mitigation actions. These extension services reach stakeholders that may not be reached by DRCs.

Water Suppliers

- **Annual Meeting of Water Suppliers:** As recommended by several water suppliers, the state needs to coordinate an annual meeting of water suppliers. This may help stakeholders formulate a consensus on issues and enhance the acceptance of proposals made at the state level.
- **Mitigation Activities:** Besides developing additional water sources, state interviews highlighted the benefits of interconnecting water systems for emergency water transfers. Additionally, many water systems continue to use declining water rate structures, which are counterproductive to water conservation efforts. Finally, successful drought mitigation efforts, such as the Town of Landrum's activities, should be highlighted and modeled across the state. Examples of large water suppliers' mitigation success stories, such as those of the Mount Pleasant Water Works and the Spartanburg Water System, should also be promoted.
- **Local Drought Response Ordinances:** Lessons from Lexington, Spartanburg, Landrum, and Mount Pleasant stressed that municipal water systems were very happy with Local Drought Response Ordinance requirements from the state. Water suppliers should continue to adopt such ordinances as required by the South Carolina Drought Response Act.

Rural Water

State planning personnel suggested several areas of focus that may help alleviate rural water problems:

- **Increased Public Education:** Increased public education about basic water principles and local geology may help citizens play a more proactive role in their own water management. People mentioned previously successful programs such as "Be Well Aware" and stated that similar promotional activities would be beneficial.
- **Low-Interest Loans:** Low interest-loans may relieve some of the financial burden in developing appropriate water sources not only during times of emergency but also in advance of a drought.
- **Development of Alternative Water Sources, Management Techniques, and the Continued Exploration of Funding Sources:** Alternative sources of water, such as community wells from high producing areas and small impoundments, were given a high priority. Included in this discussion was the need for additional mapping of favorable development areas, enhanced water-related databases, alternative management strategies, and funding to carry out all of these activities. The state, other organizations such as the

South Carolina Rural Water Association, and rural representatives should work together to develop and promote solutions to water development limitations in rural areas.

Environmental Issues

- **Minimum Flows for Fish and Wildlife:** The number of complaints about the lack of in-stream flow regulations, or the enforcement of these regulations, indicates that this is an issue that the state must address. The South Carolina Water Plan (SCDNR, 1998) has clear guidelines as to minimum flows for the maintenance of water quality, fish and wildlife, and navigability, but there is no indication that these guidelines are being followed or enforced. Investigations need to be undertaken to look at this issue for the rivers and streams within the state in order to clarify laws and agency responsibilities, as well as to determine if the minimum flow recommendations for fish and wildlife are adequate and enforceable.
- **Addressing the Full Range of Potential Environmental Impacts:** Most of the concerns brought to our attention were focused on riparian and in-stream or lake habitats. Although these may be the primary interests affected, there are also a wide range of wetland and non-aquatic environmental impacts that may be caused by drought, such as: modified wildlife migration and territorial patterns, increased human and wildlife contact, habitat and forage limitations, increased incidences of wildlife disease, and an increase in invading plant species. Environmental issues must be more fully discussed in the state drought planning efforts.

Forest and Timber Resources

- **Communication of Wildfire Threats and Infestation Outbreaks:** The communication to the public of wildfire threats (including media coverage and public service announcements) and infestation outbreaks by the South Carolina Forestry Commission is believed to have reduced the number of acres burned in 2000 to below-average levels, as well as aided in the management of the southern pine beetle outbreak. This work should be continued and modeled in other drought-affected sectors.

Further Research and Revision

This study was conducted as a "snapshot" survey of South Carolina drought impacts and concerns. Drought, however, is a long-term phenomenon. Additional studies should be initiated not only to investigate more fully the issues brought up in this report, but also to monitor the state's long-term evolutionary drought impacts, mitigation, and response measures. These studies should be well documented to ensure the persistence of a state "drought memory" and dispersed throughout the state to foster a common understanding in regards to drought impacts and planning directions. The state Drought Response Program, relevant legislation, and plans should also be reviewed and updated on a regular basis to ensure their relevancy

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I. Introduction

South Carolina is blessed with an abundance of water, although its distribution is uneven across the state and from season to season (SCDNR, 1998). These disparities were made especially clear during a once-in-a-hundred-year drought lasting from June 1998 through December 2000 and still continuing in 2001. This drought caused widespread impacts throughout South Carolina, from which the state may take years to completely recover. To learn from and build on this experience, a study was undertaken to assess the effectiveness of South Carolina's Drought Response Program. The study was made possible, in part, by a quick response grant from the Natural Hazards Center at the University of Colorado and the gracious hospitality of the State of South Carolina. The grant program is designed to obtain valuable information soon after the occurrence of a natural hazard. Because of the short nature of this study, the results represent a "snapshot" of the primary concerns being addressed by South Carolina in dealing with this current drought. It is hoped that South Carolina and other states will use the results of this study to reduce their vulnerability to drought.

II. History of South Carolina Drought Management

South Carolina has one of the oldest drought response programs in the United States. The South Carolina Drought Advisory Committee was established in 1982 to "examine drought impacts and develop a means for response to such situations" (SCWRC, 1986). Subsequently, the South Carolina Water Resources Commission established the Drought Advisory Committee in 1983, which formulated the first comprehensive plan for managing drought within the state. This plan was recognized by the state with passage of the South Carolina Drought Response Act of 1985. It was one of the first state drought plans. (As of December 2000, only thirty-seven states have or are in the process of developing a plan to respond to drought.)

The Drought Response Act established procedures to monitor, conserve, and manage the state's water resources during periods of drought. It also established six drought management areas based on climatic divisions and a drought response committee within each management area. Additionally, it called for the establishment of a state drought coordinator. South Carolina's permanent state drought coordinator is the only such position within the United States and is a unique asset to the state. The Drought Response Act was amended in 2000, primarily to adjust drought management areas to correspond with the state's four major river basins, restructure the drought response committees, and clarify existing procedures within the act.

Although the state has extensive experience in drought planning, drought continues to take a large toll on the citizens, economy, and various ecosystems within the state. Because of the nature of drought, these impacts are geographically widespread and affect many economic, social, and environmental interests. A review of these effects will demonstrate the pervasive nature of drought and the difficulties involved in its management.

