INDUSTRY AND DROUGHT -- TIME TO PREPARE FOR NEXT TIME

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Introduction

Compared to others, industrial users of water are not faring badly in the current drought. The only water resource region that lists even moderate effect for either publicly provided or self-supplied water for industry is in California. Nine of eleven regions (west of the 100th meridian) show severe effects in dry land farming; three are classified as severe, and five moderate, effects for irrigation. Municipal supplies are severe in three; moderate in seven. Hydropower is affected severely only in the Pacific Northwest but moderately in four others. Cooling water is of minimal concern everywhere. But even California has reported only 1000 persons unemployed as a direct result of water shortages.

Industry usually provides itself with water and takes care, in arid areas at least, that it has an effective margin of safety. Pulp and paper production and food processing are significant users, but production is more affected by drought reduced supplies of raw materials than it is by water supply. Navigation difficulties have been reported in the Lower White Arkansas River and in the Sacramento River, but other modes of transport have probably taken up the slack. Water is not a very large part of industrial costs -- 0.60 percent of gross income for steel and 1.95 percent for petroleum, which are two other high use categories. Nor is industrial use a very large part of overall use -- about 1.8 percent of total use in the affected regions. Thus, it has not been difficult, so far, in these arid areas, to insure that industry has the water it needs to sustain output and employment.

1/ A Work Group Report to the Workshop on Drought Research Needs and Priorities, October 14-15, 1977, Washington, D. C. Co-sponsored by Western Regional Drought Action Task Force, National Science Foundation, and the Institute of Water Resources of the U. S. Army Corps of Engineers.

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The forest industry stands to be most adversely attacked by drought, through increase of fire hazard conditions. Employment and income are seriously threatened. Recreation is also affected by drought due to the fire hazard phenomena, as well as reduced water value and snow cover for ski areas.

Perhaps the most important incentive for conservation in recent years has been compliance with water pollution standards. Many processes that reduce waste discharges are cheaper to carry out if the volume of water is reduced. Reuse is encouraged. Indeed, the very few past studies of industrial response to drought have shown that industry was able to save money when it sought out ways to save water.

But will the future be the same? Is drought the same for industry in arid areas as it is in humid areas? Have we confused aridity with drought in the past and thus not understood the significance of drought in non-arid conditions? Are the changes in water use technology, East or West, arid or humid, giving industry less resiliency to meet the next drought? Are the changes simply dealing with the present problem but not increasing the ability to be resilient next time? How do firms differ in their drought response from industry to industry?

If a major drought occurred in the humid East, what would the differences be like? Does the lack of a significant irrigation sector from which to "borrow" make a difference? What is the significance of the fact that storage per capita and runoff per capita are much lower in the eastern states? What is the significance of the fact that most of the people who are members of this work group are from the East?

It is the conclusion of this work group that future research on industrial drought problems should not be myopic with respect to the recent past. It is not clear that industry would fare as well in the next drought, particularly if that drought were east of the Mississippi.

Basic Data -- Definition of Drought Indicators and Indices

Apparently, there cannot be a universal indicator (definition) for drought. Drought is a use-related phenomenon. We feel there is a need to develop drought indicators (definitions, profiles and response scenarios) relative to individual industries. Examples are hydropower, navigation, thermal plants (cooling water), the various users of large amounts of process water such as pulp and paper, iron and steel, various chemical sectors, and those less directly affected such as forestry and recreation. To measure drought conditions in hydropower, we need to establish local limits of river discharge below which a plant cannot be operative. The same is true for navigation. We stress that drought for navigation/hydropower may occur at levels where other users are not yet affected. Similarly changes in ground water conditions need to be related to user problems. Thus, specifically for the industrial sector, the drought indicators are not only specific to the industry but also to the local conditions (as in navigation).

We suspect that many industries are not aware of the drought risk they face. Definitions of drought by industry should be fairly inexpensive and quick to do, yet revealing of more specific research needs of each sector. Such information should be useful in sensitizing each industry to its stake in further research and in public management of drought.

This may be the most important line of research in the near term as far as industry is concerned.

Basic Data -- Industrial Losses Due to Water Shortages and the Evaluation of Data Products

In the process of planning for the prevention of drought impacts it is highly important to have some qualitative basis, if not quantitative basis, for estimating the actual losses suffered by industries as a consequence of certain percentages of water shortages. Individual scattered reports of monetary losses have been reported, but they have not been tied in with the size or value of the firm or community suffering this reported damage, nor with the volume of water normally consumed.

Profiles of drought impacts and adjustments by industry (suggested elsewhere in this report) would provide an important basis upon which to evaluate the adequacy of data products now produced by the National Weather Service, the Geological Survey and others. Obviously, the design of physical data collection must respond to advances in our understanding of the inner logic of the physical phenomena. But in situations where risk has substantial economic and social consequences, the character of these consequences should be taken into account in the design of data collection and interpretive data products.

