

- PN-ABS-429 ism 90002

**FUTURE DIRECTIONS
FOR IMPLEMENTING WATER POLICY:
REPORT ON A USAID-SPONSORED WORKSHOP
APRIL 28-29, 1994**

ISPAN

IRRIGATION SUPPORT PROJECT
FOR ASIA AND THE NEAR EAST

ISPAN

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FN-ABS-429
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Bureau for Asia and the Near East
U.S. Agency for International Development

July 1994

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IRRIGATION SUPPORT PROJECT
FOR ASIA AND THE NEAR EAST

Sponsored by the U.S. Agency for International Development

Irrigation Support Project for Asia and the Near East
Contract No. ANE-0289-C-00-7044-00, Project No. 398-0289 ✓
-serving the Bureau for Asia and the Near East
U.S. Agency for International Development
Washington, D.C. 20523

SUMMARY

Water is one of the most important sectors in most developing countries. Current common problems include shortages of and competition for water, degradation of water quality, and policy and institutional weaknesses. A workshop held at College Park, Maryland, examined measures that might be taken by Asian and Near East countries and their external support agencies to ameliorate such problems through demand-side changes.

Five topics were selected for discussion within the general area of resource sustainability. The topics were water-user associations, tradable water rights, pricing and cost recovery, wastewater reuse, and industrial wastewater minimization. These topics are either areas of current active study about the potential for improving sustainability or approaches seen as having such potential.

Participants included staff members of bilateral and multilateral donors, voluntary organizations, foundations, universities, and consulting firms as well as individual consultants. The workshop brought together professionals from various water sector backgrounds and produced consensus on some issues and approaches. On some matters, however, views diverged.

On water-user associations: To foster sustainable organizations, enabling legislation must allow water-user associations to adopt multiple functions rather than be restricted to water-based activities. As a corollary, line agencies will require organizational and procedural changes to respond to user management.

On tradable water rights: The key potential constraints to implementation of water allocation by markets in transferable water rights are institutional and technological. Establishing markets in tradable property rights does not imply free markets in water. Rather, a workable system would be one of managed trade, with protection against negative third-party and environmental effects. Several countries are implementing such systems. Further study and pilot projects are needed before the potential of these approaches will be known.

On pricing and cost recovery: Practitioners in the agricultural and urban water sectors expressed different views on the benefits and feasibility of managing irrigation water demands through pricing. While experience in irrigation has not yielded a practical and sustainable way to manage demand through pricing in developing countries, urban experience shows that water demand can be strongly price responsive, contrary to earlier beliefs. Donors regularly impose loan and grant conditions on cost recovery. Nevertheless, cost recovery is inhibited by many factors, especially in irrigation. Donors should fund action research, workshops, study tours, and public hearings leading to the articulation of cost recovery guidelines, and design projects with greater user management responsibilities and involvement. Participants believed that generating and retaining revenues adequate to cover at least the cost of operation and maintenance is vital to the effective performance of water projects and in turn is dependent on the financial autonomy of water service organizations. Accountability was also seen as a key factor for effective performance.

However, the view was also expressed by some that full cost recovery is not necessarily an appropriate universal policy for all countries and all conditions.

On wastewater reuse: Participants agreed that wastewater should be viewed as an economically valuable and sustainable source of water and that its reuse can be an effective strategy for environmental protection. Constraints to wastewater reuse include lack of sewerage systems, health risks because of the presence of pathogens and toxic substances in collected wastewater, cost of reclamation, institutional barriers, and psychological barriers. Measures to overcome these problems include limiting urban reuse to non-potable purposes, monitoring and control of wastewater quality, using highest quality waters for the highest quality uses, reclaiming wastewater to the quality level required by the intended use, and providing for separation of waste streams in all water planning. Other measures include integrated water management and promoting regional and inter-regional information sharing on reuse. Only the marginal cost of reclamation and delivery of used water should be charged to the users.

On industrial wastewater minimization: Industrial contaminants, including heavy metals, in collected urban wastewaters limit safe reusability. Participants agreed that pollution prevention, as distinct from end-of-pipe treatment, should be made a priority. Actual progress requires priorities for control of specific pollutants and industries, taking into account not only their effects but also their feasibility and cost of control. Participants recognized that industry-to-industry technology transfer and demonstrations are very important tools for pollution reduction through in-factory raw material, process, and housekeeping changes. However, motivation to make changes must be provided through monitoring and enforcement, economic incentives and disincentives, education and training, information dissemination, and other means.

Throughout the discussions, user and stakeholder participation in water allocation and service decision making was a recurring theme. Strengthening developing country water public and other institutions was seen as imperative for implementing improved water policies.

Participants held pessimistic as well as optimistic views of actual and prospective progress in irrigated agriculture. Some expressed concern that emphasis on sustainability, conservation, and resource economics, while critical to project planning and implementation, cannot be expected to eliminate the need for additional water supplies to meet agricultural and public health needs.

It was agreed that water policies should provide incentives for water users to conserve water. Broader social goals should be linked with private or individual goals to encourage efficient use of water. Defining and then measuring the efficiency of water use across water subsectors is needed.

Integrated management of water across institutional and use category (e.g., municipal, industrial, agricultural, and environmental) boundaries was identified as critical to efficient use and sustainable development of water. This should encompass both planning and operations.

There was general agreement that the water sector is of key importance to countries in Asia and the Near East and includes problems that will require the help of external support agencies. There are important needs for grant and loan assistance and for interventions covering a range of time periods. For these and other reasons, multilateral lending agencies, bilateral donors, and international assistance foundations all have important roles to play in the water sector. Bilateral donors are particularly important in the policy formulation and institutional restructuring areas, where they have already had great impact.

Participants were concerned that the search for good policies should not end with the adoption by donors of policy "silver bullets" as universal panaceas. Donors, it was felt, should work with governments not only on water policies but also on water policy development and implementation processes, including encouraging accountability and public participation.

There was general agreement that donors should, among other needed actions:

- Support accelerated turnover of irrigation systems and water management to user associations by talking about policy with governments to encourage meaningful user participation, financing farmer water management training, and supporting the reorientation of line agencies
- Support pilot projects and applied research to test the effects of pricing and trading policies
- Support regional and country seminars, meetings and other activities for information sharing, consensus building, and user empowerment
- Fund research and information dissemination on revenue generation to support water system operations
- Design projects with greater real user input and management responsibilities
- Actively support monitoring and control of industrial contaminants in wastewater
- Require consideration of efficiency and sustainability of use, including potential wastewater reuse, in water sector studies to support funding
- Assist governments to define and adopt hazardous waste reduction strategies and policies, and to identify priority industrial pollutants and industries

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CONTENTS

	<u>Page</u>
Acronym List	ix
Preface	xi
1. BACKGROUND	1
2. SYNTHESIS OF DISCUSSION ON THE FIVE TOPICS	3
2.1 Water-User Associations	3
2.2 Tradable Water Rights	4
2.3 Pricing and Cost Recovery	5
2.4 Wastewater Reuse	6
2.5 Industrial Wastewater Minimization	7
3. CROSS-CUTTING THEMES AND POLICY DIRECTIONS	9
3.1 Economic and Financial Issues	9
3.2 Institutional Issues	9
3.3 Meeting Water Needs	9
3.4 Water Conservation and Management Policies	10
4. GENERAL DONOR ACTION THEMES	11
5. PANELIST TOPIC PAPERS	13
Exhibit I - Keynote Presentation by Peter Rogers	15
Exhibit II - Presentation on Tradable Water Rights by Mark Rosegrant	23
Exhibit III - Presentation on Water-User Associations by Max Goldensohn	27
Exhibit IV - Presentation on Pricing and Cost Recovery by Ian Carruthers	31
Exhibit V - Presentation on Wastewater Reuse by Hillel Shuval and Comment by Dan Okun	33
Exhibit VI - Presentation on Industrial Wastewater Minimization by William Lacy	37
APPENDICES	43
Appendix A - Workshop Agenda	45
Appendix B - Participant List	47
Appendix C - Panelist Biographies	53

ACRONYM LIST

CNA	<i>Comision Nacional del Agua</i>
EEC	European Economic Community
GTZ	German aid organization
IFPRI	International Food Policy Research Institute
ISO	International Standards Organization
ISPAN	Irrigation Support Project for Asia and the Near East
NGO	Non-governmental organization
O&M	Operations and maintenance
ODA	Overseas Development Authority (United Kingdom)
PIES	Electronic network maintained by PPIC
PPIC	Pollution Prevention Information Clearinghouse
PVO	Private voluntary organization
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environmental Programme
UNIDO	United Nations Industrial Development Organization
USAID	U.S. Agency for International Development
USEPA	U.S. Environmental Protection Agency
WHO	World Health Organization
WUA	Water-user association

Preface

A workshop on future directions for implementing water policy was held at College Park, Maryland, on April 28-29, 1994. The workshop was sponsored by the Bureau for Asia and the Near East, U.S. Agency for International Development (USAID). The Irrigation Support Project for Asia and the Near East (ISPAN) provided technical and logistic support. The workshop was designed by a committee composed of representatives from the Asia and Near East Bureau, the World Bank, the non-governmental organization (NGO) community, and the ISPAN team.

This report synthesizes the highlights of the discussions, includes the outline papers presented by the keynote speaker and panelists, and records the flip-chart notes captured during the various meeting sessions. It also gives information on the format, agenda, speakers, and participants.

More than 60 individuals with experience in water resources issues participated. The attendees included staff of USAID, the World Bank, the United Nations Development Programme, the Asian Development Bank, NGOs and PVCs, international research centers, U.S. governmental agencies, congressional committees and research services, and universities. Team members of USAID's centrally funded environmental projects also participated, as well as several country representatives.