III. Study Methods

This study utilized the services of the South Carolina Drought Coordinator, Hope Mizzell, to establish contacts across the state. These contacts were visited during a field investigation from September 25 to October 1, 2000. During this trip, site visits were made to interview state employees, county officials, large and small municipality water system operators, farmers, coastal citizens, lake resort owners, and other affected homeowners and private industry professionals. Follow-up telephone interviews were also conducted to gain perspectives from interests that were not contacted during the initial field investigation. These were primarily to timber, energy, environmental, and marine resource interests. In total, forty representatives of drought-affected areas were interviewed, providing a great amount of detailed information. These interviews were used to produce a qualitative analysis of the impacts of and responses to the 1998-2000 drought.

IV. Study Findings

People often focus on the negative consequences of drought, but in this case, many success stories were also highlighted in discussions across the state. The following findings illustrate some of the primary successes, as well as the drought management concerns, noted by a wide variety of public officials and citizens of South Carolina.

A. Recreation and Tourism

Tourism is one of the primary sources of revenue for the State of South Carolina. This study found that the "ripple effect" from drought-related impacts in this South Carolina industry are significant. The direct drought impact is on local tourism operations, with secondary impacts affecting the general service area through reduced employment opportunities, losses in sales and the generation of sales tax revenue, and a reduction in recreational activities. As an example, businesses surrounding Lake Marion and Lake Moultrie conducted a brief survey of economic losses resulting from the low lake levels during the summer and fall of 2000. They reported losses of more than $3,000,000 for July and August of 2000. Depending on the size of the business, typical losses ranged between $30,000 and $120,000 for selected businesses for the two months. Reported losses included the extension and/or closure of boat ramps; lost gas sales; the loss of vendors, forcing some owners to buy retail supplies to stock their shelves; the closure of lake-front stores; decreased motel and campground rentals; personnel layoffs; decreased revenues from restaurants, pontoon and boat rentals, and fewer tour-guided fishing and recreational trips; and increased boat repairs due to boats hitting exposed stumps and incurring heavy sediment loads in engines (in one case, a marina had twenty boats that could not be repaired because they could not get them out of the water).

Losses may continue to accumulate beyond 2000 as return business could also be lost in future years due to frustrations experienced by customers during the drought. For example, it was reported that one major sponsor decided that they would not host another fishing tournament in the near future on Lake Marion because of the diminished conditions of the lake in 2000. Other clients that kept boats at marinas stated that they would not be returning since their boats were

grounded and could not be moved for the entire summer season. As of December 2000, many boats were still grounded since lake levels had not rebounded.

Business owners felt that they had the capacities to withstand a "normal" drought, but this especially severe three-year drought surpassed their coping abilities. It was stated that if drought continued into 2001, several operations would be forced out of business. The Lake Moultrie and Lake Marion survey asked the question, "If the drought continues in the Spring [of 2001], will you be able to open?" Twenty-three respondents did not answer, thirteen said "no" or some variation of that, four did not know or said that it was "questionable," and five said "yes" or "probably." These numbers illustrate the seriousness of the situation.

Business operators felt especially frustrated that upstream reservoirs were not facing the same circumstances. They stated that upstream reservoirs had held back sufficient amounts of water to maintain their needs, while leaving the lower reservoirs in serious trouble. In addition, they were upset that the local hydroelectric plant, from which they leased lake-front property, was not managing water to meet their needs. This was seen as especially troublesome since hydroelectric power only produces roughly 3% of the state's energy needs (South Carolina Energy Office, 2001), thus bringing up issues of beneficial use. Owners stressed the need for a cooperative agreement among water users on the lakes to ensure adequate lake levels during these times of crisis. They felt that the governor should also "jump on board" with a relief package that focused on assisting lake businesses in remaining solvent and promoting cooperative agreements between lake users to ensure that this situation did not happen again.

The State of South Carolina also expressed concern that parks and recreation interests were not more clearly represented in drought planning efforts. Although welcome at drought meetings, Parks and Recreation is not designated a voting seat on the drought response committee.

From a power generation perspective, dam operators reported that they were trying their best to manage the drought situation. Their main problem was the lack of expected inflow into the reservoir systems. Operators typically release water every spring in anticipation of high inflows, based on an estimated "rule curve." That is, they release water from the reservoir to provide room for the expected spring inflows. During the last several years of drought, they have not received the anticipated inflows, leaving the reservoirs at lower levels. In the case of Santee Cooper, the company operating the dams for Lake Marion and Lake Moultrie, this has meant that they have been forced to reduce summer water releases and subsequent hydropower generation and replace the lost power from other sources. Because other sources of energy cost more to produce, the switch cost Santee Cooper approximately $6.5 million from April to December of 2000. As for passing additional water downstream to other reservoirs, some operators also felt that the additional flows would not be enough to significantly raise water levels in downstream reservoirs in many cases because of natural in-stream water losses. Santee Cooper also stressed the difficult situation they are in because the company must release water in order to prevent salt water intrusion problems and meet the in-stream flow requirements downstream.

On a positive note, the drought has forced some tourism-dependent businesses to begin organizing and working toward new solutions and cooperative agreements for drought preparedness and response. Lake Moultrie and Lake Marion businesses have formed the

Committee for the Preservation of Lake Marion and Lake Moultrie, a subcommittee of the Fisheries Division of the national Wildlife Action group. Approximately 140 businesses make up this committee. Since our field visit, representatives of this group have met with Santee Cooper to work on enhancing drought management agreements. In response, Santee Cooper has agreed to dredge areas surrounding boat launches to assist business-owners in maintaining access to Lake Marion and Lake Moultrie. This service would be provided "at cost" to the businesses around the lake, who could then work out a suitable payment schedule as part of their lease with Santee Cooper. The Committee for the Preservation of Lake Marion and Lake Moultrie also spoke with their local drought response committee. At this same meeting, the state promised to explore economic assistance opportunities on their behalf.

B. Agriculture

Drought has caused significant agricultural impacts throughout the state over the last three growing seasons. The impacts highlighted during the study ranged from limited water for livestock, deer foraging losses, reduced feed crops, and lowered crop quality, to the total loss of row crops in some areas. As an example, a young dairy farmer was forced to water cattle from a municipal water tap when streams and impoundments ran dry. Although the farmer was fortunate enough to have an additional source of local municipal water, the higher water rates were causing an additional financial burden of $500 per month on the farm. This particular farmer was eventually able to install a new well through the USDA's Emergency Conservation Program. The program has already contributed $1.2 million toward 50/50 cost-share well-drilling grants for livestock and poultry producers in South Carolina. The program was highly praised for its rapid implementation time and application process. However, the farmer also expressed concern over the reduced quality and quantity of his feed sources (i.e., silage) due to the drought conditions.