Basic Data -- Increased Quality Testing and Quantity Monitoring Under Drought Conditions

The data base sampling methods and analytical techniques for water quantity and quality, as presently established, is biased towards high flow conditions. From a use-based definition of drought, if the quality degrades during low flow periods (as it most likely does), then a need is established for increasing the water quality data base during low flow (drought) conditions. This condition, though common with other users, is probably more relevant to industrial users.

Current designs of water quality data collection produce very crude indicators of conditions. There is a high variance of the estimates of real conditions. Hydrologic conditions which affect the concentration of pollutants are rarely factored into sampling designs. Thus, the available data is rarely precise enough for effective management. Obviously, cost is an important factor. Thus, as suggested elsewhere in this report, an understanding of where increased precision would "pay off" in returns from user adjustment and adaptation must be stressed. We suspect that this is of greater significance for industrial users and in time of drought than for other users and at other times. Research is needed to find out which pollutant concentrations tend to increase during droughts and to find out what the best means are for improving conditions.

Drought Management -- Indices of Natural Flow Steadiness

For the purpose of streamflow firm-up and drought abatement, the irregularity of natural flow may be the most important factor. In some regions of the U. S. (or the world) only 20 percent of the average yearly flow volume may be required for reservoir storage to firm up the streamflow to 50 percent of long-term average flow, while in other regions 500 percent may be required.

At least for broad-scale regional planning of water resources, it would be highly useful to construct a map of natural streamflow regularity to aid in determining the costs of streamflow firm-up.

As a counterpart of investigating water shortage losses, the benefits derived from augmenting low streamflow through reservoir storage should be investigated, together with other environmental effects, positive or negative, of streamflow firm-up.

Substantial capability to insure flows during drought conditions probably resides in the existing network of federal reservoirs in eastern and western U. S.

Drought Management -- Broad Analysis of the Effects of Water-Saving Processes in Industry

Water-saving industrial processes have been sought and found in many cases where available water supplies have been limited. Research should be conducted on the side effects of these process improvements aside from quantitative water savings. Some questions to be answered are:

1. Do these processes lead to some reclamation of otherwise polluting substances, or do they result in higher and unacceptable concentrations of pollutants of some of the effluents?

2. Can the greater heat concentrated in the smaller volumes of industrial water be used beneficially to pre-process industrial materials, heat or cool buildings, or otherwise?

Drought Management -- EPA's Research and Drought

Research looking to the reduction of demands for water by industry should have a high priority in the program of drought research needs. Development of dry or contained industrial processes in lieu of present processes using large amounts of pass-through water could lead to drought resistant industries, and would have the concommitant benefits, in many instances, of reducing the discharge of pollutants into water courses and reducing total water demands. Approaches to the problem might be through looking at ways of reducing the volume of discharged pollutants, as contemplated by EPA in its issuance of regulations controlling industrial pollution, through tax or other economic incentives or disincentives.

Some industries have very good records in reducing water use, such as paper mills, some steel mills, and oil refineries. We might look at the reasons or incentives which stimulated such reductions, looking toward making them more generally used.

The monumental effort by EPA to produce guidelines for some 2000 different industrial groups provides a potential for further analysis of industrial water use technology. The close relation between quality and quantity concerns suggests that a cooperative arrangement with EPA should be fruitful in carrying out this line of research.

Policy Analysis -- Regional Organization for Drought

The river basin and the watershed probably continue to be the "natural" physical unit for public management. But political authority necessary for drought management is now and will continue to be found in units of general government -- local, state and federal. Like so many other aspects of water management, drought stresses the capacity of government to respond. Who identifies that there is a crisis? Who does what and when? Industry has a special stake in how these institutions evolve, especially in the process of "load shedding" that appears important in drought response management.

Industrial users are often self-supplied and the inter-relation of their supply to other supplies is not known to potential drought managers. Nor is the social and economic impact of reductions in use understood well enough to compare impacts between industrial groups or between industry and others. Even when potential drought managers have adequate legal authority, they may not have adequate real power.

Should river basin and watershed agencies be expected to be drought managers? If so, how can they develop adequate capacity to efficiently and fairly manage industrial water use? How is this related to other tasks for basin and watershed managers? If the hydrologic unit is not to be an organizational unit, then how will its potential as a management unit be realized with respect to industrial adjustment to drought?

Policy Analysis -- Changes in Exposure to Drought Damages in the Eastern United States

The eastern U. S. has enjoyed plentiful and reliable supplies of water, frequently available at relatively low cost without public subsidy. Although precipitation and streamflows are subject to wide variation, water supply systems have usually proved adequate to avoid shortages. Even where shortages have occurred, water use has displayed sufficient resiliency to avoid serious damages.

A number of changes and trends have occurred or will occur which may drastically increase the East's exposure to drought damages. First of all, increasing use of existing supplies reduces the ability of supply systems to prevent supply deficits. Past lower levels of use tended to mask the inherent variability in water source. Second, changes in the nature of water use may be acting to eliminate "slack" in water use, thus increasing the damages that would result from any given shortage. Past shortages, rising real cost of water and effluent restrictions have combined to increase recycling and decrease low value uses by industrial users. Rising real costs and changing housing patterns have reduced the most elastic residential uses of water (lawn irrigation, eg.), greatly reducing the effectiveness of use restrictions.

