TESTIMONY OF
HENRY VAUX, JR.
University of California, Berkeley
on
THE NATIONAL WATER RESEARCH AND DEVELOPMENT INITIATIVE ACT
House Committee on Science and Technology
U.S. House of Representatives
March 4, 2009

Mr. Chairman, my name is **Henry Vaux, Jr**. and I am Professor, Emeritus of Resource Economics at the University of California, Berkeley. I am also Associate Vice President, Emeritus of the University of California System. I wish to thank you for the opportunity to appear before your Committee this morning at this hearing on the proposed National Water Research and Development Initiative Act.

At the outset, I should state that I was the Chair of the National Academy Committees which created two of the reports referred to in Section 2 of the proposed Act. These reports were entitled: *Envisioning the Agenda for Water Resources Research in the 21st Century* and *Confronting the Nation's Water Problems: The Role of Research.* Although I do not formally speak for the National Research Council most of my testimony is based on those analyses and on the recommendations contained in the second of these reports (hereinafter identified as "NRC Committee Report").

The Need for New Water Science

Although our nation faces many difficult challenges in this first decade of the 21st century, the challenge of husbanding and managing our water resources is a long-term challenge that will be with us over the remainder of this century. Water scarcity will continue to intensify.
Our water supplies are basically finite although their occurrence varies over time. Long term observations of precipitation and run-off suggest that hardly any year is an average year. The extremes of flood and drought recur periodically and there is evidence to suggest that these extremes will become more frequent. There is also evidence to suggest that for many regions of the United States, the advent of climate change may entail some general decline and changing in the timing of precipitation and run-off. Continuing deterioration of water quality will also mean less water available for many important and valuable uses. Reversing the trends of water quality declines and enhancing the aggregate level of water quality in the U.S. will be necessary to avoid further erosion in the quantities of available supply. The general water supply picture that emerges for the future suggests water supplies will be less available then they were in the past. There is less likelihood that they would remain stable and virtually no possibility that they could be made to grow.

Arrayed against such declining (or static) future levels of water supply are a number of factors which suggest that the demand for water may grow. These include:

- **Population Growth** - Some estimates suggest that U.S. population may grow by as much as 50% between now and 2050. Taken alone, a population increase of such magnitude will cause significant increases in the demand for water.

- **Expansion of Irrigated Agriculture** - The need to feed an increased domestic population as well as a global population that is projected to be 3 billion larger by the end of the century will be translated into growing demands for agricultural water everywhere. Though rain fed agriculture will play a very important role, there will be pressure to expand irrigated agriculture because it is more productive. In the U.S., for example, about one-third of the farm land is irrigated and that one-third accounts for 45% of the total production.

- **Protecting the Environment** - Past water development practices have entailed the transfer of water from environmental uses to municipal, industrial and agricultural uses. It is unlikely that this practice can continue for long without incur major and highly costly damages in the form of lost environmental services and reduced environmental amenities. There is some evidence to suggest that we may have to allocate more water to environmental purposes - not less - if we are to protect environmental services and amenities.

The trends of growing demands and static or declining supplies of water mean that water scarcity will intensify over the coming decades. As a consequence, competition of limited supplies of water will intensify and conflicts over the allocation of available supplies will also increase. Professor William Jury and I have recently completed work concluding that the ease or difficulty with which we adapt to this intensifying water scarcity will depend critically upon our willingness to invest in additional science. Properly focused, such an investment will considerably help identify ways to ameliorate water scarcity and reduce conflict over water allocation and use.

The State of Federally Funded Water Research

Today, the annual federal investment in water resources research is approximately $700 million in constant 2000 dollars. This figure is the same in real terms as the annual federal investment in water research in FY 1975. Thus, we face an intensifying water scarcity in circumstances in which there has been little change in the magnitude of federal water research funding over the past 35 years. In other words, support for water science has not kept pace with population growth, growth in gross domestic product or growth in federal budget outlays for at least the last four decades. This has occurred despite the fact that the productivity and value of water has increased even while the challenges of managing limited waters effectively and efficiently have grown.

