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Getting to Know Basins Better

As the world wakens to the reality that water is a resource that is finite and becoming increasingly scarce (see Making real water savings to offset water scarcity, IWMI News, Vol. 2. No. 2.), science requires better tools to understand and manage it. Three IWMI scientists have developed a promising way to examine water basins more closely and efficiently, thus enabling better conservation of this precious resource.

The concept is called "hydronomic zones" ("hydro," for water, and "nomus," from the Greek for a system of rules governing a specific field). In March 1999, it was presented at a conference on measuring water balance, held at San Luis Obispo, California, USA, by David J. Molden, Research Leader of IWMI's Performance and Impact Assessment Program; R. Sakthivadivel, Senior Scientist; and Jack Keller, an IWMI Fellow. The scientists' framework is designed primarily to manage water for irrigation schemes, but it can also be used to understand water for urban, ecological, or other purposes in a basin context.

"All terrestrial freshwater use," note the IWMI scientists, "takes place in a basin context." But within each basin, different areas or reaches are likely to have quite distinct characteristics. Developing the framework of hydronomic zones represents an effort to deal with these differences. As the IWMI researchers state, water issues are site-specific and, "water management strategies and means to evaluate performance should be tailored to each zone in a basin. Too often, unfortunately, this is not done and the same water management strategies are employed without consideration to the characteristics of each zone."

Molden, Sakthivadivel, and Keller say the zones are characterized mainly by the nature of return flows—whether the water that leaves the zones comes back, and, if so, in what form and of what quality. Their framework defines five major zones for irrigation management, and two additional zones that are important for nonirrigation use. The zones (see figure), listed as they occur from upstream to downstream in a waterway, are:

Natural Recapture Zone: This is the area of the basin where runoff water, both surface and subsurface, is naturally recaptured by the main body of water. In upland areas, even water that is diverted for irrigation returns by gravity to the river from which it came. Such a system is "self-conserving," say the researchers. An example of a Natural Recapture zone is the Nile River Valley in upper Egypt, where irrigation water returns to the river via seepage or drainage canals.

Regulated Recapture Zone: This area is similar to the Natural Recapture zone, except that the water does not return naturally to the river. Instead, physical link-

Workshop on Modernization of Irrigation Systems

The management and operation of irrigation systems require modernization to generate an adequate and reliable service to users. That was the tone of the fifth international meeting of the Information Techniques for Irrigation Systems (ITIS) Network, held in October 1998 in Aurangabad, Maharashtra State, India. Sixty professionals—managers, decision makers, and researchers—from around the world participated in the meeting.

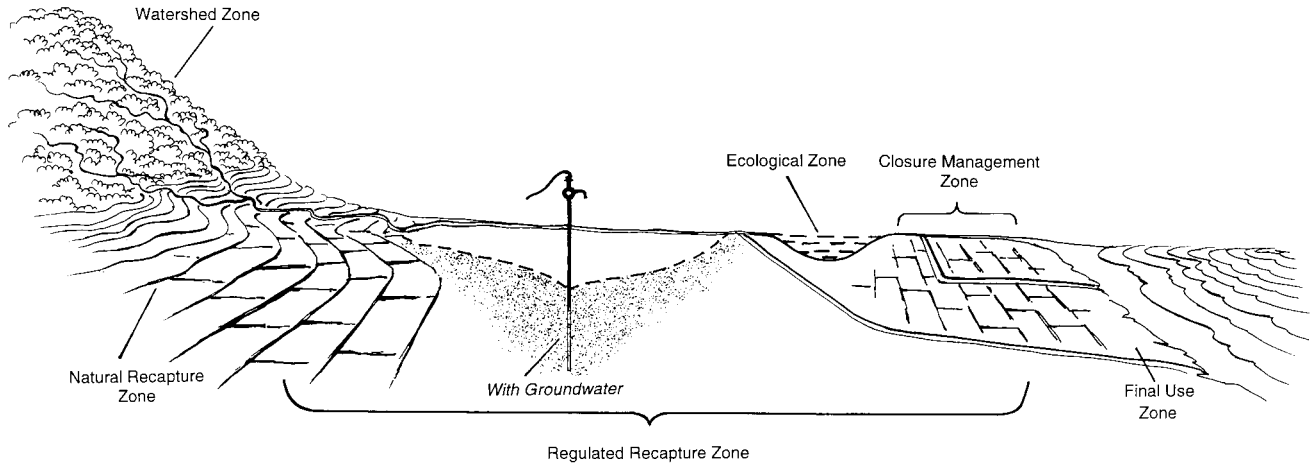
The network, of which IWMI is a supporter along with Cemagref in France and the FAO, "conducted its meeting with a basic assumption," reported IWMI's Daniel Renault, who also serves as ITIS coordinator, "that modernization of irrigation system operations is the key to success in increasing yield and productivity in agriculture, and in enhancing the management of limited natural resources such as water."