The objectives of the workshop were to:

- Present some of the major water policy issues facing the world in the 21st century
- Identify policy and strategy options in five preselected topic areas related to resource sustainability
- Identify constraints to implementing these policy and strategy options
- Identify specific donor actions needed to move forward in these five areas

Margaret Carpenter, Assistant Administrator of the Asia and Near East Bureau, officially opened the workshop. Peter Rogers, Gordon McKay Professor of Environmental Engineering at Harvard University, presented the keynote address.

Facilitators ensured maximum interaction and participation during the two-day workshop. Five panelists made brief presentations that were followed by in-depth small group discussion sessions. The panelists made thought-provoking openings to the discussion sessions and also provided brief written statements, which are included in this report.

The panel presenters were:

Mark Rosegrant of the International Food Policy Research Center (on tradable water rights)
Max Goldensohn of Development Alternatives, Inc. (on water-user associations)
Ian Carruthers of Wye College, University of London (on pricing and cost recovery)
Hillel Shual of Hebrew University (on wastewater reuse)
William Lacy of Lacy and Company (on industrial wastewater minimization)

Following the panel presentations, participants formed discussion groups by topic. The panelists were supplemented by other resource persons. They were Atif Kubursi of McMaster University, William Easter of the University of Minnesota, Daniel Okun, and Leslie Small of Rutgers University. After each day's topic group discussions, plenary synthesizing sessions were held.

During the wrap-up session, participants identified the major conclusions from the workshop sessions and also developed conclusions on certain water issues not constrained by the five preselected topics.

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1. BACKGROUND

Water is one of the most important sectors in most developing countries. Current common problems include:

- Widespread shortages
- Increasing competition among and within different sectors
- Growing degradation of the quality of water resources
- Policy failures and institutional weaknesses

Developing countries in Asia and the Near East face a rapidly growing demand on water resources from agricultural, household, industrial, and environmental users accompanied by accelerating degradation of the watersheds supporting the water resource. Furthermore, new sources of water are increasingly expensive to exploit. The main source of additional water supplies to meet growing demand will generally come from saving water through more efficient use of existing supplies rather than from finding new sources of water.

Taking into account the limits on what could be achieved in two days of discussions, five topics were selected that fall within the area of efficiency improvement and resource sustainability.

While many important topics could have been included under this broad issue area, the five that were selected were:

- Water-user associations
- Tradable water rights
- Pricing and cost recovery
- Wastewater reuse
- Industrial wastewater minimization

All of these topics are either areas of current active study regarding their potential for improving sustainability or approaches generally seen as having such potential.

The workshop brought together people from various water sector backgrounds and produced consensus on some issues and approaches. On some matters, however, views differed, even on some basic points of donor conventional wisdom.

2. SYNTHESIS OF DISCUSSION ON THE FIVE TOPICS

2.1 Water-User Associations

Countries in Asia and the Near East are shifting their attention from developing new water delivery systems to improving the management of existing ones. The burden of heavy operation and maintenance costs of these systems has encouraged governments to shift responsibility from line agencies to water users. The subject was included in the workshop because, in spite of apparent difficulties in sustainable implementation, the formation of water-user associations (WUAs) is the current "silver bullet" of irrigation management.

For two decades, donors and cooperating countries in Asia and the Near East have supported the creation and strengthening of WUAs as vehicles for improved system performance. However, experience shows that user associations, especially those created by governments, are short-lived, usually flourishing during the design and construction phases of system development or rehabilitation, but falling into inactivity during the operation and maintenance phase. Incentives for the associations to continue to maintain systems have generally been lacking.

Despite the apparent failures, many countries in Asia and elsewhere are considering or implementing turnover policies that transfer system management responsibilities from line agencies to end-user groups in order to shift the burden of recurrent costs. Important questions remain:

- Can and should WUAs be sustainable?
- Should they concentrate exclusively on water?
- Will turnover programs lead to improved system performance through greater user participation?
- Can WUAs be vehicles for expanded democratization in rural areas?

The record on water-user groups is disappointing: groups have little chance of succeeding because they are generally created and supported in the region. Workshop participants identified a number of responsible factors. Most commonly, the approach taken is top-down and cookie-cutter, even though one type cannot fit all situations. On the government side, agencies continue to exert central authority and are not held accountable. Rivalries between line agencies are common, and a bias towards construction rather than nonstructural approaches is widespread. On the user side, clear water rights and formal responsibilities are lacking, and the users have not received adequate benefits from taking over the maintenance work. For both, technical and management capacities are inadequate.

Workshop participants agreed on the following policy directions, which need further development:

- Enabling organizations to adopt multiple functions rather than being restricted to exclusively water-based functions
- Clarifying laws about water and land rights
- Restructuring line agencies to respond to a climate of greater user management responsibilities
- Encouraging agreement by donors on common approaches to the transfer of management responsibilities to users
- Giving WUAs responsibility and authority to allocate water
- Increasing beneficiary cost sharing
- Supporting the acceleration of turnover efforts by encouraging user participation and policy dialogue, financing local farmer management training, and supporting the reorientation of line agencies

2.2 Tradable Water Rights

Technological and management approaches to saving water through more efficient irrigation have not worked as well as hoped because they have not been linked to the basic mechanisms and incentives by which water is allocated. A promising approach beginning to receive the attention of developing country policy makers is the reform of laws and institutions to establish well-defined, transferable water rights for water users or groups of water users. The topic was included in the workshop because this potentially useful approach being implemented in several countries in the American hemisphere may have applicability in Asia and the Near East.

Institutional and technological issues impede the implementation of water allocation by markets in transferable water rights. Establishing markets in tradable property rights does not imply free markets in water. Rather, the system would provide for managed trade, with institutions in place to protect against negative effects on third parties and against negative environmental effects that are not eliminated by the change in incentives.

A number of important issues arise in the process of establishing markets in tradable water rights. Laws, institutions, and contracts must be reformed or developed to equitably assign initial rights, to deal with variability of water supply, and to protect against third-party impairment from water transfers.

Workshop participants suggested three broad areas for donor action:

- Providing incentives for policy change, including support for pilot projects to test the effects of pricing and trading on water allocations, and support for local university and professional applied research on the effect of policy changes
- ⊕ Enhancing of public participation by directing funds to programs for user empowerment and for stimulating public debate

- Clarifying resource ownership through support of regional seminars and local meetings within countries as ways of building consensus and providing feedback on decisions about resource ownership

2.3 Pricing and Cost Recovery

Practitioners in the agricultural and urban water sectors expressed different views on the benefits and feasibility of managing water demands through pricing. Actual experience in irrigation has not yielded a practical and sustainable way to measure surface water volumes supplied to farmers. This means that charges for irrigation water seldom include a "price" (i.e., a charge per unit volume taken). The lack of a link between the cost and volume of irrigation water used prevents using price as a tool to manage demand.

Some irrigation experts stated, however, that flow measurement is not even needed because of the low elasticity of water demand in relation to price. This was refuted by others who referred to data showing that water demand can be strongly price responsive. Governments tend to subsidize water for agriculture for political reasons and make the convenient assumption that demand is not elastic. Urban water specialists also pointed out that the idea that price does not influence use was believed of domestic water supply 20 years ago, but experience has shown that urban water demand is significantly responsive to price.

The operation and maintenance of large-scale water delivery systems constructed, particularly for irrigation, over the past 20 years has imposed a heavy financial burden on countries in Asia and the Near East. Donors regularly impose loan and grant conditions focusing on the recovery of costs from users. However, especially in irrigation, few revenue programs cover even operation and maintenance costs adequately. The discussion on irrigation system cost recovery emphasized the need for revenue collection and retention to cover water system operations rather than to support or repay the system costs borne by government. Financial autonomy and accountability of water distributing organizations was seen as critical to the promotion of effective assessment, collection, and use of water revenues.

Participants cited many technical, political, and social constraints to the formulation and implementation of resource mobilization policies. Among the most important and widespread of these are the lack of adequate research and information on which to base policy changes, the institutional culture of entrenched bureaucracies, the shortage of investment funds, the age and condition of facilities, political avoidance of the issue, the pressure on donors to move money and not enforce covenants, a lack of accountability, and the inability or unwillingness of users to pay.

Given these constraints, workshop participants identified needed donor actions on cost recovery:

- Fund research, workshops, study tours, and public hearings leading to the articulation of guidelines to build consensus on the need for revenue generation

- Design projects with greater real user management responsibilities and ensure agreement by all stakeholders before implementation
- Maintain policy dialogue among donors and coordinate their efforts
- Undertake more careful assessments of political constraints within countries
- Support data collection and analysis on the real costs of system operation before imposing policy changes

2.4 Wastewater Reuse

Wastewater reuse has occurred informally in many places for a long time, often with serious health consequences. It is now receiving attention as a planned water conservation measure in both industrialized and developing countries. Approaches to wastewater reuse are the subject of some debate. The topic was included because of the large potential benefits and the significant constraints to its adoption.

Participants agreed that wastewater should be viewed as an economically valuable and sustainable source of water. Wastewater reclamation and delivery costs were seen as a charge to the reuser. Therefore, reclaimed water should be metered. Only the marginal costs of additional treatment and delivery to the users should be charged to reuse. All other costs of environmentally sound disposal of wastewater should be borne by the urban water and wastewater system. (A minority view was expressed that advantage should be taken of any demand for reclaimed water to generate extra revenue to help defray the costs of sewerage.)

In evaluating potential reuse projects, workshop participants agreed that both social and environmental benefits should be considered in addition to the economic value in use of the reclaimed water.