The topical balance of the federal water research portfolio has changed significantly since the period 1965-1975 in ways that make it inconsistent with today's water research priorities. Specifically, research on water demand, water law and other institutional topics and research on water supply augmentation and conservation currently receive a smaller proportion of total water research funding then they did 30 years ago. The NRC Committee concluded that these topics currently appear to be underfunded. In addition, the current water portfolio is heavily weighted toward short-term research. Longer-term research, necessary to help address the water problems of the future and to help support the applied research that will need to be done a decade hence, is significantly underemphasized in agency water research budgets. For all of these reasons the NRC Committee concluded that we are obtaining less for the annual $700 million in federal water research than we should.

The major explanation for this state of water research is not necessarily that the funding is inadequate. The explanation lies more importantly with the fact that federal research is largely uncoordinated. This means that the President and Congress lack information about:

- **The size and shape of the entire federal water research portfolio;**
- **Measures of magnitude and effectiveness of individual elements in the portfolio;**
- **Any sense of national priorities of water research;**
- **Guidance about what might be an appropriate balance among research elements.**

The proposed legislation from the National Water Research and Development Initiative would, if enacted in its present form, create a strong and appropriate basis for addressing the problems that currently characterize the nation's water research efforts. It accurately captures a number of important recommendations found in the report of the NRC Committee. Thus, for example, the legislation would:

- **Require the establishment of a unified national water research agenda;**
- **Require coordination of water federal research, development, data collection and information dissemination activities;**
- **Encourage cooperation among federal agencies engaged in water research and technology development;**
- **Require technology transfer, communication and information exchange with State and local governments, industry and other stakeholders;**
- **Establishes an appropriate institutional arrangement, including a requirement for budget coordination in the Executive branch, for accomplishing these four tasks.**

A further strength of the proposed legislation, as written, lies with the emphasis on the collection, management and exchange of data on water resources. The last two decades have been characterized significant disinvestment in the acquisition of water and water related data. We have fewer stream gauges now than we did 20 years ago; our monitoring and measuring of water quality is less adequate now than it was 20 years ago even though the threats to water quality

have grown; and we are unable to measure water use adequately over time. There has been a notable failure to take full advantage of modern remote sensing technology to acquire water resources data. In addition, there has been little coordination or standardization of existing data gathering efforts with the result that we are getting less from those efforts than we could be getting. Without more coordination and investment in gathering, managing, and interpreting water resource data, both management efforts and needed research will be less effective than they might be.

Recommendations for Improvement

While the legislation as written has significant strengths, there are a number of ways in which it might be further strengthened:

- ***Additional Funding:*** First, there are a large number of federal agencies that undertake water resources research. Those agencies are more likely to behave productively in pursuing the objectives of the legislation if additional research funding were to be authorized and the availability of that funding made contingent upon the various requirements contained in the Act.
  The concern here arises because the Interagency Committee authorized by the Act is not dissimilar from the Water Resources Council authorized by the Water Resources Planning Act of 1965. As the record shows, the Water Resources Council was largely ineffective as the member agencies focused on protecting their own turf and on little else.

  The NRC Committee suggested that existing levels of federal investment in research might be adequate if the research portfolio were altered to place more emphasis on topics such as conservation, water supply augmentation and the development of institutions for managing water resources. Alternatively, the Committee suggested that additional funding on the order of $70 million might be made available for the purposes of rebalancing the research portfolio. Those funds could also defray the operational costs of the Interagency Committee and provide incentives for productive interaction and coordination among the agencies that conduct water resources research.

- ***Additional Research Outcomes:*** The list of Water Research Outcomes in Subsection 2(c)(2) is reasonably comprehensive. However, a ninth category needs to be added that emphasizes the need for research on the development of water management institutions. This is critically important research area that has the potential to develop institutions which will facilitate the management of scarce water resources more efficiently and effectively in the future. This area has been identified as underfunded. Indeed, in recent years the level of federal funding for the social sciences needed to aid in the development of improved water institutions has not been significantly different from zero. The legislation would be considerably strengthened by acknowledging the importance of social science and institutional research. A tenth category focused on understanding the

hydrologic and water use implications of climate change should also be added.