The participants avoided discussions of new hardware and specific techniques as there is a poor record of success of past rehabilitation and modernization in irrigation. They preferred instead, to seek generic and strategic actions that might increase the success of modernization efforts. These included rethinking the operation of irrigation systems within a more global framework; development of rapid evaluation methods for modernization at the project level; implementation of adapted training and capacity building programs; and partial replacement of "the monoculture of engineer-builders" in irrigation agencies with "a new culture of engineer-managers."

Modernization, agreed the participants, should not be limited to the introduction of new hardware and software, but rather, should be seen "as a fundamental transformation of the management of water resources."

The International Irrigation Management Institute, one of sixteen centers supported by the Consultative Group on International Agricultural Research (CGIAR), was incorporated by an Act of Parliament in Sri Lanka. The Act is currently under amendment to read as International Water Management Institute (IWMI).

Hydronomic zones in a River Basin.



ages must be built to recapture the water. Sometimes, this can be accomplished by gravity schemes and, sometimes, through pumping. An advantage of this zone, say the scientists, is that "the reuse can be managed for quality as well as for quantity control."

"Typically," write the authors, "Regulated Recapture zones may be found in the upper reaches of river deltas that are adjacent to coastal plains." An example is the upper three-quarters of Egypt's Nile Delta.

Final Use Zone: The final use zone lies in areas where there is no opportunity for reusing outflows for human enterprises. Typically, the final use lies at the terminal end of basins next to a sea or other salt sink. Outflows may be required to remove pollutants or to maintain environments such as coastal lagoons or estuaries.

Stagnation Zones: These include any isolated areas within the Natural Recapture, Regulated Recapture, or Final Use zones "where the drainage capacity is insufficient for the removal of leached salts and any excess inflow water." Here, water percolates into groundwater supplies leading to rising water tables, waterlogging, and salinization. Where drainage waters are saline or polluted, they are not readily recoverable. Stagnation zones may be found in portions of Pakistan and northwestern India, which have pockets of saline, shallow groundwater.

Watershed Zone: In a typical river basin, this zone is the catchment where most of the water supply originates. This zone is included because everyone agrees it is a major component in any water management plan for a river basin.

Ecological Zone: This is any area where water flows are managed partly or totally for ecological purposes. In a typical basin, Ecological Zones exist at the end of the river. But, they also may be found in internal lakes and swamps. Special consideration is required in these areas.

IWMI's scientists have proffered additional considerations, all of which contribute to informed management of water basins and their constituent zones. Two conditions in particular, the presence of pollution or salinity, and the degree to which groundwater is present, have an important bearing on the development of the water management strategies for the basin.

Equipped with an understanding of the diverse zones within a basin, managers and planners can more rapidly understand the basin to create strategies that use the basin's water resources more effectively. For example, in a closing basin [see box] more emphasis should normally be placed on technologies that increase local efficiencies in the Final Use zone, while less emphasis would be placed on these technologies in the Natural Recapture zone.

"There is a need to view irrigation in the context of whole river basins" say IWMI researchers. "But basin interactions are very complex. Separating the basin into several hydronomic zones simplifies the understanding of these interactions, and provides a framework for people to consider irrigation and other water uses in a basin context."

For more information on this article, contact David Molden, Research Leader, Performance and Impact Assessment Program, IWMI.

"Open" and "Closed" Basins

Researchers have classified water basins into three categories—open basins, which produce abundant year-long outflows; closing basins, which have outflows during only part of the year; and closed basins, which discharge no useable water at all because all of their water is already fully committed and used within the basin.