Row crops such as cotton and corn were also severely affected by the long drought. Some fields were not even harvested as a result of the devastation. Some larger producers were able to utilize irrigation, but many reported that they could not afford it because of high costs and the relatively small size of their fields. The average farm size in South Carolina is roughly 233 acres, compared to the national average of 470 acres (South Carolina Agricultural Statistics Service, 1997), and, indeed, many of the fields are as small as 10-12 acres, making them hard to irrigate effectively. Even with irrigation, expenses were reported to be high, crop losses continued, and groundwater declines and availability were also seen as problems.

Because of unreliable rainfall, many farmers plant a variety of crops in the hopes that one variety will make it through a drought, but farmers are becoming more reliant on cotton, which is one of the more drought-resistant crops. However, even some cotton crops were completely lost during the recent drought. Universal negative sentiments were also expressed over fertilizer and herbicide applications that were not activated because of the lack of precipitation. Farmers stressed that many operators use best farming management practices, take advantage of state and federal technical assistance and federal financial assistance programs, and respond to weather forecasts, but that they continue to accumulate debt during drought, especially during multiple-year droughts.

Farmers also expressed concern for agriculture-dependent businesses and communities. They felt that these entities must continue to work together for their continued viability and were appreciative of some businesses that were trying hard to help farmers during this drought. It was reported that some businesses were assisting farmers with debt deferments and reduced interest rates.

Farmers and local county commissioners indicated that the State Soil and Water Conservation Districts were also a success in that they provide a good communication system between local environmental planners and district constituents, as well as between local interests and the drought response committees. This is seen as important not only to the farming community but other environmental interests in general.

Farming in South Carolina is inherently tied to national farm policies. Low crop prices, increased fuel prices, and limited crop insurance policies make drought losses especially damaging. Since most economic drought relief for farmers is directed by national programs, local perceptions are that such programs are out of the hands of the state. Farmers did express appreciation for the assistance provided by federal programs but felt that it was not enough. They felt that insurance and subsidies should, at least, cover their expenses during times of drought so that they could begin again the next year without being further in debt. In addition, the agricultural community expressed frustration that their concerns were not weighed as heavily as those of larger producers from the midwestern region of the United States. Although smaller in scale than operations in other states, farming is still a strong part of the social fabric of South Carolina. These respondents noted that accumulated debt and the general agricultural conditions are demoralizing for the region's farmers. One fourth-generation African American farmer stated that he just couldn't see persuading his daughter to take over the family farm when she could take advantage of better opportunities elsewhere. This common theme is highlighted by the average age of a farmer in South Carolina - approximately 56 years (U.S. Bureau of the Census, 1994).

The State of South Carolina also expressed concern about the plight of South Carolina farmers. They noted that state personnel have continuously attempted to provide technical and managerial support to the state's agricultural interests, but that large-scale financial relief packages are beyond their capacity. They stressed that the state has also been involved in dealing with a widening variety of interrelated environmental and agricultural interests in the state by creating non-adversarial forums for discussion and mitigation. For example, the U.S. Farm Bureau (personal communication, 2000) reported that farmers lose approximately $53 million per year in crops because of deer foraging. The DNR has been working over the last five years to develop cooperative solutions with local farmers to address the problem. State personnel echoed the thoughts of farmers in stressing that additional federal loans were not the answer. Other means, including the possibility of grant assistance, are seen as necessary for ensuring the viability and quality of life of South Carolina's agricultural and agriculture-dependent communities.

C. Large Public Water Suppliers

In general, large municipalities feel that they are best able to withstand the effects of drought. It was stressed that large municipalities have the resources to develop plans and water sources that meet long-term water needs. Planning personnel stress that long-term vision is a key in meeting

ever-increasing demands placed on them by users and expanding development efforts. The Spartanburg Water Supply System is one large water supplier that was minimally affected by the recent drought because of their long-term water supply planning and their close working relationship with relevant state agencies. Although the plan development and implementation required high initial capital investments, the rewards are especially visible during the multi-year 1998-2000 drought.

Large water suppliers' main concern revolves around the issue of local flexibility in user restrictions during drought. Many of these suppliers invest large amounts of money in preparing for times of shortage. When a drought declaration is made by the state on a regional basis, placing mandatory water restrictions on users, they lose revenue. For systems that still have adequate water storage, this declaration may supersede mitigation actions that have been taken by the water supplier. Suggestions included allowing the public water suppliers to regulate their own services except under times of extreme drought, or granting decision-making authority to local drought management teams within the corresponding drought management area for enhanced local flexibility. Another suggestion was made to include a representative of public drinking water interests on the State Drought Response Committee. Recommended candidates include a water supplier or a representative from the American Water Works Association or other related agency.

Some water suppliers also expressed frustration over the amount of regulation placed on them while the power industry was virtually unregulated. They also feel that industries are granted leniency in developing new water sources, often at their expense. On this matter, more inclusive, cooperative, long-term planning is seen as necessary to ensure an equitable and efficient use of the state's water. Increased education and communication were highlighted as key points for building a strong foundation between competing interests. State guidance is seen as necessary to increase education on long-term planning methods to all water-related entities, provide timely information on the state's water resources (which they are doing well), and create the proper forums and legislation for ensuring that all water users are evenly represented in water access and regulation.

Suppliers did express appreciation regarding the state's current efforts at providing information on statewide water availability and other drought information, especially the data provided by the State Drought Response Program web site. Although they do not always see "eye to eye" with state planners, they also recognized the great value of having a state drought coordinator and the accompanying drought planning structure.