A lack of sewerage systems commonly constrains the expanded reuse of reclaimed wastewater. Other constraints to reuse implementation include health barriers such as the presence of pathogens and toxic substances in collected wastewater, as well as psychological barriers. Toxics potentially affect reuse of both water and sewage sludge (as fertilizer). Measures to overcome these problems include:

- Limiting urban reuse to non-potable purposes and providing public information
- Supporting the monitoring and control of wastewater quality, including quantifying and reducing industrial contaminants in wastewater
- Preventing the discharge of toxic materials to sewerage systems
- Promoting studies on the long-term effects of wastewater reuse on soils and groundwater

To increase the economic benefit to cost relationship, wastewater reuse should include the following strategies:

- Use the highest quality waters for the highest quality uses
- Reclaim wastewater only to the quality level required by the intended user
- Stage development of sewerage, basic wastewater treatment, reclamation, and reuse
- Provide for separation of waste streams in all wastewater planning

Institutional barriers also were seen as constituting an important set of constraints to wastewater reuse. Such barriers include the separation of water supply and wastewater utilities. Therefore, donors should promote the use of integrated water management and institutional or economic analyses in water resource projects, including consideration of joint water and wastewater utilities.

To support proper consideration of wastewater reclamation and reuse, it was agreed that donors should:

- Require all water sector studies to include reuse as an option
- Promote regional and inter-regional information sharing through conferences, meetings, and newsletters

2.5 Industrial Wastewater Minimization

Although quantification is poor, the presence of toxic industrial contaminants, including heavy metals, in collected urban wastewaters limits their safe reusability for agricultural purposes. This is the principal reason for the inclusion of waste minimization as a workshop topic.

Workshop participants agreed that pollution prevention, as distinct from end-of-pipe treatment, should be made a priority. They also pointed out that effective reduction requires governments to set rationally based priorities for control of specific pollutants and industries, taking into account not only toxic effects but also the feasibility and cost of control. To facilitate control and information sharing, the use of international standards, e.g., the ISO guidelines, should be promoted.

Participants also recognized that industry-to-industry technology transfers and demonstrations are very important tools for pollution reduction through in-factory material, process, and housekeeping changes. However, motivation to make changes must be provided through monitoring and enforcement, economic incentives and disincentives, education and training, information dissemination, and other means.

A very important strategy for governments is making information on pollution open to the public and encouraging the involvement of NGOs. When properly informed, NGOs can be very effective in bringing about changes. To support this strategy, and to encourage governments to

act, the international community should share failures as well as successes in pollution reduction. Coordinated policy dialogue is needed between donors and governments.

Several critical constraints impede progress on industrial pollution reduction. These include weakness and lack of political will on the part of governments, which are generally protective of industry and employment. Governments also generally lack information on the possibilities for low-cost or no-cost waste minimization. Inadequate information on usage and losses of toxic and other hazardous materials by industry (also by agriculture) and inadequate sharing of this information further constrain the reduction of pollution.

A number of recommendations about donor actions to promote industrial pollution reduction were made. These included promoting the inclusion of environmental management in higher educational curricula and supporting environmental technology training and staff exchanges. Donors should also assist countries to identify priority pollutants and industries; chromium from metal finishing and tanning in Indonesia was quoted as an example. Information and policy dialogues should be undertaken between donors in host countries, governments, NGOs, and interested institutions. Governments should be encouraged to request the UN and its agencies (e.g., UNEP Industrial Program and UNIDO) to take leadership roles.

3. CROSS-CUTTING THEMES AND POLICY DIRECTIONS

3.1 Economic and Financial Issues

Economic and financial issues received a great deal of attention, not limited to the sessions devoted to pricing and cost recovery. While the notion that water is an economic good and should be treated as such in the evaluation of all proposed water programs and projects was a consensus view, views differed on demand management through pricing and on revenue generation.

Feasibility and methods of cost recovery were discussed in several sessions, but no universal policy consensus was reached. Participants believed that the generation of revenues adequate to cover at least the cost of operation and maintenance is vital to the effective performance of water projects. However, some expressed the view that full cost recovery is not necessarily an appropriate universal policy for all countries and all conditions.

3.2 Institutional Issues

The critical importance of user and stakeholder participation in water allocation and service decision making was a recurring theme but, except in relation to agricultural water-user associations, was not developed in any detail. Strengthening a developing country's water, public, and other institutions was seen as imperative for implementing water policies.

Financial autonomy of water service organizations was considered an important aid to the collection and retention of revenues to sustain operations. Accountability to users for the adequacy of system operations is also necessary to ensure effective and reliable operation and maintenance. Private sector involvement was seen as often useful, but private sector functions were not defined. NGO involvement in mobilizing public opinion and monitoring the effects of water policies, and the need to support NGOs, was seen as very important.

Institutional barriers often impede integrated water planning and management. Sustainable water development often depends on finding ways to eliminate or work across such barriers.

3.3 Meeting Water Needs

Participants expressed both pessimistic and somewhat optimistic views of actual and prospective progress in irrigated agriculture. Some of the group noted that progress in food production to date was primarily nutrient-related and had not justified the tremendous expenditures made in irrigation. Others pointed to the great gains in productivity and changes in cropping patterns that could not have occurred without water, as well as the potential either to provide more water or to improve the efficiency of water use.

Some participants expressed concern that emphasis on sustainability, conservation, and resource economics, while critical to project planning and implementation, cannot be expected to eliminate the need for additional water supplies to meet agricultural and public health needs.

3.4 Water Conservation and Management Policies

Participants agreed that water policies should provide incentives for water users to conserve water. Broader social goals should be linked with private or individual goals to encourage efficient use of water. There is a need to define efficiency of water use across water subsectors in a way that permits measurement of performance in achieving it.

Wastewater is a valuable resource for the future; in some cases, it may have a higher value than "fresh" water because of its reliability. Policies need to anticipate future water reuse, for example, by requiring separation of waste streams.

The integrated management of water across institutional and user category boundaries was identified as critical to the efficient use and sustainable development of water. This should encompass both planning and operations.

4. GENERAL DONOR ACTION THEMES

There was consensus that the water sector is of key importance to countries in Asia and the Near East and includes problems that will require the help of external support agencies. Such agencies should therefore stay involved in the water business.

There are important needs for both grant and loan assistance, and for interventions covering a range of time periods. For these and other reasons, multilateral lending agencies, bilateral donors, and international assistance foundations all have important roles to play in the water sector. Bilateral donors are particularly important in the policy formulation and institutional restructuring areas, where they have already had positive effects.

Given the importance of sound water policy formulation and implementation for many countries, these are key areas for external assistance. Donors can provide initiative, information, examples, demonstrations, and technical assistance in policy and strategy development as well as infrastructure development assistance. Especially in the non-infrastructure areas, donors should not undercut one another; instead, they should maintain some degree of cooperation in water policy directions.

However, the group also agreed on the critical importance of countries' maintaining responsibility for and ownership of their policies and programs in water, as in other sectors. This means that external assistance agencies should tread the fine line between externally coordinated guidance on sustainable water policy implementation and unquestioning support of national water policies and programs. There was concern that while donors need to show more resolve in water policy areas, they also need to be more aware of the factors within countries that bear on political will to take difficult policy initiatives.

Just as participation was a key theme throughout the workshop discussions of country programs and policies, it was also featured in the discussions of donor approaches. Within countries, within regions, and among regions, it was felt that much more sharing of information and experiences is needed, together with discussion of the implementability and effects of policy options. Participants expressed the concern that the search for good policies should not end with the adoption by donors of policy "silver bullets" as universal panaceas.

Donors, it was felt, should work with governments not only on water policies but also on water policy development and implementation processes, including encouraging accountability and public participation.

While the group recognized that there are no panaceas, it did agree that certain policy principles and needs have already been well demonstrated and should be fundamental components of donor approaches. These include:

- Encouraging governments to use integrated water resource planning

- Promoting public participation
- Considering the opportunity cost of water in making investment decisions about water
- Focusing on capacity building, streamlining, and reformulating public sector organizations, with decentralization and creation of autonomous service providers, including privatization where appropriate
- Encouraging efficient water use including reuse of wastewater
- Encouraging the separation of waste streams with the eventual goal of eliminating toxic discharges (zero discharge of toxic and other hazardous substances) to protect the environment and to facilitate the safe reuse of wastewater and sludge
- Supporting the acquisition of better data on the extent and effect of toxic substances in industrial wastes and agricultural drainage

Participants felt that some international institutional actions would be helpful in providing appropriate emphasis, coordination, information sharing, and technical support to the water sector. Given the narrow focus and dwindling funds of some international agricultural research centers, the question was raised whether one or more of these should adopt a broad water sector agenda to address such issues as scarcity, efficiency, allocation, and sustainability. Increased involvement at the country level of relevant UN entities or programs was discussed as a possible approach for improved donor cooperation.

Everyone generally agreed that donors should, among other needed actions:

- Support accelerated turnover of irrigation system and water management to user associations by talking about policy with governments to encourage meaningful user participation, financing farmer water management training, and supporting the reorientation of line agencies
- Support pilot projects and applied research to test the effects of pricing and trading policies
- Support regional and country seminars, meetings, and other activities for information sharing, consensus building, and user empowerment
- Fund research and information dissemination on revenue generation to support water system operations
- Design projects with greater real user input and management responsibilities
- Actively support monitoring and control of industrial contaminants in wastewater
- Require consideration of efficiency and sustainability of use, including potential wastewater reuse, in water sector studies to support funding
- Assist governments to define and adopt hazardous waste reduction strategies and policies, and to identify priority industrial pollutants and industries

5. PANELIST TOPIC PAPERS

Exhibit I - Keynote Presentation by Peter Rogers

Exhibit II - Presentation on Tradable Water Rights by Mark Rosegrant

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Exhibit IV - Presentation on Pricing and Cost Recovery by Ian Carruthers

**Exhibit V - Presentation on Wastewater Reuse by Hillel Shuval and Comment by
Dan Okun**

Exhibit VI - Presentation on Industrial Wastewater Minimization by William Lacy

Exhibit I
KEYNOTE PRESENTATION
Dr. Peter Rogers

INTRODUCTION

It is interesting to note that the title of this workshop is "Future Directions for Implementing Water Policy" not "Future Directions for Water Policy." By this, I assume that we already know what "water policy" is and merely have to focus on the best way to implement it. For me this is a strong assumption. Do we really know the best water policy for the different countries around the world? There is a growing literature on water policy that should be helpful in answering this question.