- ***Emphasize Modern Research Themes:*** Just as it is important that all significant outcomes are included, it will also be important to acknowledge in the body of the bill, the importance of new modes of research. The report of the NRC Committee on the role of research emphasized that future water research should be carried out of necessity in modes different from the traditional reductionist mode which typifies most research over the last century. The Committee identified four modern research themes: 1) an interdisciplinary approach; 2) a broad systems perspective in the conduct of the research; 3) acknowledging and characterizing uncertainty; and 4) the importance of being adaptive. These should be acknowledged in the bill.

- **Interdisciplinary:** The need for interdisciplinary research has been widely recognized in the scientific literature. Indeed, it appears unlikely that an adequate understanding of the environmental importance of water can be developed in the absence of involvement of scientists from a number of disciplines. Thus, for example, research on aquatic ecosystems must be based on ecological and biological principles as well as the science of hydrology and an understanding of how human use transforms the quantity and quality of water.

- **Broad Systems Context:** A systems approach requires not only that the variables which contribute to a problem be identified and understood and that the linkages between these variables must be understood as well. Indeed, understanding the linkages between causal variables are now thought to be just as important as understanding the variables themselves.

- **Uncertainty:** Scientific information and the results of scientific investigation can rarely be expressed with complete certainty. Virtually every data point and virtually every finding is characterized by some degree of uncertainty. In the future, it will be incumbent upon researchers to acknowledge the existence of uncertainty and, where possible, characterize the extent of it quantitatively.

- **Adaptation:** Adaptation can be conceived as a combination of flexibility in solving problems and a willingness to shift norms and standards in response to novel circumstances and situations. Adaptation will be critical for both water researchers and managers in the coming decades as we confront water problems for which there has been no historical experience.

The proposed legislation could be strengthened by acknowledging the importance of these four themes in the framing and conduct of research. Their use cannot be mandated but agencies will need every encouragement to abandon traditional approaches to research and emphasize more modern approaches that are likely to be more acceptable.

Involve the Academic Community

A final suggestion for improvement in the legislation is based upon the need to involve academic researchers in the efforts called for in the bill. The academic community has played a large role in water research and will continue to do so in the future. Moreover, there is need to expand the proportion of long-term and investigator-initiated research in the national portfolio. The academic community is better situated to perform longer term research since it is not tied to the operational missions of the agencies which tend to result in research agendas focused on more immediate short-term problems. There are several ways in which the academic community might be involved. Perhaps the most straightforward way would be by including the broad array of water resource research activities at the nation's land grant Universities directly by identifying a role for the Water Resources Research Institutes, most recently reauthorized in the Water Resources Research Act Amendments of 2006 (P.L. 109-471). One or more Water Institute Director representatives should be authorized to serve on the InterAgency Committee created in Section 2(b) either *ex officio* or as regular members. This addition would be especially important since it takes advantage of established relationships between the federal government and the academic water research community. In this way all of the major actors in the water research community would be directly involved in the activities of the Water Research and Development Initiative Activities that would be authorized by this legislation.

In summary, then, I believe the proposed legislation to be a significant step forward. It would address the need for new and productive water research. It would provide a mechanism for establishing priorities and ensuring the results and data are fully shared and disseminated. The legislation could be strengthened by: 1) authorizing new funding to support the coordination and agenda setting activities as well as new research; 2) including the social sciences and the development of institutions as well as climate change in the research outcomes; 3) specifically acknowledging four modern water research themes in the legislation; and 4) including academic researchers and the academic community in the research and development initiative.

Mr. Chairman, I wish to thank you again for the opportunity to appear this morning and to state my views on National Water Research and Development legislation.