Water for World Development

Proceedings of the VIth IWRA World Congress on Water Resources

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Volume I

Summary, Special Sessions, Training and Education

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Preface

Every three years, the International Water Resources Association (IWRA) invites delegates from around the world to assemble and talk about water, especially about major water issues. These delegates come from a wide variety of disciplines and from an even wider international audience, all of whom share a common concern for the future of the world's water resources. They come to encourage cooperation between disciplines and nations, and between other organizations involved in water resources fields. They also come to take new knowledge back with them to their homelands. IWRA takes pride in being one of the few organizations that draws together people from the widest possible range of disciplines and nations to focus attention on water management – so vital for the quality of life, development, and industrial expansion.

Previous IWRA congresses were held in Chicago (1972), New Delhi (1975), Mexico City (1979), Buenos Aires (1982) and Brussels (1985). The VIth congress was held from May 29 to June 3, 1988, in Ottawa, Canada. This congress attracted 812 delegates from over 80 countries.

Organizing an international congress requires considerable planning. Preparations usually begin four to five years earlier. For this congress, the Canadian Committee of IWRA presented a formal prospective to the Executive Board of IWRA during the Vth congress, which was held in 1985.

In deciding upon the theme for this congress, the planning committee considered the many water programs that had been initiated in past decades. The committee examined these programs and, unfortunately, saw many failures. The world had made little progress in bringing clean water to all the earth's people. Furthermore, environmental restraints were being voiced on many new large developments. Consequently, the planning committee for the VIth congress believed it was time to reexamine the world's water situation and consider the role water can play in sustainable development.

The congress was organized around eight main topics: training and education; hydrology and groundwater; climate; energy; agriculture, irrigation, and drainage; environment; water supply; and socio-economics. This volume contains the papers presented during ten additional special sessions and during the sessions on training and education.

The sessions on *Training and Education* evaluated the fundamental worldwide problems associated with water resources training and education from one or more of the following perspectives:

Donor countries and agencies

International agencies and their roles

Recipient countries and agencies

Other papers focused on either different approaches required for different levels of education and training – that is, professional, technical, and less skilled – or on where such education and training should take place. Authors were asked to draw on their personal experiences to help answer the questions of where donor emphasis should be placed in training, and whom the training should serve.

The overwhelming conclusion from these sessions was that effective water resource activity requires skilled human resources, which in turn depend on appropriate education and training programs.

Organization of the Proceedings

The response to IWRA's call for papers was overwhelming. The congress abstract review committee received over 400 abstracts from more than 70 different nations. From this wealth of material, the committee selected the roughly 350 papers that were presented at the congress.

Although IWRA would have liked to publish all of the material presented at the congress, necessity required that the organization place three stipulations on inclusion in the proceedings. The first stipulation was that the author supply IWRA with a camera-ready copy of his or her paper prior to the start of the congress so that the paper could be reviewed by either the topic coordinator or a reviewer. Any changes to the papers based on the reviews had to be submitted within 30 days after the congress. The second stipulation was that the author share in the cost of publishing the proceedings by paying his or her congress registration fee. Last, the author was required to be in attendance at the congress to present the paper. If any of these conditions was not met, the author's paper was deleted from the proceedings. The latter stipulation was waived by the Congress Organizing Committee in cases of illness or extenuating circumstances.

Four papers were withdrawn from the proceedings to be published in *Water International*. These include the Chow Memorial Lecture delivered by Vujica Yevjevich and the three major keynote speeches, which were presented by Margaret Catley-Carson, President of the Canadian International Development Agency, Ivan L. Head, President of the International Development Research Centre, and Mostafa K. Tolba, Executive Director of the United Nations Environment Programme. In the end, 277 papers were published in the four-volume set.

The proceedings were organized according to the eight topics used by the congress, with an additional section containing a summary of the congress and papers from the special sessions. For the most part, the papers in the proceedings were published in the same subject area in which they were presented during the congress. However, there were a few exceptions. A handful of papers were presented in sessions on topics different from those for which the papers were designated by the Congress Organizing Committee. This change was usually made for logistical reasons. For example, W.J. Brown's paper on rural water supply and sanitation was designated as belonging in the sessions on water supply (A7), but because of a shortage of space in these sessions, Brown's paper was transplanted into a session on environment. In the proceedings, however, Brown's paper appears in its rightful place along with other papers on water supply.