The obvious blueprint for water policy around the world should be Chapter 18 of Agenda 21 adopted at the UN Conference on Environment and Development (UNCED, 1992). Starting from the clear position:

Effectively integrated management of water resources is important to all socio-economic sectors relying on water. Rational allocation prevents conflict and enhances the social development of local communities, as well as economic planning and productivity. Efficient demand management allows water-using sectors to achieve long-term savings on water costs and stimulated resource-conscious production technologies. Health conditions and environmental quality should also improve, either as a result of integrated development planning or as a beneficial consequence of improved environmental or social conditions.

Agenda 21 unfortunately soon got bogged down in details of the solutions, and it is hard to discern clear policy directions from it. It eventually consisted of "a long list of unreachable and unfundable targets, with no fewer than 184 activities advocated in this chapter alone" (Briscoe and Garn, 1994).

One of the preparatory conferences for the UNCED meeting in Rio, which managed to stay relatively focused, was the International Conference on Water and Environment held in Dublin, January 26-31, 1992. The conference report included a "Dublin Statement," which started as follows:

Scarcity and misuse of freshwater pose a serious and growing threat to sustainable development and protection of the environment. Human health and welfare, food security, industrial development, and the ecosystems on which they depend, are all at risk, unless the water and land resources are managed more effectively in the present decade and beyond than they have been in the past (UN ACC/ISGWR, 1992).

Starting from this problem statement, the Conference came up with four guiding principles:

1. Fresh water is a finite and vulnerable resource, essential to sustain life, development, and the environment.
2. Water development and management should be based on a participatory approach, involving user, planners, and policy makers at all levels.
3. Women play a central role in the provision, management, and safeguarding of water.
4. Water has an economic value in all of its competing uses and should be recognized as an economic good.

In essence, principles 2 and 4 were the relevant guiding principles for water policy enunciated by the Conference.

In 1993, the World Bank published its long-awaited Water Policy paper (World Bank, 1993). The Bank identified three major problems faced in the water area:

- Fragmented public investment programming and sector management that have failed to take account of the interdependencies among agencies, jurisdictions, and sectors
- Extended reliance on overextended government agencies that have neglected the need for economic pricing, financial accountability, and user participation and have not provided services effectively to the poor
- Public health investments and regulations that have neglected water quality, health, and environmental concerns

These problems were to be overcome in reaching the Bank's overarching policy objective "to reduce poverty by supporting the efforts of countries to promote equitable, efficient, and sustainable development," by adopting water policies that stress the following:

- Comprehensive analytic frameworks
- Institutional and regulatory systems
- Incentives for providers and users
- Water-conserving technology
- Poverty alleviation
- Decentralization
- Participation by stakeholders
- Environmental protection
- Upgrading professional skills of providers
- Design of country programs
- Management of international watercourses
- Implementation capacity

Last year also saw a flurry of water policy studies by USAID: a study of water resources and environmental sustainability (Thomas, et al., 1993), *A Strategic Framework for Water in Asia* (Bureau for Asia and the Near East, 1994), and a *Water Resources Action Plan for the Near East*

(Bureau for Asia and the Near East, 1993). The study on sustainability claimed three significant global trends in water resources:

- Widespread shortages
- Increasing competition among and within different sectors for limited resources
- Growing degradation of the quality of water resources

Water Resources Action Plan for the Near East stated USAID's goal to achieve "sustainable economic growth, high levels of employment, widespread recognition of basic human rights, and peaceful relations with neighbors, the benefits of which are shared by a broad spectrum of the population." It is claimed that five strategic objectives support this goal: private sector activity, governance, contraceptive methods, maternal and child health services, and water resources. For water resources, the following objectives were stressed:

- Increase the efficient use of water
- Enhance water quality
- Improve water management

The report, *A Strategic Framework for Water in Asia*, saw the key problems faced as:

- Policy failures and institutional weaknesses (including cost recovery issues)
- Competition for water
- Health and environmental needs and effects

Another paper done for USAID by Eriksen and Poulin (1993) compared and contrasted lessons learned from examining water policy development in Tunisia and Sri Lanka. They drew some lessons from this comparison that I believe are of general interest:

- Successful policy change is evolutionary, not revolutionary.
- Successful policy change required involvement and support of a cadre of strongly committed senior government policy makers, who see the process as one that will be useful to them.
- More helpful to policy change than charismatic leadership is leadership continuity.
- When attempting to change policy, it is vital to minimize the number of institutions affected.
- Major policy change must be based not on generalities but on solid field data and analyses. The more complicated the policy change, the more important reliable data and high-quality analysis become in the process.
- The distinction between top-down and bottom-up approaches to policy formulation is an artificial one; successful policy change requires support and commitment at both grassroots and senior policy levels.
- A specific policy-change process should never be used as an occasion to address peripheral or unrelated problems.
- A policy-change process generally needs support from more than one major donor.

Not to be outdone by other events in 1993, I also published a book entitled *America's Water: Federal Roles and Responsibilities* in which I identified the problems as the lack of coherent policies on the part of the federal government, which lacks a unifying vision of the whole water picture. I suggested seven areas of pressing concern to address the problems:

- Financing infrastructure
- Privatization
- Information
- Water research
- Meaningful regionalism
- Intergovernmental relations
- Institutional reform

For the urban water resources sector, three other recent studies are relevant. The papers by Serageldin (1994) and Briscoe and Garn (1994) reflect the new thinking on financing of water supply and sanitation, and the paper by Rogers (February 1993) takes a broad view of the entire urban water resources sector and comes out heavily in favor of economic and institutional mechanisms that would lead to cost recovery for the urban utilities. The papers by Serageldin (1994) and Briscoe and Garn (1994) reflect what they call the gap between the "old agenda," which stressed backlogs in service provision, slow pace of increasing coverage, the size of the resource gap, and the need for governments and external support agencies to increase resources so that the targets can be met, and the "new agenda," which is based upon two of the principles endorsed by the Dublin Conference. The principles state that water has an economic value in all its competing uses and should be recognized as an economic good, and that water development and management should be based upon a participatory approach, involving users, planners and policy makers at all levels, with decisions taken at the lowest appropriate level.

Given the plethora of policy statements and documents, it is really surprising to find a consensus emerging from them. Most studies find the lack of coherent integrated government policies regarding all phases of water as a major cause of current problems. All see improved efficiency in water use using pricing as part of the incentive structure; all see the need for more attention to water quality, public health, and sustainability issues. The question posed in the first paragraph above has been answered. It is now time for the water resources community to move forward to the issues involved in implementing water policy.

THIS WORKSHOP

We are now indeed at the stage of suggesting concrete steps to move toward implementing these policy initiatives. This leads to the charge faced by our Workshop over the next two days. The areas that we are expected to discuss are:

- Major water policy issues facing the world in the 21st century

- Identify policy and strategies in five areas
 - Tradable water rights
 - Water-user associations
 - Wastewater reuse
 - Pricing and cost recovery
 - Industrial wastewater minimization
- Identify constraints to implementing these policy and strategy options
- Identify specific actions to move forward in these five areas

Other topics that might be added to this list, without overloading it, are the need for resolving international conflicts, particularly in the arid Near East, and the role of pricing in improving utility management.

**TABLE 1
PROBLEM STATEMENTS**

Agenda 21

Effectively integrated management of water resources is important to all socio-economic sectors relying on water. Rational allocation prevents conflict and enhances the social development of local communities, as well as economic planning and productivity. Efficient demand management allows water-using sectors to achieve long-term savings on water costs and stimulates resource-conscious production technologies. Health conditions and environmental quality should also improve, either as a result of integrated development planning or as a beneficial consequence of improved environmental or social conditions.

Dublin Conference

Scarcity and misuse of freshwater pose a serious and growing threat to sustainable development and protection of the environment. Human health and welfare, food security, industrial development and the ecosystems on which they depend, are all at risk, unless the water and land resources are managed more effectively in the present decade and beyond than they have been in the past.

World Bank

- Fragmented public investment programming and sector management have failed to take account of the interdependencies among agencies, jurisdictions, and sectors.
- Extended reliance on overextended government agencies that have neglected the need for economic pricing, financial accountability, and user participation and have not provided services effectively to the poor.
- Public health investments and regulations have neglected water quality, health, and environmental concerns.

Sustainability Study

- Widespread shortages
- Increasing competition among and within different sectors for limited resources
- Growing degradation of the quality of water resources.

Strategic Framework for Asia

- Policy failures and institutional weaknesses (including cost recovery issues)
- Competition for water
- Health and environmental needs and effects

TABLE 2
WATER POLICY IMPLEMENTATION

Dublin Statement

- Fresh water is a finite and vulnerable resource, essential to sustain life, development, and the environment.
- Water development and management should be based upon a participatory approach, involving users, planners, and policy makers at all levels.
- Women play a central role in the provision, management, and safeguarding of water.
- Water has an economic value in all of its competing uses and should be recognized as an economic good.

Action Plan for Water in the Near East

- Increase the efficient use of water
- Reallocate water resources
- Manage demand
- Conserve water
- Improve technology
- Resolve transboundary disputes
- Enhance water quality
- Upgrade monitoring and regulation enforcement
- Introduce pollution prevention techniques
- Foster local capacity for water protection
- Improve water management
- Strengthen public sector services
- Expand financial responsibility
- Divest management responsibilities
- Encourage private sector services

World Bank

- Comprehensive analytic frameworks
- Institutional and regulatory systems
- Incentives for providers and users
- Water-conserving technology
- Poverty alleviation
- Decentralization
- Participation by stakeholders
- Environmental protection
- Upgrading professional skills of providers
- Design of country programs
- Management of international watercourses
- Implementation capacity

America's Water

- Financing infrastructure
- Privatization
- Information
- Water research
- Meaningful regionalism
- Intergovernmental relations
- Institutional reform

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Exhibit II
TRADABLE WATER RIGHTS
Dr. Mark W. Rosegrant

BACKGROUND

Developing countries in Asia and the Near East face rapidly growing demand pressure on water resources from agricultural, household, industrial, and environmental uses. This pressure is accompanied by accelerating degradation of the watersheds supporting the water resource, the agricultural land base supporting the main consumer of water-irrigated agriculture, and the declining quality of the delivered water itself.