IWMI-Burkina Faso Project Praised by AfDB

IWMI received a glowing review of its role in a small-scale irrigation project in Burkina Faso—the farmers involved did not want to see the project end.

The review came from the African Development Bank, which supported the project from 1991 to 1997. The Bank rated the project "highly satisfactory," the highest performance rating. That was certainly the conclusion of many of the growers involved. "Follow-up analyses of farm budgets in the five study areas," said AfDB, "indicate that farmers, the ultimate beneficiaries of the project, were able to practically double their annual incomes as a result of increased yields and crop diversification, due at least in part to the better water management and agronomic practices introduced by the project. . . ."

Furthermore, reported the Bank, the project generated increased interest in agriculture, notably among young people. It also produced "real interest on the part of the national authorities to make use of project outputs." One of those outputs was the realization that irrigation does not have to carry high costs of investment and maintenance, but rather that when farmers' needs and the nation's priorities are carefully considered, "irrigation systems could, in fact, be put in place and operated at lesser cost."

The Bank found that the "highly participative approach" taken by the IWMI project team in studying the needs, identifying the problems, and seeking appropriate solutions "had a social and psychological impact such that the different national partners, particularly the farmers, were finding it difficult to accept the end of the project and were hoping for a follow-up phase."

Following the conclusion of this project, the Autorité de Mise en Valeur de la Vallée du Sourou (AMVS)—a large multifunctional organization charged with developing irrigated agriculture in a location in northwest Burkina Faso with a potential of about 30,000 hectares—has applied the performance assessment methodology developed by IWMI-Burkina Faso to 5 schemes (ranging in size from 50 to 500 hectares) under its jurisdiction. Judging by the conclusions and recommendations of a draft report, the AMVS endorses the approach as "being suitable for routine, system-wide application." AMVS is now expected to develop a full-fledged proposal for setting up a systematic performance monitoring system in their project area.

Donor Support for IWMI Activities

IWMI has recently received financial support for several projects that promote greater understanding and management of water in a number of Asian and South Asian countries, and in South Africa, and for cultivating knowledge in gender and water issues. The assistance comes from a variety of sources, including the Asian Development Bank, Australia, the Ford Foundation, Sweden, and the United Kingdom.

The Asian Development Bank is funding an ambitious collaborative research project on water management institutions in five developing countries: The People's Republic of China, Indonesia, Nepal, Philippines, and Sri Lanka. The Bank itself will directly contribute US$737,000 to the project, with national agricultural research systems in participating countries adding the equivalent of US$513,000, most of it in in-kind contributions. The 3-year project seeks to "improve the management of scarce water supplies for agriculture" in the participating nations, "within and responsive to a framework for integrated resource management." IWMI, which is also providing some financial support, is participating in the institutional assessments and preparation of action plans in the countries, and will conduct case studies in two industrialized countries to look for techniques that can be transferred to the developing countries.

The Australian Centre for Agricultural Research (ACIAR) is providing A$148,412 (US$92,096) to the CGIAR's System-Wide Initiative for Water Management (SWIM), of which IWMI is the

Donor Support for IWMI Activities *(Continued..)*

lead institution, to seek ways to successfully apply water-saving irrigation (WSI) techniques in China. The concept of WSI is not new, but it needs wider use in rice-based systems, especially those in China, where per-capita freshwater availability is declining and water demand is expected to increase by 50 percent in the next 20 years. The project is being undertaken in collaboration with the Wuhan University of Hydraulic Engineering and the Zhejiang Agricultural University, China, and IWMI's sister research institution, the International Rice Research Institute of Los Baños, Philippines.

The Australian agency is also contributing A$633,199 (US$392,925) for a 3-year project to promote conjunctive management of water in irrigated areas of South Asia. "Conjunctive water management has not been effective in most parts of the world," states a project document, "due to lack of appropriate combinations of institutions and management tools." The document defines such management as "the management of water from all sources within a water basin, such that the net availability of acceptable quality water for irrigation within a water basin is optimized." The effort will identify combinations of institutions and management tools that can be used together to manage surface and subsurface water in the Rechna Doab in the Punjab, Pakistan, and in the Murrumbidgee Region in Australia. IWMI's collaborators include the Pakistan Council of Research in Water Resources (PCRWR) and Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO).