This one and other errant papers were returned to their proper subject categories so that any one ordering individual volumes from the set of proceedings could be certain to receive all of the papers published on a particular subject area.

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Volume I
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Environment

Topic Coordinators
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Contents

II. Training and Education

Water for World Development: Summary of VIth IWRA World Congress on Water Resources

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INTRODUCTION

Mr. President, Mr. Chairman, Esteemed Colleagues, Ladies and Gentlemen--Good Morning. During this week, more than 650 delegates from 71 nations have come together to discuss water for development. We are diverse, we are hydrologists, engineers, lawyers, social scientists, and natural scientists. Some of us are diplomats, some of us are policy officials, some of us are from the private sector, some of us are academics--all of us are vitally concerned with water, development and people. This week we shared our concerns formally, in 50 technical sessions, 12 special sessions, plenary sessions, and informally at wonderful lunches, dinners, receptions, and in the halls of this congress center. Our dialogue has been rich. My task is to briefly capture this richness in the next 30 minutes.

Obviously, none of us experienced this congress in exactly the same way. We attended different sessions, talked to different people, and discussed different aspects of our topics. My challenge is to paint for us a whole picture of the congress. To paint this picture, I have relied on our committee chairpersons. Throughout the week, each chairperson assessed the major issues of their sessions. I have used these issues to create this picture of the 6th World Congress. Our chairpersons performed superbly--they deserve our appreciation.

I will unfold our picture in three steps. First, let's take a random look at some of the more fascinating anecdotes from throughout the week. Second, I will review general themes which I have discerned from the obvious overlap of the most important issues which emerged. Third, I will review some of the major issues raised in 8 topic areas in our 12 special sessions.

Anecdotes

During the week, I asked myself, how would a non-water resource professional look at our congress? What would they think we are saying? How would we describe what we are saying? As I answered these questions, I found myself turning to specifics or anecdotes which I have heard during the week, rather than creating eloquent generalizations. So let's begin our picture with some of these interesting anecdotes. Let's take a minute and listen to ourselves. During the week we heard that:

- Drought in East China during the 1960s through 1980s could be related to drought in India and the Sahel.
- Saudi Arabia has easily extracted ground water reserves sufficient for 320 years--but Saudi Arabian ground water is really a nonrenewable resource because only 5-10 percent is rechargeable.
- A Yugoslavian ground water program to collect karst water in galleries supports a 25 million man-day tourist business--which is also a main source of foreign exchange.
- Water stresses in Africa are beyond the point where food production can be sustained.
- Irrigation systems in engineering are not new. Ancient civilizations had remarkable knowledge and expertise in irrigation systems.
- Greenhouse gas warming could lower the Great Lakes by 10-30 percent.
- Possibilities exist for reverse technology transfer in water supply, North America may be able to use innovative techniques from developing countries.
- A draft treaty--the Bellagio draft--has been developed for managing international ground water. It includes water quality, water quantity, drought management, planned depletion, and transboundary transfers of allocated waters.
- By the 1990s, water, and not oil, will be the precious liquid in the Middle East: water, and not oil, is more likely to cause conflict.
- Floods and droughts have always been with us and are likely to continue. They may even worsen as population increases and as our standards of living increase.
- The Brundtland Commission did not go far enough. Two-thirds of the African population is exposed to water scarcity vulnerability; IWRA should help arrest such water illiteracy.
- More than 40 percent of the world's population live on rivers that cross national boundaries; indeed, most major river systems which are not developed, cross national boundaries.

- During the UN decade, 300,000,000 additional people have been served with water and 180,000,000 with sanitation.

- One-half of sub-Sahara Africa live in absolute poverty and 3 out of 4 people do not have potable water.

- One-half of the world still does not have access to good water.

- Environmental quality is becoming an issue of international security. There are cases where revisions of norms and design criteria can reduce costs of sewage systems by 50 percent.

General Themes

These statements give us a snapshot of the diversity, scope, and richness of our discussions. Now, let's turn to 18 general themes which I have discerned from our deliberations. These have been constructed from what I heard through the filter of our chairpersons. They are not in any order of importance.

1. The need to better manage and resolve disputes and conflicts arising in water resources developments at local levels, within countries and among countries. Such conflicts and disputes are arising from among other reasons.