One example of a large public water system adopting proactive mitigation strategies based on long-term planning and understanding the nature of drought is the Mount Pleasant Waterworks (MPW), which has had to deal with the combined issues of rapid growth and drought during the past several years. This system, located along the coast and serving approximately 50,000 customers, uses groundwater as its primary water source. Some of the MPW's mitigation actions that will help reduce drought impacts during future droughts include: 1) a local drought ordinance submitted to the state drought coordinator planning specific responses during a drought, 2) a growth cap on new permits into the system to prevent strain and increased vulnerability of the system, 3) a three-tiered "increasing block" rate structure that is adjustable

during droughts, 4) detailed monitoring of well levels, 5) regular leak detection to maintain peak efficiency, and 6) seasonal storage into the aquifer for later use during periods of high demand. Finally, MPW officials felt that their very active public education and communication emphasis was extremely helpful in building customer support of MPW operations, especially during droughts.

D. Small Public Water Suppliers

Small water suppliers are often more vulnerable to drought than their larger counterparts. Their limited resources often restrict long-term planning options. That is not to say that long-term planning should not be done; rather, it necessitates creativity and longer water planning horizons. The city of Landrum in northwestern South Carolina is one example. There, city officials have undertaken both short- and long-term water planning efforts as a result of a crisis situation during the summer of 1999. In terms of short-term planning, the city has undertaken several mitigative actions (such as implementing a leak detection program that reduced water usage by 18%), purchased back-up supplies such as a spare pump, adopted a modified version of the state-recommended drought ordinance that dropped voluntary water use by 8-11% during the summer of 1999, dredged their reservoir, published water system statistics in their local paper, and worked with the Nature Conservancy to acquire an additional water source on Conservancy property. They are still working on acquiring additional water supplies and modifying water rates to meet their short-term needs, and they are also developing a 40- to 50-year plan. Since providing water use guidelines and informing the public about their current water situation and future needs, city planners feel that the public has been very responsive and receptive to their actions. They also feel that the recent drought provided the appropriate context for motivating the community in these endeavors.

Even with abundant water supplies, there are inevitably times when water will be in short supply. Restrictions on water use are often necessary, and water emergencies are a real threat, especially for small water systems. This threat is exacerbated when other circumstances such as chemical contamination reduce available water supplies. This was the case in the town of Lexington in central South Carolina during the summer of 2000. A local chemical leak contaminated one water supply source and drought severely depleted the other. City personnel stressed that cooperation among small public water suppliers in the area was essential in getting them through the drought. Great success was achieved because of the interconnections between the local suppliers and their willingness to share their valuable water resources. During the emergency, water was transferred between systems to ensure at least a minimal amount of water for service areas.

A strong concern was also expressed over conflicts between competing water users during drought. Along rivers and streams, upstream water use resulted in situations where not enough water was being delivered to meet the needs of public water suppliers. Because of traditionally shared water rights in the state, suppliers feel that there is an unclear designation of beneficial water use during times of drought. It was brought to our attention that the Department of Health and Environmental Control does have legal authority to regulate beneficial use in matters of health and human safety but that the judicial system was hesitant to hear such suits. With state water laws based on the principle of shared water uses, this is a difficult situation, but one that

informants feel must be addressed during times of drought. City officials also recommended that state water laws be revised so that emergency water supplies for a community could be obtained in cases involving public safety issues. The South Carolina Drought Act does enable the State Drought Response Committee to establish a forum for water conflict resolution (negotiation/mediation), but the option has not yet been utilized.

The smaller water suppliers saw the role of the state drought coordinator as "a livesaver." The coordinator was seen as especially critical during drought response efforts as she provided an easily identifiable point of contact for guidance and technical assistance. Because of limited resources, these suppliers stressed that they rely heavily on information provided by the State Drought Response Program.

E. Upland Rural Water Systems

Geology plays a primary role in determining available water sources in the upland region of South Carolina, most of which is classified as the Piedmont physiographic province. According to the South Carolina Department of Natural Resources (1998), "water stored in the Piedmont region is controlled by the location and size of fractures in the bedrock and the thickness of the overlying weathered portion of the bedrock. Replenishment of this water is primarily from precipitation." Rivers and streams also contribute as water sources but are often limited in volume and distribution.

The primary sources of water for rural homeowners are bedrock fractures and unconfined sediments. Most rural homeowners rely on shallow "bored wells" in unconfined aquifers that are vulnerable to aquifer depletion during drought. Although more economical in the short run, the pumping capacity of these wells is often diminished when rainfall fails to maintain groundwater levels. Other homes use "drilled wells" that capture water in deeper bedrock fractures. Although much more expensive, these wells are typically able to produce water longer during periods of drought. Adding to the cost of these wells is the uncertainty associated with the fracture distribution. It may take several drilling attempts to locate a fracture with adequate water, if one is located at all. Many bored wells were significantly affected during the 1998-2000 drought, and the state has implemented stricter guidelines for the installation of these types of wells. It was stated during interviews that state and federal assistance is not currently available for these rural homeowners, except perhaps in very specific circumstances such as low-income HUD loans.

State personnel suggested four areas of focus that may help alleviate the rural water problems: increased public education, low-interest loans, the development of alternative water sources and management techniques, and continued investigation of external funding assistance. Increased public education about basic water principles and local geology may help citizens play a more proactive role in their own water management. Similarly, low-interest loans may relieve some of the financial burden in developing appropriate water sources not only during times of emergency but also in advance of a drought. Developing alternative sources of water, such as community wells from high-producing areas and small impoundments, was also given a high priority. Included in this discussion was the need for additional mapping of favorable development areas, enhanced water-related databases, alternative management strategies, and funding to carry out all of these activities.

Other water system operators expressed similar concerns about rural homeowners, but stressed that limitations have been placed on rural water systems because of federal regulations. Rural water systems are subject to strict EPA guidelines on water quality, which small systems are often unable to meet because of the necessary infrastructure and personnel training costs.

F. Aquatics and Marine Resources

According to the South Carolina Department of Natural Resources, their office has received calls from people concerned about the high concentration of fish due to low water levels, especially in the rivers near the coast. The concerned citizens state that the high concentrations are allowing fisherman to catch them at a much higher rate, "exploiting" some vulnerable species. In addition, the DNR trout hatchery is operating at a reduced capacity. Flows have been reduced to one-third of normal, limiting the numbers of trout that can be produced. Subsequently, the DNR is running several months behind in stocking trout around the state.

Lake Moultrie and Lake Marion were said to be two of the lakes most affected by the drought. The reduced operation of the DNR fish lift at these lakes has been limiting the ability of certain fish species to move up system and spawn. However, there have not been any extraordinary fish kills reported because of the drought. A DNR representative also reported that there has been a reduction in revenue to the state from licenses, and that the financial losses will likely continue to linger for several years as people go elsewhere for more reliable fishing.