South Africa's Northern Province is one of the country's driest and poorest. It is also the home of some 14,000 hectares of small-scale irrigation schemes, but productivity and farmers' income remain low. The United Kingdom's Department for International Development (DFID) is contributing Sterling Pounds 225,000 (US$355,000) toward a 3-year effort to identify practical strategies and useful institutional arrangements for "productive, profitable, socially equitable, and sustainable irrigation systems" in the province and to strengthen local partners' research capabilities. South Africa's University of the North is IWMI's main collaborator. The university has received a grant of R863,500 (US$141,000) for 3 years from the Water Research Commission of South Africa for "Sustainable Management of Smallholder Irrigation," a project directly related to the DFID-sponsored study. The province's women farmers are expected to be among the major beneficiaries.

Women and farming constitute the subject of another grant, of US$198,200 from the New Delhi office of the US-based Ford Foundation. The 18-month-long project will attempt to remedy what its planners call "the paucity of good research—and competent researchers—in the general area of gender and natural resources management, and particularly gender and water." IWMI will use the support to identify and train researchers, carry out research into gender issues, and communicate the results to a wider audience of educators, program managers, and policy makers.

In support of the wider issues related to gender and poverty, the Swedish International Development Agency (Sida) has contributed US$260,000 to IWMI's gender, water, and poverty project. The project is designed to increase the understanding of the linkages between irrigation, gendered poverty eradication, and land and water productivity; and to support research designed to provide better tools and methodologies to help poor women and men participate in the management of their irrigation and water resources systems. Research is being undertaken in India, Mexico, Pakistan, and South Africa.

Women, particularly female children, are most vulnerable to water-borne diseases and health risks posed by increasing exposure to contaminated water. "Their role as laborers in agriculture and having primary responsibility for domestic chores account for these increased risks" states the project document. IWMI, together with the Center for Drainage and Water Management, McGill University, Montreal, Canada, is addressing these problems in a joint project designed to bridge the gap that exists between irrigation, and water and sanitation sectors so that future initiatives take into account all uses and users of water. The Canadian International Development Agency (CIDA) is providing Can$150,000 (US$93,080) to support this project being undertaken in the Punjab, Pakistan. The lessons learned here should be applicable to other South Asian countries.

BOOKSHOP

New Research Reports

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- Merrey, D., and S. Baviskar (Eds.). 1998. *Gender analysis and reform of irrigation management: Concepts, cases, and gaps in knowledge.*

SWIM Papers

- Daene C. Mc Kinney, Ximing Cai, Mark W. Rosegrant, Claudia Ringler, and Christopher A. Scott. 1999. *Modeling water resources management at the basin level: Review and future directions.* SWIM Paper 6.
- Theib Oweis, Ahmed Hachum, and Jacob Kijne. 1999. *Water harvesting and supplementary irrigation for improved water use efficiency in dry areas.* SWIM Paper 7.
- Bakker, Margaretha, Randolf Barker, Ruth Meinzen-Dick, and Flemming Konradsen. 1999. *Multiple uses of water in irrigated areas: A case study from Sri Lanka.* SWIM Paper 8.

Monograph

- Harald D. Frederiksen, and Rodney J. Vissia 1998. *Considerations in formulating the transfer of services in the water sector.* International Water Management Institute. Colombo, Sri Lanka.

Special Issue of Agriculture and Human Values

- Agriculture and Human Values: *Journal of the Agriculture, Food, and Human Values Society,* 15(4). December 1998.

  This special issue is on the theme, "Choice, complexity, and change: Gendered livelihoods and the management of water." The papers in this collection grew out of a workshop on Gender and Water sponsored by the International Water Management Institute.

Special Issue of the International Journal of Water Resources Development

- International Journal of Water Resources Development, 15(1&2), March/June 1999. Special Double Issue: Research from the International Water Management Institute (IWMI).

  This issue is devoted to IWMI and contains 12 research papers on IWMI's research work. The volume reports our work on assessing global water supply and demand and the implications of water scarcity for future water and food security policies; analyses of whole river basins; applications of remote sensing for measuring water consumption and agricultural performance; use of new quantitative techniques for assessing the impacts of interventions; and activities aimed at identifying and finding solutions to water problems affecting the quality of life, such as water-related diseases and gender inequities.