    - Clashes of water use
    - Clashes of values held by people using water
    - Quantity vs. Quality
    - Clashes even among experts such as ourselves
    - Climate changes
    - Project operations
    - And, others

We should apply the lessons of the new field of alternative dispute resolution (ADR) to water resources conflicts.

2. People in communities must be involved in planning, designing, implementing, and operating water development projects. This means:

    - More power sharing among interests and between the publics and experts;
    - Creating a broader sense of ownership among implementors and users of water development projects.

3. Since water does not follow political boundaries, the geographic perspectives of river basins often conflict with the political

perspectives of jurisdictions. This clash occurs both within and among nations and we must find better ways of managing the tension between these perspectives.

4. Water resources development can be an important "entry point" in societies to help solve broader social problems. Water can provide the opportunity for dialogue; water can bring people together.

5. Water resources development must seek sustainability of projects. Sustainability depends on, among other things: attitude changes of traditional, technical people and engineers; community participation; cost recovery; institutional arrangements; and other activities.

6. The institutional arrangements which guide, plan, manage, and operate water resources development are often inadequate; new ideas and models are needed.

7. Non-governmental organizations (NGO) are crucial to successful water resources development.

8. Water resources development is becoming more interdisciplinary; for example, we need to include microbiologists, climatologists, social scientists, and others.

9. Cost recovery and who pays are becoming more explicit considerations of projects; but self-financing has pros and cons.

10. Data in models must be used cautiously; models must be appropriate to situations and reflect political, cultural realities, and the limitations of data.

11. Women must participate and assume leadership roles in water resources development projects.

12. Tensions exist over scale of projects; between large or small projects; between complex or simple technologies; and between interbasin transfer approaches or localized approaches.

13. Tensions exist between philosophies of approaches: Do we manage the natural system through structures or the human system through behavioral changes? Do we move people to water or water to people? And, How do we decide?

14. While our water stock is fixed, the deficiency problems stem from distribution of the stock. This includes distribution of rich to poor; within poor areas and even within rich areas such as North America and the USSR.

15. We are moving into an era of management, not just development concern. This means increased importance of operations, maintenance, reallocation, decommissioning, and rehabilitation issues.

16. Water resources development must accommodate the complex forces of social change in transformation such as:

    - o Expanding time or what is called future shock.
    - o Spacial reduction or what we call crowding.
    - o The growing awareness that we live on "one" earth.

17. Once again, the importance of training, technology transfer, and education are continually reaffirmed.

18. It is not clear how much and where privatization is appropriate in water resources development.

Now let us turn to a review of our 12 special sessions in 8 topic areas.

Review of 12 Special Sessions in 8 Topic Areas

During the week we participated in 12 special sessions: International Aquifers; Water, Peace, and Conflict Management; Water Law and Administration as Management Tools; Water Strategies for the 21st Century; Sustainable Water Development; Natural Hydrologic Hazards; NGO's Grassroots Action Program in Developing Counties; UN Water Decade; Management of River Basin Systems; Time-Cost Delays and Improvements in the Implementation of Water Resources; Large-scale Water Transfers, and Water Resources Management in the USSR. During these sessions, we learned that there is little experience in managing transboundary ground waters, even though the pressure on use of these ground waters is growing. Overcoming anticipatory fear is crucial in the initial stages of negotiation over water resources development.

Our NGO session clearly stated that NGO's must control their own funds. We also learned of the growing cooperation of NGO's in the developed countries with NGO's in the 3rd world. Once again, the need for better hydrologic data collection to aid 3rd world countries was cited.

The experiences of special district governments for water in the western US may be very useful for other countries; however, ground water law is moving slowly toward regulation including conjunctive use in most parts of the world.

During our session on the UN, we were challenged with the questions: Is there a water crisis? If yes, what can we do about it? What is the most important way to use this planet's water resources? We found cause to be optimistic because we have made progress. We know where we are going and that the networks are in place. We also learned that the future will emphasize: partnerships; community participation; participation by women; new cost recovery mechanisms; simpler technologies; affordable technologies; participation of the private sector; new disciplines; integration of sanitation hygiene; and, awareness of past mistakes.

For the 21st century, strategies are needed to alleviate immediate problems in areas that have almost collapsed, but these strategies need new visions based on broader perspectives. New institutional arrangements are required. We need models of administrative-legislative solutions for arid and semi-arid areas, to find ways for stimulating attitude change and to stimulate integrated approaches to land use. Once again, we are reminded that the 5th World Congress in Brussels proposed a water attitude regional network within IWRA. Such a network could warn people of the dangers of water shortages. Such networking has yet to be fully enacted within IWRA.