A DNR representative brought up a number of drought-related concerns about aquatic plant species within the state. The main concern revolves around drought effects on the growth of exotic, or invasive, species. It was noted that the extent of losses due to exotic aquatic species doubled in drought years. Drought lowers lake levels, changing the distribution and population of these nuisance species, as well as causing algae problems. It also interferes with mitigation actions aimed at controlling these species, such as a program utilizing carp to remove unwanted species. Addressing these concerns increases state expenditures, putting additional strain on its limited resources.

One environmental group did express some frustration with the state's response to stream-related environmental needs. They discussed their efforts to get the state to establish minimum streamflow standards in accordance with environmental needs - efforts that have gone unheeded. They believed that environmental issues were "not in the loop" in terms of water quantity issues. However, they had higher praise for the state in terms of water quality issues. They noted that the state has been actively involved with several environmental groups in dealing with several water quality issues at the state level.

Environmentalists also expressed frustration with South Carolina's current drought regulations and legislature. They stated that South Carolina's government agencies are relatively progressive with the introduction of new ideas. State agencies will suggest legislation, seek public input, and adopt suggestions from environment groups, but the legislative process then becomes "bogged down." Industry gets involved and says "we don't want to go beyond federal standards," so the legislature will balk at the passage of the innovative approaches. "Good ideas always get stopped by the legislature."

G. Forestry and Timber Issues

The timber industry is the third largest manufacturing industry in the State of South Carolina (personal communication, South Carolina Forestry Commission, 2001). The state contains roughly 13 million acres of forested land in addition to commercial tree nurseries. Of this acreage, 67-68% is owned by private landowners, 20% by commercial companies, and the remainder is public forest land. A State Forestry Commission representative reported that seedling survival has been a large problem in the state over the last three years because of drought. Not only are there costs to replant these seedlings ($50/acre), but there is also the loss of the year's growth. In some places, replanting has been necessary in each of the last three years. For example, the seedling survival over the last three years for loblolly pine was 80%, compared to 85-90% in a normal year, and for longleaf pines the survival was around 50%, compared to a normal year of 75%. It was reported that there are cost-share programs that will cover 40-50% of the replanting costs.

Other losses were reported from southern pine beetle outbreaks. There are some losses due to the pine beetles every year, but it is much worse during drought because they target stressed trees. Losses due to the southern pine beetle (and other dark beetles) are estimated at $40 million for 2000. The 1960-1997 annual average is only $750,000 per year. Losses for 2000 were the second highest in recorded history, behind 1995, during which there were $110 million in losses. There have only been four years with losses of more than $10 million.

The state's response to the beetles was to fly foresters over the region to look for outbreaks. When they were identified, the state would contact the landowner and provide them with information on how to control the outbreak. Media spots were also provided to the local media, including information to help identify whether damage was from the southern pine beetle or from other types of beetles. With help from the federal Forest Service, maps were produced showing the affected counties and local outbreak zones. The state also worked with the landowners, loggers, and mill operators to make sure the affected trees were moved quickly to mills for processing. Since timber quality reduces rapidly, a quick response does salvage some lumber for the landowner.

Although there were problems with seedling and other tree losses, state forestry officials were especially pleased with the relatively low number of acres damaged by forest fires. Although the number of fires in 2000 was slightly above normal, the acres burned were below normal. They attribute much of this year's success to an information campaign employing the media and public service announcements. These efforts were aimed at increasing the public's awareness of fire danger and providing them with recommendations on how to reduce fire threats. State officials said that the low fire season allowed their fire crews to help fight fires in other states that were in need of assistance, as they are part of a 13-state compact to battle fires in the southeastern United States.

V. Comments and Recommendations

As pointed out by the National Drought Policy Commission (2000), drought education, mitigation, consensus building, and the establishment of appropriate financial safety nets should be the cornerstones on which to build a drought planning structure. South Carolina is well on in its way in promoting these efforts. Local planners have already worked together to develop appropriate recommendations (such as those included in the South Carolina Water Plan [SCDNR, 1998]) for short- and long-term water management within the state. Some of the South Carolina Water Plan recommendations were "based on the existing requirements of the South Carolina Drought Response Act of 1995" (p. 12).

Our study provides recommendations toward the expansion of these efforts, based on suggestions received from across the state and experience gained by working with other states and the National Drought Policy Commission. Because of the highly legalized nature of the state drought response plan, our recommendations are tailored for both long-term actions that might require legislative approval and short-term actions that could be implemented immediately.

A. General Recommendations

- **State Drought Program Coordinator:** Interviews showed general agreement on one point in particular: the usefulness and support of the state drought coordinator position. The current coordinator, Hope Mizzell, plays a vital role in drought planning and management within the state, especially among water suppliers. Several states have short-term drought coordinators or drought planning committees, but South Carolina citizens believed the "one-stop" state drought contact was very beneficial. This role should be maintained, if not strengthened, with additional staff and resources to play an enhanced role in other impacted sectors. The web site of the Drought Response Program was also noted by interviewees as a particularly useful monitoring and planning tool, although they recommended that it be updated more frequently.
- **Drought Response Committees (DRCs):** DRCs were also viewed as successful in that they are aimed at being non-adversarial; providing an avenue for compromise, communication, and coordination; and helping to establish an atmosphere of "trust, credibility, and reliance" between DRC members.
- **Drought Planning Education:** Detailed drought planning education should be continued throughout the state. A lack of training and/or a lack of understanding about its importance are the primary limitations to drought planning. Enhanced communication and cooperation are seen as key issues in these efforts by planners throughout the state. The South Carolina Drought Response Program should be utilized to facilitate these efforts, with assistance from other relevant state agencies.
- **Drought Mitigation:** Secretary of Agriculture Dan Glickman recently stated that the U.S. Department of Agriculture provided "no fundamental direction" to change farm policy in recent years because the system is propping up so many farmers with emergency aid that neither farmers nor lawmakers have any appetite to change (Thompson, 2000). This thinking should not be allowed to prevail within South Carolina, especially since the federal government is working to reduce aid assistance by promoting local mitigation alternatives. The concept of mitigation focuses on implementing actions in advance or in the early stages of drought to minimize subsequent drought damage. Therefore, drought education and planning should focus on short- and long-term

mitigation actions to foster sustainable water development. Drought response actions are also an essential part of drought planning but should be considered secondary to drought mitigation. As other states have already done, South Carolina may want to investigate the possibility of developing drought impact committees to continually work on drought impact assessment and mitigation activities, or mandate that these activities be carried out by the DRCs. To ensure that these activities are carried out, mitigation concepts should be enhanced within the state's Drought Response Plan structure. A variety of mitigation actions are listed on the web site of the National Drought Mitigation Center at http://enso.unl.edu/ndmc:

  - **Vulnerability Modeling:** Vulnerability modeling has been shown to be one mitigative action that is especially useful to state and local planners around the country for targeting high-priority regions. For example, Wilhelmi (1999) and Knutson et al. (2001) focused on agricultural vulnerability modeling in Nebraska. Similarly, the State of Nebraska, as part of their drought planning activities, identified vulnerable water systems throughout the state. At the University of South Carolina, Dow and Yarnal have also been researching the perception of community water system managers regarding their vulnerability to drought and their use of weather and climate forecasts (Yarnal and Dow, 2000). Such research should continue to be supported throughout the state, and expanded to other relevant sectors.
  - **Climate Forecasts:** Climate forecasts are another important mitigation tool. State and federal government agencies have allocated vast resources to developing climate forecasts, including drought forecasts. Although there is inherent variability in any forecast, state and private planners should attempt to incorporate these forecasts into their planning efforts to some degree. Reservoir operators, especially, should attempt to use forecasts in planning spring water releases for lake level maintenance. State and federal agencies should continue to promote these activities and help foster forums and discussions regarding the application of climate forecasts.

- **Inclusive Participation:** The state should encourage more cooperation between differing interests to develop drought solutions. As the competition for water resources becomes more contentious because of increasing population and changing priorities, conflicts will undoubtedly become more of a problem. An important emphasis was placed on the need for enhanced cooperation between DHEC and the DNR. As interviews highlighted, inclusive public participation is also required to ensure that all concerns are addressed. In some cases, this participation may need to be solicited or mandated. Resources may need to be provided to allow some minority interests to effectively participate.
- **Financial Assistance:** An investigation of financial resources for drought mitigation strategies and emergency funds for drought response should be completed by South Carolina, looking closely at potential incentive and cost-share programs. Several states, including Nebraska and New Mexico, have established, or considered establishing, revolving emergency funds to supplement federal assistance to needy areas affected by drought. Depending on the circumstances and the state, these funds can be used, for example, to help farmers or others cover the difference between federal assistance and operating costs during droughts, to help tourism-related businesses survive revenue losses due to extreme drought conditions, or to help bring drinking water to a community.

- **Legislative Action and Implementation:** Drought policies and planning structures in South Carolina tend to be far more legalized than those in most other states around the country. Perhaps as a response, citizens continually expressed frustration over the slow passage of legislation, especially in terms of environmental issues and innovative water management techniques. Many interviewees noted the willingness of state agencies to elicit public input and develop innovative proposals, but they felt that new ideas were continually "bogged down" by the legislative and governmental implementation process. Perhaps some discretionary actions could be placed under the authority of the drought response committees or a water management council as authorized by the South Carolina Drought Response Act to enhance the responsiveness of drought planning proposals.

B. Drought Response Committee Recommendations

- **Drought Management Areas and Authority:** The change from six to four Drought Management Areas (DMAs) was most likely a positive change, although it was not seen as successful in 2000. The change was made primarily to create new DMAs around river basins (instead of climate divisions) to promote basin-wide drought planning. Each DMA has twelve representatives, with no more than two individuals per county. In some cases, the DMAs are very large. Therefore, it is important that the drought response committees (DRCs) have the power to declare drought for individual counties within a DMA. It is strongly recommended that the state expedite the appointment of all representatives to the DRCs. In addition, it is also recommended that the state review the process of appointing representatives and simplify this process in order to ensure that complete representation will be continuous in each DMA. Continual input on the drought response committees is extremely valuable, especially during a drought situation such as the state has experienced during the last three years.
- **Parks and Recreation:** Parks and Recreation representatives are not legal members of the DRCs. They have been invited to participate at each meeting, but becoming a member would give them voting privileges and additional credibility. The recreation and tourism losses of the 1998-2000 drought demonstrated the importance and vulnerability of this sector. To address this major impact within the state, the State Parks and Recreation Department, and local representatives, should be considered as permanent members on the DRCs. The State Drought Response Act states that the "Governor may appoint additional members [to drought response committees] as necessary to insure broad-based input on the committee and may make interim appointments when the General Assembly is not in session." Recreation representatives could be immediately appointed to drought response committees until their official inclusion through modification of the State Drought Response Act.
- **Public Water Suppliers:** There are approximately 1200 public water suppliers within the state. These suppliers stressed the need for additional representation on the drought response committees. There may be some confusion as to the committee representation from state agencies, and this should be addressed. Currently, DHEC is considered the state agency representing water suppliers. In addition, water suppliers are very concerned about basin-wide or county-wide mandatory water restrictions when they still have sufficient water reserves. This legitimate concern should be addressed by the individual drought response committees. Universal mandatory water restrictions are

counterproductive to drought mitigation. Perhaps these issues could be settled through the issuance of restriction "variances" or mediation as authorized and outlined in the South Carolina Drought Response Act.