New sources of water are increasingly expensive to exploit. The main source of incremental water supplies to meet growing demand will thus have to come from saving water through a more efficient use of existing water supplies. The only source of water savings of the necessary magnitude to meet growing demand is irrigated agriculture, which generally accounts for at least 80 percent of consumptive use of water in developing countries in Asia and the Near East. The paramount objective for water resource policy is thus to sustain production growth from irrigated areas while saving water through more efficient allocation of irrigation water and reversing the degradation of land and water.

However, technological and management approaches to saving water through more efficient irrigation have not worked as well as hoped because they have not been linked to the basic mechanisms and incentives by which water is allocated. A promising approach beginning to receive the attention of developing country policy makers is the reform of laws and institutions to establish well-defined, transferable water rights for water users or groups of water users.

CRITICAL ISSUES

What are the potential benefits of establishing markets in tradable water rights, and what are the main obstacles to effective implementation of this water allocation mechanism?

Devolution of water rights from centralized bureaucratic agencies to farmers and other water users has a number of potential advantages.

- The first is empowerment of the water users by requiring their consent to any reallocation of water and compensation for any water transferred.
- The second is to provide security of water rights tenure to the water users. If well-defined rights are established, the water users can invest in water-saving technology knowing that they will benefit from the investment.
- Third, a system of marketable rights to water would induce water users to consider the full opportunity cost of water, including its value in alternative uses, thus

providing incentives to efficiently use water and to gain additional income through the sale of saved water.

- Fourth, a properly managed system of tradable water rights will provide incentives for water users to take account of the external costs imposed by their water use, reducing the pressure to degrade resources.
- Fifth, compared to the often-recommended volumetric pricing of irrigation water, the rights-based approach would be more acceptable to farmers. Imposition of volumetric pricing would be seen by farmers as expropriation of traditional water rights, which would create capital losses in established irrigated farms. Establishment of transferable water rights would instead formalize existing rights to water.
- Finally, allocation of water through tradable rights provides maximum flexibility in responding to changes in crop prices and water values as demand patterns and comparative advantage change and diversification of cropping proceeds. The market-based system is more responsive than centralized allocation of water.

The key potential constraints to implementation of water allocation by markets in transferable water rights are institutional and technological in nature. Establishment of markets in tradable property rights does not imply free markets in water. Rather, the system would be one of managed trade, with institutions in place to protect against negative effects on third parties and against negative environmental effects that are not eliminated by the change in incentives.

A number of important issues arise in the process of establishing markets in tradable water rights. Laws, institutions, and contracts must be reformed or developed to equitably assign initial rights, to deal with variability of water supply, and to protect against third-party impairment from water transfers.

Development of markets cannot be isolated from the real-world institutional and technological context of developing-country irrigation. Effective development of markets in tradable property rights will likely require continued improvement in irrigation technology for conveyance, diversion, and metering; institutional improvement in management of the irrigation systems; and in many cases, development of water-user associations to manage water allocation. (For a more comprehensive treatment of these issues, see Rosegrant and Binswanger, forthcoming, 1994.)

SOME ACTIONS BEING TAKEN

Interest among policy makers in the concept of water allocation through tradable property rights is growing rapidly in Asia and Near East countries, including Egypt, India, Jordan, Malaysia, and Thailand. The developing countries with the most comprehensive water laws establishing a system of tradable water rights are Chile and Mexico. Brief highlights of these laws are summarized here. (For more detail, see Gazmuri, 1994; and Rosegrant and Gazmuri, 1994.)

The Chilean water law, passed in 1976, secures tradable water rights, expressed in terms of water volume per unit of time, permits trades within and between agricultural and non-

agricultural sectors, establishes protection for third-party rights, institutes water-user associations and a National Water Authority to solve most conflicts, and provides for judiciary solutions to conflicts not solved by users organization or the water authority (Gazmuri, 1994).

In Chile, any transfer of rights of use requires prior authorization, with trades monitored at two levels, the local water-user association, and the National Water Authority. Issues of third-party impairment and conflicts over water trades can be resolved at either level. If agreement is not reached at these levels, conflicts are moved to the court system. Evidence indicates that the establishment of the system of transferable water rights in Chile has greatly reduced the number of water conflicts reaching courts, with a large share of conflicts being resolved at the level of the water-user associations.

The new water law establishing tradable water rights in Mexico was passed in December 1992, and the regulations implementing the law were published in January 1994, so it is still in the early stages of implementation. The law establishes concessions of volumetric transferable water rights of 5 to 50 years' duration, assigns initial rights based mainly on historical use, and establishes strong third-party and environmental protection overseen by the *Comision Nacional del Agua* (CNA).

Fundamental to the establishment of water rights in Mexico is the turnover of irrigation districts to newly organized water-user associations. Under law, water rights can be provided to individuals or groups, but there appears to be a strong preference within CNA for concessions to be made to groups, with the groups then able to grant subsidiary water rights to their members through internal processes initially authorized by CNA.

Since CNA approves all trades other than exact transfer of original consumptive use, it by definition monitors and has approval over any trade potentially involving third-party effects. Protection of third parties through prohibition of damaging transfers or setting of compensation also receives separate emphasis in the water law as a responsibility of CNA. The water law establishes strong explicit protection of the environment for the first time in Mexican water law, using a regulatory, rather than a market approach. The quality of discharge for non-agricultural uses must be specified in the granting of the water right, and the CNA can invoke restrictions over water use in the event of severe water shortages, damage to ecosystems, overexploitation of aquifers, and other environmental impacts.

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Exhibit III
WATER-USER ASSOCIATIONS
Dr. Max D. Goldensohn

BACKGROUND

After the independence of most of the countries of Asia and the Near East, donors and host governments began a program of heavy investments in improving irrigated agriculture. Most of these investments paid for the construction of new irrigation infrastructure or the rehabilitation of old works that had fallen apart during the inter-regnum of World War II. The objective of these investments was to increase the area devoted to irrigated agriculture and thus to expand food production and employment opportunities. By the late 1960s, the donors found that host governments were already beginning to request funds to rehabilitate infrastructure built only a few years before. There seemed to have been a general failure to operate the new infrastructure properly and to maintain the canals and drainage systems. This failure seemed particularly acute at the downstream end of the new systems. Farmers were doing little to maintain their new infrastructure.

In the early 1970s, the National Irrigation Administration of the Philippines began to create water-user associations among farmers to contribute to paying the growing cost of new and rehabilitated infrastructure and take over the operation and maintenance of the downstream (tertiary and quaternary) infrastructure. The Participatory Method very successfully mobilized farmer resources to contribute to construction planning, design, and implementation in the Philippines. The methodology spread quickly to other countries in Asia and has since been adopted in most countries where irrigation is a significant contributor to agricultural production by small-holding farmers.

Now, after 20 years of implementation, host governments and donors have begun to see problems with the results of the participatory method. While very successful at mobilizing farmer resources and at getting construction and rehabilitation work done quickly and well, the water-user associations have in general disappeared at the end of the construction phase and in many areas, the farmers' contribution to O&M is no greater than before the elaboration and implementation of the Participatory Method.

The USAID Asia/DR/TR office has commissioned the ISPAN Project to carry out an applied study of water-user associations in six countries of Asia (Philippines, Indonesia, Pakistan, Nepal, Sri Lanka, and India) and in Egypt. The objective of the study is to see under what circumstances water-user associations seem to contribute to the improved performance of irrigation systems and under what conditions they seem to become permanent, sustainable parts of the agricultural economy. The study is also to look at the effect of water-user associations on rural participation in democratic processes and at the process of turning over irrigation systems or parts of systems to farmers.

SOME CRITICAL ISSUES

- A. Question: Should water-user associations be sustainable?** Water-user associations have worked very well to mobilize farmer resources for construction and to generate participation in the planning, design, and construction of appropriate irrigation systems. Why bother to try to change them into sustainable organizations?

Answer: Yes. Small-holding farmers cannot effectively defend their interests as individuals. In the modern world, where irrigated agriculture is embedded in multi-tiered economic and administrative structure, farmers need to organize to survive. In irrigation systems, water is a very appropriate basis for that organization.

- B. Question: Should water-user associations concentrate exclusively on water?** Until very recently, all those involved in creating and strengthening water-user associations felt that farmers should organize around the issue of water exclusively: O&M of infrastructure, resolution of allocation conflicts, payment of irrigation service fees, etc. They felt that permitting water-user associations to get involved in other activities would distract them from water and lead to the failure of the organizations.

Answer: No. Effective rural organizations have to represent all the interests of their members and especially their most fundamental interests: increasing their incomes and increasing their control over decisions that affect their lives. Or put another way, if the organizations do not help the farmers obtain more money and more power, they are unlikely to last.

- C. Question: Is water an end in itself or a means to an end?** Are conveyance systems more important than the farms to which the water is conveyed? Water-user associations are formed to improve water conveyance systems. Once they have done this, those agencies that work with water-user associations are satisfied.

Answer: Water is clearly a means to an end. The end is making a living from irrigated agriculture. A rural organization that worries only about water delivery and not about water use and the economic returns to water use is likely to prove non-sustainable.

- D. Question: Is there a difference between national agricultural interests and individual farmer interests?** Most irrigation programs assume that what nations want is good for their citizens: increased agricultural production, low cost food for cities and armies, saving of water for use in other sectors, etc.

Answer: Yes, there is a dramatic difference. Farmers want to earn money from their farms at minimal risk to their investments, while maximizing the control they have over decisions that affect them. Farmers care little for food self-sufficiency. They are interested in getting a good price for their outputs. Scarcity suits them well. Farmers do not care about saving water for municipal use or for use on other people's farms. They care about

optimal water availability for their own irrigation system and farm. To understand what makes rural organizations sustainable, governments will have to reconcile national interests and farmer interests.