Research is required to:

1. Determine whether increased use can be expected to significantly increase the frequency of water supply deficits in the East.

2. Determine whether changes in the resiliency of water use have increased, or are likely to increase, damages which would result from future water supply shortages.

Policy Analysis -- Effects of Water Law Structure on Water Allocation Resiliency

Eastern water law formulation may be so inflexible that during periods of drought one consumer sector may not find it possible to purchase water rights which another sector may well be willing to give up temporarily if the price were right.

Research could be done on steps taken by some industries or municipalities in acquiring water in the East, versus seemingly unsurmountable roadblocks encountered by other groups.

Certain eastern states including Kentucky have introduced a withdrawal permit program for industrial and municipal systems. This allows a data base of use to be established and the potential to manage shortage during deficiency periods.

Comparisons with western institutions should be instructive. Not only is the law of property in water different but institutions for short and long term transfers are more highly developed. Observation of actual experience could be critical. In other words, a law library study is not what we have in mind. For example, note that the "de facto" rights to water in the East operate in a paucity of agencies that actually monitor self-supplied use, much less allocate water in times of stress. Downstream users are not accustomed to protecting their rights, leaving open the possibility that upstream users take more than their "legal" share in times of shortage. Real riparian rights may be quite different from the "dejure" rights.

Policy Analysis -- Incentives for Investment and Conservation

Industrial uses of water, much like municipal systems, are usually expected to pay their own way and not to need or deserve public subsidy. In general, we suspect that this attitude has served the nation well in the past and will continue to do so in the future as an overall policy guide. But it may be useful nonetheless to examine some circumstances in which the incentives which this policy produces fail to adequately serve the public interest. In particular, when would it pay to provide drought reserves for industry that industry doesn't find worth doing on its own. And when should government provide incentives for industry to release supplies in time of drought, that from the point of view of the firm would not be worth releasing under present market arrangement?

One example is the western ski industry and its impact on regional employment. The ski centers may underinvest in snow making capacity when only their direct profits are considered. In other words, the impact on the regional economy of a lack of snow may justify community sharing in the cost of snow-making capacity.

Load shedding in a drought striken watershed may be facilitated by assuring beforehand that some costs will be compensated. In some urban settings, for example, municipalities have found it cheaper to replace lawns at public expense than to pay for the normally idle capacity to provide water for lawn watering in a drought. We suspect that an industry-by-industry analysis of drought impacts and adjustments would reveal similar opportunities for social cost savings.

Much like the function of fire insurance companies in providing fire risk inspections and requirements for coverage, drought management agencies could do likewise with respect to water conservation. Many industries -- we suspect particularly in the East -- turn attention to conservation only in time of drought. The horse may already be gone. Shutting the barn door early may require more vigorous action before the drought, including technical assistance and appropriate incentives.

Policy Analysis -- Strategies to Improve Research Utilization

The key management people in industry generally do not read research reports nor articles published in the technical literature, even though many of the findings would, if applied, be very helpful. Contributing problems probably include reports being too technically sophisticated or too basic for industrial management to recognize the value to them, and industrial management being too preoccupied in other matters to keep abreast of more difficult material.

If drought research is going to be applied by industry, special effort will be necessary to transfer the results to industrial users. This will require some analysis of how industry absorbs innovations outside the normal scope of its production technology and of the factors motivating or working against such adoptions. For example, regulatory agencies with other missions -- such as water quality -- may be effective vehicles to encourage conservation. A technology transfer method should be designed to do the best possible job of communicating to industrial management while providing a feedback function to researchers. The method should be biased toward those managers who most need to change their practices for the public benefit, and the priority given this research should depend on the importance of revising industrial practice to improve water management during droughts. The role of consulting firms as cost-effective vehicles for technology transfer to industry should be carefully evaluated.

Summary

Predictions of hydrologic drought are hindered by adequate data and analysis. Improvements will depend upon research that moves in two directions. First, the physical phenomena in low rainfall periods must be better understood. Second, and at least as important, the institutional and management requirement for data must be linked to the designs for collection and data product generation.

Definitions of drought by industry are needed. These will identify the stake that each industry has in problem-solving research and institutional development. The Environmental Protection Agency's recent development of guidelines for water quality technology provide a major shift in water quantity parameters as well as a basis for drought definition research. Changes in resiliency potential should be a major focus particularly in the humid East. Case studies of industrial adjustment to drought in the East as well as the West are called for.

The relationships between self-supply and public management institutions are in need of more careful examination. Orderly transfer of water from low priority uses to high priority uses in times of drought will require more effective organization by watershed and better understanding of the reality of water rights.

Technology transfer with respect to industry appears to require organizational mechanisms not now in place. The analogy with the extension service in agriculture is tempting but may be too superficial. What are the incentive changes that are needed to accompany technical assistance? What are the existing processes by which such technology is adopted in industry?

Indeed, who are the industrial clients for improved drought management?