- **Administrative Jurisdiction:** The state needs to clarify the responsibilities of the DRCs and the governor's State Emergency Response Team so that the transition between the two is smooth and effective when the governor's team is established and so that each knows the responsibilities of the other so that activities can be effectively coordinated. This transition has been shown to be very ineffective in other states.
- **Water Conflicts:** DRCs must understand and promote their role in water use conflicts. This subject encompasses the issue of water rights and questions involving priorities and the essential users of water. The Drought Act states the responsibility of the DRCs and the Department of Natural Resources in water conflict resolution (negotiation/mediation), but these avenues have not yet been utilized. Additionally, water suppliers recommend that state water laws be revised so that emergency water supplies for a community could be obtained in cases involving public safety issues. This emergency assistance should be investigated.
- **Regulation Enforcement:** The South Carolina Drought Act states, "During severe or extreme drought conditions, the South Carolina Department of Natural Resources may require mandatory reduction or curtailment of non-essential use in affected drought management." In addition, "municipalities, counties . . . engaged in the business or activity of supplying water for any purpose shall develop and implement drought response ordinances, or local drought plans when authority to enact ordinances does not exist." Some water suppliers expressed concern over the lack of enforcement in regard to these issues. Some entities have complied while others have not, creating resentment. The question of whether the DNR or DRCs should take on more responsibility for enforcing compliance with local drought response ordinances should be investigated.
- **Assistance to Rural Areas:** DRCs need to better address the assistance available to meet the water needs of individual landowners/homeowners, particularly in the rural areas of northern South Carolina. More cooperation between the state, the DRCs, and the South Carolina Rural Water Association may be useful in these efforts.
- **Interagency Coordination:** The interaction and coordination needs to be maintained, if not strengthened, between the Department of Natural Resources (DNR) and the Department of Health and Environmental Control (DHEC). The DNR is mandated to promote activities that help protect the state's natural resources, while DHEC has monitoring, permitting, and regulatory responsibilities within the state.

C. Tourism and Recreation

- **Business Assistance Programs:** South Carolina has no business assistance programs available at the state level for addressing the economic impacts resulting from tourism- and recreation-related drought losses. This is especially important given that the Small Business Administration (SBA) does not consider drought losses. The state needs to address this issue, given the seriousness of economic losses in 2000 and the potential for increased losses in 2001.
- **Water-Shortage Contingency Plan:** The DNR in the South Carolina Water Plan (SCDNR, 1998) suggests that a "water-shortage contingency plan should be developed

for lakes and approved by DHEC in coordination with DNR." Not all lakes/reservoirs have developed these contingency plans, resulting in devastating impacts to some lake users. It is recommended that these efforts be pushed forward through cooperative agreements not only with dam operators and state agencies, but also through the active participation of relevant cities, homeowners, and recreational service providers. A positive example is the work being done between the Committee for the Preservation of Lake Marion and Lake Moultrie, the Santee Cooper company, and the Department of Natural Resources.

- **Climate Forecast Information:** The use and dispersion of climate forecast information should play a stronger role in these planning efforts for such issues as water release planning and for helping the public to understand current and future water availability. In order to play a more participatory role in drought preparedness and response, recreation interests must also fully realize their own responsibilities. As service providers, they have a personal responsibility to plan for worst-case scenarios through a continual investment of time and resources. Continual, smaller expenditures will help buffer against crippling drought losses. Organization and communication is another key in preparing for drought. Individuals must work together to develop strategies. They must also develop ways to better communicate with their clientele to provide adequate information on lake conditions and develop alternative use strategies (i.e., provide time for renters to get their boats out of the water and provide storage areas until water levels rise). Many recreational interests have already begun these efforts and should continue even when drought is not an immediate problem.
- **"Safety Net" Proposals:** The state must play a more dominant role in assisting and recognizing the drought impacts on tourism and recreation. The state can provide important technical and organizational assistance and should consider economic "safety net" proposals during exceptional drought situations. Assistance is especially needed for newer operators that do not have drought experience and lack resources to buffer against multi-year droughts. The state should also help coordinate cooperation among utility interests to ensure appropriate lake-level maintenance.

D. Agricultural Production

Agricultural producers and state planners continuously express frustration over their lack of control in determining current national farming policies. Drought losses place an additional strain on their limited resources. However, there are many strategies that state and local planners can undertake to address drought concerns that will assist the agricultural community in general. Many of these mitigation measures are discussed on the web site of the National Drought Mitigation Center (2001) (http://enso.unl.edu/ndmc). Some important mitigation actions that were stressed by South Carolina citizens are:

- **Drought Planning Education:** Drought planning education should be continued with the state's farmers. Studies show that most operators still receive weather information through traditional television, radio, and newspapers (Knutson et al., 2001). Our limited exposure to South Carolina agricultural producers corroborates this view. Therefore, information products should be tailored for these media outlets in addition to other contemporary government outlets such as mailings, public meetings, and the Internet.

- **Vulnerability Modeling:** Agricultural vulnerability modeling, such as that done in Nebraska by Wilhelmi (1999) and Knutson et al. (2001), is also necessary to allow state and local planners to target high-priority regions for increased mitigative action. Wilhelmi combined climate, irrigation, land use, and soil data to produce a state agricultural vulnerability map. Knutson et al. found that other criteria, such as capital reserves, conservation techniques, and farm/ranch diversity, should also be addressed in these modeling efforts for enhanced vulnerability representations.
- **Enhanced Communication and Cooperation:** Although may producers would make some modifications to their operations before drought, many are hesitant to fully commit to mitigation efforts because of the uncertainty in long-term weather forecasts (Knutson et al., 2001). In many cases, resistance is also caused by lending requirements and the high human and monetary costs of modification. Enhanced three-way communication between producers, financial lenders, and drought forecasters or their representatives may allow for a broader understanding of forecast benefits and limitations and "get everyone on the same page" in terms of needs and expectations. As pointed out by a South Carolina farmer, another recommendation would be to promote activities that bring agricultural producers, agriculture-dependent businesses, and drought planners together. The farmer felt that although many businesses were beginning to work more with farmers again, they generally were more responsive to the needs of farmers in the past. Suggestions include business owners becoming more flexible on payment plans to conform to producers' income schedules (i.e. annual payments), equipment dealers providing increased incentives on equipment that promotes conservation practices, and businesses playing a more educational service role in farm planning.
- **Agriculture Incentives and Assistance Programs:** Additional or more identifiable state, federal, and private incentives and assistance programs may also be needed to help operators implement capital-intensive mitigation measures as well as participate in other drought assistance programs. The National Drought Policy Commission (2000) cites 80 federal and state drought programs. One program cited by a South Carolina dairy operator as being especially helpful was the USDA Emergency Conservation Program. Additional grant programs were also seen as necessary to assist producers that are currently "saturated" with debt. Available programs should be marketed to local producers along with adequate technical assistance during the implementation and application process.
- **Agricultural Marketing:** Reliable and appropriate markets for alternative crops must be established in order for many farmers to change planting strategies. As one producer cited in Knutson et al. (2001) stated, "We'll plant anything they want as long as there's a price for it." There is a realization that many of these related issues are decided at the federal level, but it was suggested that state and local planners can help ensure local markets, provide incentives, and increase their voice at the national level. A strong state voice is especially necessary for a state with limited agricultural production.
- **Insurance Research:** Insurance issues were also brought up by a number of South Carolina producers. They felt that their payments were not in line with their received benefits. In particular, concern was expressed that available insurance (and other drought assistance packages) were not enough to cover their operating expenses during drought years. This was especially troublesome during multi-year droughts where debts become cumulative. Additional research should be done to address these concerns.