- E. **Question: Will turnover programs, which give to farmers control over their own downstream infrastructure, lead to better irrigation system performance and more sustainable water-user associations?** Many countries have launched intensive programs to deliver tertiary and quaternary infrastructure to water-user associations. The stated reasons for this program are to have farmers take over the O&M of those parts of the irrigation systems that they use directly and that governments can no longer afford to operate or maintain, and to give farmers a sense of ownership of the infrastructure, which will lead to better O&M.

Answer: Probably not. That government officials and donors refer to these programs as turn-overs is significant. They should talk, rather, about the take-over of the systems by the water-user associations. Turn-over programs will not create better water-user associations. You need a good, strong water-user association **before** the water-user association takes over the system. Particularly in areas where governments have historically paid for all O&M themselves, turn-over is an undesirable step for most water-user associations.

SOME IMPLICATIONS

- A. Asian agriculture cannot survive without irrigation. Most Asian people live from agriculture and most Asian farmers are poor. They are among the most disenfranchised people on the earth. As donors and host governments pay more attention to participation, empowerment, and democratic initiatives, they should keep in mind that **Asian democracy has to begin with the empowerment of rural people.** Most democratic initiatives to date deal with urban phenomena: media, political processes, rule of law, labor unions, and business associations. These initiatives should start to emphasize the empowerment of the rural poor as well. The rural poor are overwhelmingly agricultural and depend on irrigation systems for their livelihood. **Water distribution systems are a natural starting place for rural organizations that can contribute quickly and materially to empowering their members.**
- B. Donors have begun to show signs of discouragement with the irrigation sector and investment in irrigation projects has declined in recent years. USAID has few, if any, irrigation projects in the works. But irrigation is critical to the economic and social survival of many of our Asian allies. If irrigation projects have not worked up to expectations so far, it is perhaps not because the sector is hopeless, but rather that we have gone about things in the wrong way. Irrigation is a critical input for agriculture, not a domain in itself. By systematically separating irrigation from agriculture, donors and host governments have warped the nature of our participation in financing agricultural development. Water-user associations are but one example. We need to adopt a new

paradigm for the development of water-user associations: the Opportunity-Oriented Farmer Organization should replace the water-user associations. The Opportunity-Oriented Farmer Organization should become a rural organization that represents farmers' interests in both empowerment and enrichment. An Opportunity-Oriented Farmer Organization should take care of irrigation O&M to the extent that farmers need irrigation water to grow their crops to make their living. In this context, O&M makes sense and Opportunity-Oriented Farmer Organizations, if they succeed in contributing to the enrichment and empowerment of their members, have a good chance to become permanent parts of the agro-economic landscape of Asia.

Exhibit IV
PRICING AND COST RECOVERY
Dr. Ian Carruthers

BACKGROUND

Irrigation and water supply services appear to be in dire straits. But so are, for example, railways, ports, and telephone services, and most schools and hospitals are in worse shape. Symptoms such as unfulfilled covenants, poor O&M, user fees below costs, collections below budget, and so forth, are both a cause and an effect of substandard irrigation. To resolve problems, agencies still search for panaceas, and pricing and cost recovery are currently seen to be a solution. Improved policy in this area will make a contribution, but will not prove to be the central solution to the complex problems of irrigation.

Pricing is really a misnomer because irrigation water is seldom measured, and there is a real technology gap for measuring low value silty water in field conditions. If you cannot measure water, then you cannot price it.

More money would certainly help solve some of the problems stemming from poor irrigation maintenance, unfinished schemes (e.g., no land leveling or drainage) and modernization needs, but money shortages are only part of the problem. Collection and retention of agreed fees is seldom within the remit of the irrigation agencies, and they generally do not retain any fees. They have little or no incentive to encourage farmer payments.

Despite widespread and often justified criticism of irrigation, we should not underestimate the value and the level of achievement in many projects and the undoubted potential to assist the protection or the enhancement of the environment on schemes or indirectly in areas such as hillsides or low rainfall zones, which are more at risk (for full set of arguments for irrigation investments, see my background paper to the Workshop). Water is today scarce and valuable and now is not the time to neglect investment in the subsector.

CRITICAL ISSUES

Is the macroeconomic and legal framework in place and the government of a mind to take a tough stance in relation to irrigation budgets and finance? Can governments find the resources to rehabilitate or modernize run-down facilities given the many calls on their resources and the fall off in aid flows to agriculture in general and to irrigation in particular? Given the failure to reform irrigation service fees in almost every country to date, is a new effort worthwhile now? Is water to be a leading reform sector or should countries wait for the electricity prices, public transport fares, drinking water charges, and the rest to be brought into line before acting, or should they simultaneously implement pricing reforms? In other words, any reform program has to be sensibly sequenced. Is it reasonable or sensible to expect aid agencies to delve in high profile domestic politics such as are implied by charging water service fees for a hitherto free

or highly subsidized irrigation service? Note that greater popular democracy could make the situation worse at least in the short run.

SOME ACTIONS BEING TAKEN

Macroeconomic policy reform, including the elimination of subsidies for public services, is the current orthodoxy. Nevertheless, where overvalued exchange rates still exist or where farmers have to pay bribes for water services, then indirectly farmers are already paying for water. User charges, at least to the level of O&M costs, are being urged. Some determination is being shown and early successes such as in the Philippines are well publicized. But policy failures also abound, e.g., the situation in parts of India where electricity is virtually free for groundwater pumping despite power shortages and overpumping of limited fresh groundwater aquifers. (Failure to rationally manage aquifers is almost universal, and U.S. experience is not always a guide to good practice.) The more important aspect of financial autonomy of the agency is still neglected. Where it is clear that neither the farmers nor the government will set or collect agreed fees (e.g., drainage charges in Pakistan) all parties, including aid donors, have a conspiracy of silence.

QUESTIONS AND CHALLENGES

Are the macroeconomic policies and liberalization measures in place so that we can wheel out farmers for the fee treatment? It appears that in many low income countries they cannot afford to rehabilitate or to complete their irrigation infrastructure, nor can they afford to let it deteriorate, as the opportunity costs are vast. Is farmer-financed irrigation a mirage or an attainable vision? Is the timetable for reform urged by external agencies unrealistic given the depth and complexity of the problems? Indeed, do we understand how to get a functioning cost recovery system in the current socio-political context of many poor (and some rich) countries?

One of the current aid themes, at least in the area of social development, is to let the recipients of aid determine their own priorities. How do we react if one priority is to have free water? In pursuing "pricism" are we not ignoring the history, hostility to change, innate conservatism and religious rationale, unwillingness to listen, and so forth in many countries? Given this, is financial autonomy a realistic goal, and if not, what moves in this direction could be regarded as progress?

Aid is not today a popular or fashionable cause; agriculture is not a fashionable area within aid; water is one of the most problematic areas within agriculture. Yet there are huge economic and social costs in failing to resolve the challenges inhibiting realization of the potential in the currently installed irrigation capacity. Water has never been so valuable. Now is not a time to neglect trying to improve its management.

Exhibit V
WASTEWATER REUSE
Dr. Hillel Shuval

BACKGROUND

A number of the countries in the Middle East and Asia will face severe water shortages that may bring them to well below the so called "water stress" level. For example, within a 30-year period, with an estimated doubling of their population, the Jordanians, Israelis, and Palestinians will have available to them, from their current water reserves, just about the limit of what is needed for survival based solely on domestic, urban, and industrial use, with no fresh water available for agriculture.

For such peoples in arid regions and others, the recycling and reuse of about 65 to 80 percent of the water supplied for urban/industrial use can often generate the only significant additional low cost water resources for agricultural/industrial and urban non-potable purposes.

CRITICAL ISSUES

Desalinated sea water, estimated to cost about US\$1.00/cubic meter, will not normally be economically feasible for agricultural use. There are a few Middle Eastern countries that are using highly subsidized desalinated seawater for growing grain and other agricultural crops at real costs several times that of the world market price. This practice is explained by these countries under a concept of "food security." This can hardly be seen as an economically sound or sustainable water or agricultural policy in the long run.

In those countries facing the most severe conditions of water stress, priority in the allocation of renewable fresh water resources should go for domestic, urban, and industrial use. As populations grow and natural sources of renewable water are depleted, desalination may become a logical and economically feasible source of water for urban and industrial use. Urban users and many types of industry can normally afford the price of desalinated seawater.

Under such conditions, recycled wastewater is the only water resource whose quantity will continue to increase as more and more water is used by the urban/industrial sector and can thus provide a rational and sustainable basis for limited agriculture, in such severely water short countries. It is estimated that a minimum water requirement of 125 cubic meters/person/year is needed to support a reasonable level of urban life with employment based mainly on commerce and industry with no allocation of fresh water for agriculture. If total urban/industrial water consumption is 125 cubic meters/capita/year and 80 percent is recycled, it would thus be possible to generate an additional 100 cubic meters/capita/year for agriculture or other purposes. This can provide a significant amount of water for a limited but sustainable agriculture. It is more than enough water to cover most of the local fresh food crop needs.

The capital investment in sewerage infrastructure is high, about US\$300-US\$500/person, which means that an investment of as much as US\$500 million dollars/million urban residents will be required. However, in densely populated countries, a high level of wastewater collection and treatment is essential, in any event, to protect the public health and to prevent environmental pollution. Enteric diseases, mosquito-borne disease, and severe environmental and ecological hazards and nuisances can result from the lack of an effective central sewerage system and the absence of adequate wastewater treatment prior to disposal into the environment. The cost of central sewerage systems and wastewater treatment to meet the requirement of safe and effective health and environmental protection should be seen as part of the cost of supplying safe water for urban and industrial use, and should be covered by those consumers.