We also noted the need to reduce time to construct. The "appropriate technology" concept can be used for modeling; that is, models must be appropriate to our cultures and situations. Finally, large-scale transfer schemes, both in North America and in the USSR, are proceeding slowly. They are expensive and emotionally charged.

Specific Topic Areas

In addition to the special sessions, we met in 50 technical sessions which covered 8 topic areas: socio-economic; environment; hydrology and ground water; agriculture, irrigation, and drainage; climate; water supply; education and training; and, energy. In addition to several of the points already mentioned, our socio-economic topic area discussed the inadequacy of our methods of evaluation. While economic methods of evaluation provide values, they are not necessarily adequate. For example, we could begin to use more biophysically-based measures.

Discussions in this session also talked about the relationship among analytical planning outputs and political actions. How can planning generate political action? Are there better ways to formulate alternatives and to generate a broader range of alternatives? New developments in using optimization models and micro and mainframe software for socio-economic analyses were discussed. We reaffirm the importance of capacity issues and of water marketing and pricing. It was noted that care must be taken in self-financing of projects. Operating reservoir draw-downs were noted to have unequal impacts; indeed, government investment and irrigation often aims to stabilize rural populations to avoid urban overcrowding. Secondary effects of water projects were once again noted as extremely important development.

During our discussions on environment, the need to look at viruses as a source of pollution was identified. Microbiologists must communicate with the water community. Research and development is needed in this area. IWRA could sponsor workshops among the water community and microbiologists. We learned that environment transcends national boundaries. The question is how to resolve multi-national disputes and to satisfy various interests. Once again, we asked who will pay for the degradation. How much should infrastructure be privatized? The session also pondered numerous technical questions such as: What is the capability of successful runoff transport models to handle different sediment sizes? Would a pyramid below culverts interfere with fish and migration? How could ocean outflows work as low-cost waste treatment?

In the hydrology and ground water section, we learned of the increased sophistication of data which allows the use of more complex models. On the other hand, we heard that simple models can also be effective, especially where seasonal variations are highly predictable. Research programs in countries as diverse as Mexico and Germany were also discussed. We learned that human intervention causes measuring problems in stream flow data used for operating systems. This section also examined optimization models used for water supply which could improve availability by 10 percent in Kracow, Poland. During these sessions in this topic area, we discussed the need to go back to physical hydrology, geomorphical analysis, unit hydrographs, and regional analyses. We discussed how observed frequency distributions compared to the generalized gamma distributions. The high cost of installing hand pumps in developing countries was also raised.

In contrast to the hydrology topic area, discussions in the agricultural irrigation and drainage sessions found it dangerous to rely too heavily on models. The use of models for crop water requirements in canal simulations were discussed. The application of small-scale solutions, especially in the Sahel, were suggested. The complexity of using irrigation to ease drought, because of political and technical clashes, was described. We noted that water rights conflicts demand multiple agency approaches. Contamination by pesticides was called a time-bomb ready to explode. We also learned that drainage policies clash with wetland and wildlife preservation. We heard of ground water contamination cases due to overuse in the United States, Saudi Arabia, and Canada. A warning was issued for adopting micro-irrigation methods in certain parts of Canada. Policy changes that affect irrigation cost can have unexpected affects on production and other rural development policies. Finally, the session discussed trickle irrigation.

Climate was a new topic for our world congresses. Discussions in this topic area focused on the need for more data, more measurement, better information exchange, and networks for sharing forecasts. Better user surveys were suggested as a way to achieve these goals. Climate vulnerability needs to be factored into water resources design, planning, and management.

The differences in perceptions in how Canadians and the U.S. citizens view acid rain were described. The Great Lakes management strategies must be flexible enough to deal with both the lower and higher-level lake scenarios and that shore line management may be the best way to achieve this. Discussions in this session also talked about how better management strategies in small-scale irrigation can mitigate effects of the magnitude of the 1936-1937 droughts. We heard about cases in Kenya and Sudan.

As to be expected, the effects of CO_2 enrichment were described. Climate changes will clearly produce new conflicts. Hydrologists must participate with climatologists. Finally, selling of irrigation water rights in the U.S. and its effect on ground water, not included in those rights on water allocation, were discussed.