- **Flexible Rental Agreements:** Landlords and tenants should work together to develop flexible arrangements that increase the viability of the land and operation before and during drought. Compromises must be met to create a sustainable farming community. "Floating" rate structures on leases are particularly useful agreements to reduce drought risk.
- **Community and Informal Support Networks:** Family, community, and church support is seen as essential in sustaining producers through periods of drought. Family counseling specialists and members of the clergy should be included in state and local drought planning and response efforts. The Nebraska documentary "The Farmers Wife" is a good educational tool for illustrating the pressures placed on today's rural farming/ranching families. Other states have also realized the benefits of implementing free mental health hotlines and counseling sessions during drought for addressing suicide, domestic violence, and general farm-related stress issues. These hotlines should also be expanded to meet the needs of other drought-affected groups.
- **Extension Services:** The state needs to work more closely with the extension services operating at Clemson University and South Carolina State University to develop and promote mitigation and response measures. These extension services reach stakeholders that may not be reached by DRCs.

E. Water Suppliers

- **Annual Meeting of Water Suppliers:** As recommended by several water suppliers, the state needs to coordinate an annual meeting of water suppliers. This meeting could be arranged as a two-day forum: the first day as a discussion about issues and problems, the second day focusing on solutions and recommendations. This may help stakeholders to develop a consensus on water issues, have more input into decision making, and enhance the acceptance of decisions made at the state level.
- **Mitigation Activities:** Mitigation activities should be continued by water suppliers to ensure adequate water supplies for their clients. Besides developing additional water sources, state interviews have highlighted the benefits of interconnecting water systems for emergency water transfers. Additionally, many water systems continue to use a declining water rate structure. Although these structures may provide incentives for attracting large water users and increasing water sales, they are counterproductive to water conservation efforts. These structures should be converted to increasing rate structures, at least during times of drought. Finally, successful drought mitigation efforts, such as the town of Landrum's activities, should be highlighted and modeled across the state. Examples of large water suppliers' success stories should also be promoted, such as those of the Spartanburg Water System and the Mount Pleasant Waterworks.
- **Local Drought Response Ordinances:** Lessons from Lexington, Spartanburg, Landrum, and Mount Pleasant show that municipal water systems were very happy with local drought response ordinance requirements from the state. They felt that the ordinances were a valuable tool for reducing local water use during drought. Water suppliers should adopt and implement a drought response ordinance as required by the South Carolina Drought Response Act.

F. Rural Water

State planning personnel suggested several areas of focus that may help alleviate rural water problems.

- **Increased Public Education:** It is believed that increased public education about basic water principles and local geology may help citizens play a more proactive role in their own water management. In interviews, people mentioned previous successful programs such as "Be Well Aware" and stated that similar promotional activities would be beneficial.
- **Low-Interest Loans:** Low-interest loans may relieve some of the financial burden in developing appropriate water sources not only during times of emergency but also in advance of a drought.
- **Development of Alternative Water Sources, Management Techniques, and the Continued Exploration of Funding Sources:** Alternative sources of water, such as community wells from high-producing areas and small impoundments, were given a high priority. Included in this discussion was the need for additional mapping of favorable development areas, enhanced water-related databases, alternative management strategies, and funding to carry out all of these activities. Water suppliers echoed this recommendation but highlighted the limitations placed on small rural water and municipal systems by EPA water quality regulations. The state, other organizations such as the South Carolina Rural Water Association, and rural representatives should work together to develop and promote solutions to water development limitations in rural areas.

G. Environmental Issues

- **Minimum Flow Requirements for Fish and Wildlife:** The number of complaints about the lack of in-stream flow regulations, or the enforcement of these regulations, indicates that this is an issue that the state must address. The South Carolina Water Plan (SCDNR, 1998) has clear guidelines as to minimum flows for the maintenance of water quality, fish and wildlife, and navigability, but there is no indication that these guidelines are being followed or enforced. Investigations need to be undertaken to look at this issue for the rivers and streams within the state in order to clarify laws and agency responsibilities, as well as to determine if the minimum flow recommendations for fish and wildlife are adequate and enforceable.
- **Addressing the Full Range of Potential Environmental Impacts:** South Carolina government agencies and environmental groups recognize many of the serious consequences of drought on plant and animal species within the state. Most of the concerns brought to our attention were focused on riparian and in-stream or lake habitats. Although these may be the primary interests affected, many wetland and non-aquatic environmental impacts may be caused by drought, such as modified wildlife migration and territorial patterns, increased human and wildlife contact, habitat and forage limitations, increased incidences of wildlife disease, and an increase in invading plant species. As pointed out by the National Drought Policy Commission (2000), the full range of environmental issues is often overlooked in drought management. Environmental issues must be more fully discussed in state drought planning efforts.

H. Forest and Timber Resources

- **Communication of Wildfire Threats and Infestation Outbreaks:** Communication to the public of wildfire threats (including media coverage and public service announcements) and infestation outbreaks by the South Carolina Forestry Commission is believed to have reduced the number of acres burned in 2000 to below-average levels, as well as aided in the management of the southern pine beetle outbreak. This work should be continued and modeled in other drought-affected sectors. It is believed that press releases from both the Forestry Commission and the State Drought Program increase public attention more than from either agency alone.

VI. Further Research and Revision

This study was conducted as a "snapshot" survey of South Carolina drought impacts and concerns. However, drought is a long-term phenomenon. Additional studies should be initiated to not only more fully investigate the issues brought up in this report, but also to monitor the state's long-term evolutionary drought impacts, mitigation, and response measures. These studies should be well documented to ensure the persistence of a state "drought memory," and dispersed throughout the state to foster a common understanding in regard to drought impacts and planning directions. The State Drought Response Program, relevant legislation, and plans should also be reviewed and updated on a regular basis to ensure their relevancy.

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