Thus, the additional marginal cost of treatment, storage, and conveyance of purified wastewater required for unrestricted agricultural reuse, meeting the WHO health criteria, will be only a fraction of the total wastewater treatment and disposal costs, or about US\$.10/cubic meter out of a total of US\$.35/cubic meter.

SOME ACTIONS BEING TAKEN

The newly developed health guidelines for wastewater recycling and reuse developed by the World Health Organization in cooperation with the international community and the United Nations agencies are based on extensive research, sound epidemiological evidence, and engineering feasibility. These guidelines restrict the number of disease-causing helminth (worm) eggs to none in 10 liters of effluent and the fecal coliform bacteria to 1000/100ml. An effluent meeting such microbial guidelines can often be achieved in warm, sunny regions, where sufficient land is available, in low cost, effective and easily operated multi-celled stabilization ponds with 25 to 30 days of detention, which do not require expensive equipment or outside energy.

The 1992 USEPA/USAID *Guidelines for Water Reuse* prepared for them by one of the well-known American consulting engineering firms are a much stricter version of the early strict Wastewater Irrigation Standards promulgated by the California State Health Department in 1948. These new USAID *Guidelines* call for zero coliform bacteria in the wastewater effluent, which is similar to the requirement for the microbial quality of drinking water. In order to achieve these U.S. *Guidelines*, it is necessary to construct high-cost/high-tech conventional energy and equipment intensive plants, followed by additional treatment processes such as sand filtration and disinfection. Such high-tech treatment systems require a highly trained staff of operators and a sophisticated technical infrastructure to ensure sustainable treatment. Despite the claims of the consulting engineering firms, it is highly questionable that such types of treatment would be technologically or economically feasible for developing countries. In reality, many developed countries, including areas of the United States, find it difficult to ensure the continuous efficient operation of such plants. Nevertheless, USAID has distributed the U.S. *Guidelines* to all of the developing countries in which they operate.

These new American *Guidelines* are apparently based on the "zero exposure=zero risk" concept without adequate public health or epidemiological evidence to justify such a restrictive policy. For example, few if any of the natural rivers used without any restrictions for unregulated irrigation in the United States or elsewhere in the world could meet these standards. Even the microbial standards for sea water, at bathing beaches for human body contact sports, allow between 100-1,000 coliform bacteria/100ml. The California Standard has been copied by many of the developing countries, but since they are so expensive to meet, little or no progress has been made in achieving any reasonable treatment of wastewater, which is used widely in the Third World countries to irrigate vegetables without any treatment at all.

Countries now actively considering developing a wastewater recycling and reuse strategy would be well advised to use their own judgement in establishing wastewater irrigation standards. They should carefully consider the international guidelines established by the World Health Organization that provide a high level of health and environmental protection and are achievable with economically feasible and sustainable technology.

In conclusion, recycling and reuse of wastewater for agriculture, industry, and urban non-potable reuse can have the multiple benefit of an effective strategy of environmental protection and water resource conservation.

Comment by Dr. Daniel A. Okun

At the end of Dr. Shuval's excellent paper, which is applicable to water reuse only for agricultural irrigation, he mischaracterizes the 1992 USEPA/USAID *Guidelines for Water Reuse*. The *Guidelines* manual addresses all types of water reuse, especially urban and industrial reuse along with agricultural reuse.

The WHO agricultural reuse guidelines are included in the *Guidelines* manual. They are limited to only agricultural irrigation, and their application and low cost depend upon the use of stabilization ponds. However, where stabilization ponds are not appropriate, and this is generally in large municipalities where the considerable land areas required for ponds are not available, or where urban uses are to be served, conventional wastewater treatment processes are required, the level depending on the type of use. However, such treatment should not be characterized as "high-cost/high-tech." Where such practices have been introduced, as is illustrated in the manual, the costs are lower than alternative sources of water supply. Also, such facilities provide non-potable water for a wider range of uses continuously and efficiently.

The decision as to the technology to be used needs to be site specific. Cyprus, for example, as described in the manual, has adopted ponds and the WHO standards for two small installations, but conventional wastewater reclamation and higher standards for two large cities.

Exhibit VI
INDUSTRIAL WASTEWATER MINIMIZATION
Dr. William Lacy

BACKGROUND

An increasing number of U.S. Agency for International Development (USAID) initiatives are focusing on waste minimization/pollution prevention. This presentation will serve as an introduction to a waste minimization program. The goal is to support effective program implementation chiefly by people in the field.

The terms *waste minimization* and *pollution prevention* will be used interchangeably in this presentation.

Pollution prevention is the use of materials, processes, or practices that reduce or eliminate the creation of pollutants or wastes at the source. It includes practices that reduce the use of hazardous and non-hazardous materials, energy, water, or other resources as well as those that protect natural resources through conservation or more efficient use.

A pollution prevention program is an ongoing, comprehensive examination of the operations at a facility with the goal of minimizing all types of waste products. An effective pollution prevention program will:

- Reduce risk of criminal and civil liability
- Reduce operating costs
- Improve employee morale and participation
- Enhance a company's image in the community
- Protect public health and the environment

BENEFITS

In the case of waste minimization, the developing countries' national environmental goals will coincide with industries' economic interests. Businesses have strong incentives to reduce the toxicity and sheer volume of the waste they generate. A company with an effective, ongoing waste minimization plan may well be the lowest-cost producer and the least polluting company. The result is a significant competitive edge. Their public image will also be enhanced.

What broad areas of industrial, agricultural, and other activities in developing countries offer opportunities to apply pollution prevention thinking?

Are there particular environmental problems and issues related to economics, economic development, trade, and competitiveness in certain sectors that create conditions that pollution prevention projects can take advantage of because they offer unique benefits?

How can the best opportunities be identified, with regard to both economic and environmental paybacks?

In any host country, there will be a large number of existing and planned activities that have diverse environmental impacts. It is necessary to have some practical analytical framework and evaluation criteria to help make objective decisions about setting priorities for spending on pollution prevention projects, particularly ones that can be early pilot or demonstration projects to serve as models of success. Solid analysis and data may be necessary to overcome less objective support for particular projects.

What characteristics of existing industrial activities pose difficult obstacles to achieving pollution prevention success and should be given lower priority?

It is important to identify: existing facilities with large traditional pollution control investments; the attitudes and educational backgrounds of the technical workforce; and ownership conditions and management structures. Various conditions can pose barriers that would require substantial time and resources to overcome.

What general characteristics of the social, economic, and political structures in a developing country need to be understood if pollution prevention initiatives are to succeed?

Many social practices and traditions, economic conditions and priorities, and government policies, plans, and organizations will provide either a receptive or hostile set of circumstances for pollution prevention.

The above questions illustrate the goal of translating general policy support and direction for pollution prevention (such as USAID's EP3 program) into delivery systems that can rapidly deploy pollution prevention. Any person who is faced with implementing pollution prevention has many difficult decisions. Reducing complexity improves implementation. Experience with pollution prevention has shown that it is necessary to avoid being too general and too unfocused. The greatest need is to find efficient ways of identifying targets of opportunity and establishing priorities for leveraging pollution prevention investments and multiplying their positive results. Effective implementation means converting ideas into measurable economic and environmental benefits.

Another need is to identify U.S. sources of proven pollution prevention technologies and products that can be closely matched to specific opportunities in the host country. It is also necessary to balance short- and long-term needs and opportunities. If there is any major lesson to learn from the past decade of pollution prevention experience in the United States, it is that the rhetoric of pollution prevention usually exceeds its actual implementation. As the 1992 Rio Earth Summit conference illustrated, however, accelerating global concerns about environmental problems necessitates a fast-track approach to pollution prevention implementation.

It is extremely important that individuals who are relatively new to the environmental area or to the pollution prevention strategy take advantage of the past decade's research and experience. The following brief discussions are designed to provide the reader with a practical understanding of issues that confront pollution prevention programs and projects, and to distill what has been learned during the past decade.

Implementing pollution prevention in a developing country is highly complex, as it has been in the United States, and there are unavoidable obstacles to overcome, far beyond the environmental area.

Engineers alone will not make pollution prevention programs successful. There is a need to pay close attention to many institutions (e.g., financial, educational, and political) and how they can be introduced to pollution prevention and become committed to it for the long term. It is helpful to have an idealistic vision of pollution prevention: it is the path to achieving a zero waste, zero pollution, zero environmental impact industrialized and prosperous society. A number of CEOs of American corporations have publicly expressed these kind of idealistic goals for their companies in order to motivate their workforces.

To a significant degree, pollution prevention is being offered not solely on the basis of what industrialized countries have already done with it, but also as a strategy to leapfrog and avoid what the United States has mostly used to address environmental problems for over 20 years. The traditional approaches have often achieved considerable environmental success in reducing pollution, but they have imposed high costs and over time they become less efficient in reaching lower levels of pollution.

Government environmental command-and-control regulations, which nearly always are based on pollution control and waste management, provide economic incentives for pollution prevention, but they also divert resources away from using pollution prevention. Attempts by developing countries to replicate regulatory programs in developed countries can be so costly and difficult that they can divert attention and resources away from pollution prevention. But we know how to approach this problem.

Although regulations are important to foster pollution prevention, compromises are needed, and special attention to having the most flexible kinds of regulations that support pollution prevention is critical (e.g., delayed compliance and avoidance of fines or penalties for non-compliance if investments in pollution prevention are made). Direct support for pollution prevention through technical and economic assistance is also necessary.

To sum up, developing countries must introduce flexibility and regulatory compliance and use various economic incentives so that companies can use alternative pollution prevention responses. To some degree, developing countries with relatively young regulatory programs have more opportunity to facilitate pollution prevention than more mature programs, if they see enough advantages from employing pollution prevention as both an environmental and economic development strategy.

Developing countries must also provide active support, assistance, and public encouragement for using pollution prevention methods, and USAID and other donors can play a valuable role in this effort.

ASSISTANCE

This appendix lists offices of the USEPA that can assist you in developing and maintaining a pollution prevention program.

U.S. Environmental Protection Agency

Pollution Prevention Information Clearinghouse (PPIC)

The PPIC is dedicated to reducing industrial pollutants through technology transfer, education, and public awareness. It provides technical, policy, programmatic, legislative, and financial information upon request.

The PPIC provides businesses and government agencies with information to assist them in a range of pollution prevention activities, such as:

- Establishing pollution prevention programs
- Learning about new technical options arising from U.S. and foreign research and development
- Locating and ordering documents
- Identifying upcoming events
- Discovering grant and project funding opportunities
- Identifying pertinent legislation
- Saving money by reducing waste

The PPIC disseminates this information through a number of services. These include:

- A telephone hotline
- A repository of publications, reports, and industry-specific fact sheets
- An electronic information exchange network
- Indexed bibliographies and abstracts of reports, publications, and case studies
- A calendar of conferences and seminars
- A directory of waste exchanges
- Information packets and workshops.

The electronic network maintained by PPIC is designated as PIES. It provides access to information databases and can be used to place orders for documents. The subsystems of PIES include:

- A message center
- A publication reference database
- A directory of experts
- Case studies
- A calendar of events
- Program studies
- Legislation summaries
- Topical mini-exchanges

This interactive system can deliver information to the user through screen display, downloading, and fax. It is available to off-site computers via modem 24 hours a day. For information on linking to PIES, contact:

PIES Technical Assistance
Science Applications International Corp.
8400 Westpart Drive
McLean, VA 22102
(703) 821-4800

The PPIC operates a telephone hotline for questions and requests for information. The hotline provides users who cannot access PIES electronically with access to its information and services. For information on any of PPIC's services, write to:

U.S. EPA Pollution Prevention Office
401 M Street SW (PM-219)
Washington, DC 20460

or call:

Myles E. Morse
Office of Environmental Engineering and Technology Demonstration
(202) 475-7161

APPENDICES

A. Workshop Agenda

B. Participant List

C. Panelist Biographies



Appendix A - Workshop Agenda

FUTURE DIRECTIONS FOR IMPLEMENTING WATER POLICY

**THE CHESAPEAKE ROOM
UNIVERSITY OF MARYLAND UNIVERSITY COLLEGE CONFERENCE CENTER
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College Park, MD
(301) 985-7303
April 28-29, 1994**

APRIL 28

- 8:30 Official Welcome from A.I.D.
Margaret Carpenter, Assistant Administrator, Asia & the Near East Bureau
Get Acquainted Activity
Workshop Objectives and Agenda
- 9:30 Keynote Speaker: "Future Directions for Implementing Water Policy"
Dr. Peter Rogers, Gordon McKay Professor of Environmental Engineering at
Harvard University
- 10:30 Break
- 11:00 Panel presentation
- Tradable Water Rights:
Dr. Mark Rosegrant, International Food Policy Research Institute
 - Water-User Associations:
Dr. Max Goldensohn, Development Alternatives, Inc.
 - Wastewater Reuse:
Dr. Hillel Shuval, Visiting Scholar, Harvard University and Hebrew
University Professor
- 12:00 Lunch
- 1:00 Working groups on each of the three areas will address the goals for the future, major
constraints, and specific actions that should be taken over the next two to three years.
Resource persons joining these working groups include Dr. Atif Kubursi and Dr. Dan
Okun.
- 2:45 Break
- 3:15 Working groups report to plenary session
- 4:30 Closure

APRIL 29

- 8:30 Introductory activities for Day Two
- 8:45 Panel Presentation
- Pricing and Cost Recovery:
 Dr. Ian Carruthers, Wye College, University of London
 - Industrial Wastewater Minimization:
 Dr. William Lacy, Lacy & Co., Environmental Consulting
- 9:30 Working groups will identify goals and major constraints for each of the two issues. Resource persons joining these discussions are Dr. Les Small and Dr. Bill Easter.
- 10:30 Break
- 10:45 Plenary discussion on goals and constraints
- 12:00 Lunch
- 1:00 Working groups will identify specific actions that should be taken in each of the two areas over the next two to three years.
- 2:00 Plenary discussion on these actions
- 3:00 Break
- 3:15 Plenary discussion:
 Summary and Conclusions:
 Dr. Peter Rogers
- 4:30 Closure

Appendix B - Participant List

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Appendix C - Panelist Biographies

DR. PETER PHILIPS ROGERS, KEYNOTE PRESENTER

DR. PETER ROGERS has served since 1977 as Gordon McKay Professor of Environmental Engineering and Professor of City and Regional Planning at Harvard University, where he also is a member of the Center for Population Studies. His research areas include improved methods for managing natural resources and the environment, with emphasis on the use of analytic optimizing methods to incorporate both the natural phenomena and engineering controls, and the development of meso-scale models of resource management that relate directly to macro-economic parameters.

Dr. Rogers has held numerous academic and professional appointments and has served on many committees, panels, and working groups with the American Geophysical Union, the National Academy of Sciences, the American Association for the Advancement of Science, and the World Conservation Union. He has served as a consultant on water and energy issues to the governments of Pakistan, Bangladesh, and Ethiopia.

DR. MARK ROSEGRANT, PANEL PRESENTER

DR. ROSEGRANT received a B.A. in government from Beloit College and his Ph.D. in public policy studies at the University of Michigan in 1978. He worked as a policy analyst with the Ministry of Agriculture of the Philippines until he joined the International Food Policy Research Institute (IFPRI) as a research fellow in 1980. While in the Philippines, he was also a visiting lecturer at the University of the Philippines. Dr. Rosegrant has published extensively in his areas of research interest, including agricultural productivity growth, government investment behavior, food pricing policy, irrigation investment policy, and water resource allocation policy.

DR. MAX GOLDENSOHN, PANEL PRESENTER

DR. MAX GOLDENSOHN, Senior Vice President of Development Alternatives, Inc., has 26 years of experience in managing, designing, and evaluating development projects in Asia, Africa, and the Caribbean. Dr. Goldensohn specializes in institutional and policy analysis related to agricultural and agribusiness development, the adaptation of modern private and public sector organizations to the demands of changing economic and social conditions, and project start-up and implementation. He has paid particular attention to the links between remote agricultural producing areas and urban agro-industrial processing and marketing centers. Dr. Goldensohn is experienced in all aspects of field office operations, having served as Chief of Party of three large, long-term USAID projects in Mauritania, Zaire, and Sri Lanka.

DR. HILLEL SHUVAL, PANEL PRESENTER

DR. HILLEL SHUVAL settled in Israel in the early years after the founding of the State and joined the staff of the Ministry of Health where he served as Chief Environmental Health Engineer until 1965. In 1965, Dr. Shuval was appointed Professor of Environmental Sciences at the Hebrew University of Jerusalem. He has served as consultant on environmental engineering questions to the World Health Organization (WHO), the World Bank, EEC and the United Nations Environment Program. He has also served as a consultant to governmental agencies, consulting engineers and industries in many countries, most recently to Chile on waterborne cholera and to the People's Republic of China.

As an advisor to the World Bank and World Health Organization, he played a critical role in drafting the Engelberg Report and the new WHO health guidelines for recycling and reuse of wastewater in agriculture. In recent years, he has been active in studies on resolving the water conflicts of the Middle East and is co-author of a joint Israeli-Palestinian Water for Peace Plan. Professor Shuval has published 200 scientific papers and seven books on various aspects of environmental sciences and engineering, particularly on the health and technological aspects of wastewater recycling and reuse, viruses in water, water quality, and disinfection.

DR. IAN CARRUTHERS, PANEL PRESENTER

DR. IAN CARRUTHERS has been Professor of Agrarian Development at Wye College, University of London since 1984. Originally trained in Horticulture (University of London) and Economics (Oxford University), he was awarded a Ph.D. in agricultural economics in 1976 (University of London) in water resource economics. Professor Carruthers has written numerous papers and books about water resource economics, groundwater development, irrigation, drinking water, and related areas of agricultural development. He has held consultancies with the World Bank, the United Nations agencies, Ford Foundation, ODA, and USAID and has extensive field experience in many countries including Pakistan, Uganda, and Kenya. He is currently engaged as a consultant to GTZ on an applied research programme, MAINTAIN, addressing problems of irrigation maintenance.

Professor Carruthers is the Director of the Wye College External Programme, a unique worldwide educational initiative that provides master's level training for London University degrees in agricultural development and in environmental management using the methods of distance learning. He is also a Board Member of the Commonwealth Development Corporation, a British public corporation that invests in the private sector in developing countries.

DR. WILLIAM J. LACY, PANEL PRESENTER

DR. WILLIAM J. LACY, a Chemical Engineer, is President of LACY & CO., an international environmental consulting firm to industries and governments. He received his B.S. from the University of Connecticut, completed his master's degree at New York University College of Engineering, studied at the Oak Ridge Institute for Nuclear Studies, the University of Michigan, and Michigan State

University. The School for Advanced Chemistry at Paul Sabatier University, France, awarded him the University Medal in 1983, and an honorary Doctorate of Science in environmental engineering.

He worked for the Corps of Engineers, in the Pentagon for the Secretary of Defense, and in the Executive Office of the President before joining EPA.

Dr. Lacy served at EPA Headquarters from 1968 to 1984 as Chief of Applied Sciences, Director of the National Industrial Pollution Control Program, Director of Monitoring, and the Principal Engineering Science Advisor. He managed and directed the Minority Research Institute Program, established the National Dioxin Monitoring Network, and headed the International Cooperative Research and Development Program.

Dr. Lacy has authored 192 technical publications, including 11 textbooks. He has three patents and serves on the editorial advisory board of five technical journals.

For his efforts, Dr. Lacy has received numerous awards and medals from Thailand, India, Egypt, Belgium, France, Poland, and Italy. Other honors include the American Defense Preparedness Association Award, Secretary of Defense Special Service Award, Presidential Recognition Award, EPA, Bronze Medal, and the U.S. Government Distinguished Service Medal.