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STAFF

Douglas Merrey is the new Deputy Director General (Research Programs) at IWMI.

Dr. Merrey, who joined IWMI in 1985, holds a Ph.D. in cultural anthropology from the University of Pennsylvania, USA. He has extensive experience in irrigation management issues, much of it in Asia and the Middle East. In addition to his new position, he continues as Leader of the Policy, Institutions, and Management Program.

David Governey is IWMI's new Deputy Director General (Operations). Before joining IWMI in 1986 as Director of Finance and Administration, he held a similar post at the International Institute of Tropical Agriculture (IITA) in Ibadan, Nigeria. He is a Fellow of the Institute of Chartered Accountants of Ireland.

Yutaka Matsuno has moved from postdoctoral fellow to full member of IWMI's research staff in Colombo. He received his doctorate in agricultural engineering from the University of Idaho, USA, where he conducted computer simulations and research in the transport of dissolved substances in irrigation systems. He joined IWMI in 1996.

Ralf Starkloff, Sociologist, joined IWMI in January 1999 as a postdoctoral fellow, and works on irrigation issues in IWMI Pakistan. Dr. Starkloff has done research in Sri Lanka on participatory water supply projects, focusing on the social and environmental factors related to water scarcity in hill-country catchments. Before joining IWMI, he was a Senior Lecturer at the Sabargamuwa University in Sri Lanka.

VISITORS

Dr. K. R. Sharma, Chief, Research and Technology Development Branch, Kathmandu, Nepal, and Dr. Krishna Prasad, Research Coordinator, IWMI-Nepal, came to IWMI in Colombo on 13 January for a 10-day visit. During this time they acquainted themselves with IWMI's research programs and drafted some project proposals.

Dr. Wim Bastiaanssen, an IWMI Fellow working at the International Institute for Aerospace Survey and Earth Sciences (ITC), the Netherlands, visited IWMI from 19 January to 5 February. During this time he worked on remote sensing in Kirindi Oya, and completed a research paper and a project proposal.

Dr. Johan Holmberg, Director, Department of Natural Resources and the Environment of the Swedish International Development Corporation Agency (Sida), visited IWMI on 25 February. The visit was arranged to increase the agency's knowledge of the institute's programs and activities. Sida became a new donor to IWMI in 1998.

Dr. David Dawe, an Economist from IRRI, visited IWMI for 3 days in March. During this time he worked with IWMI staff on the World Water Council Vision project, due to be presented in the Hague in March 2000.

Dr. Mark Svendsen, a Private Consultant from the USA, visited IWMI in Colombo for 7 days in early April to start writing the final report on the institute's project in Turkey. He subsequently traveled to IWMI's office in Izmir, Turkey, to complete the report.

CONJECTURES AND REFUTATIONS

If irrigation is to help eradicate poverty in the future, there must be a new perspective on society's exploitation of water available for agricultural use. Take the case of three major poverty groups: urban and rural poor net food buyers; rural poor producers; and rural laborers in irrigation-related occupations.

Claims that irrigation development benefited these three groups were valid in recent decades, when rapidly expanding, highly subsidized infrastructure development improved irrigated food production. This in turn lowered and stabilized food prices, which was important for poor net food buyers, who spend as much as 80 percent of their incomes on food.

Poor net producers gained, too, if their land happened to fall within the project area, or if land reform policies provided them with newly irrigated plots. And many poor women and men found work indirectly through irrigation—in intensified agriculture, construction, and spin-off employment.

But now the irrigation environment has changed drastically. Infrastructure subsidies have declined; the cheapest and most accessible water resources have already been developed; and in a growing number of basins, all the water is committed. Meanwhile, farmers are being urged to diversify their crops and grow high-value foods for the urban elite.

What does this mean for the three poverty groups? Poor net food buyers do not consume high-value crops, and thus risk exclusion from the benefits of irrigated agriculture. Profits from new cropping patterns could at least benefit the poor cultivators—if they have and keep access to water as well as expensive inputs. But those who were excluded from access to water in the past, and who lack the means to get it now, may be excluded forever.

Poor cultivators who have at least some access are probably the ones who will be forced to bear the burden of required water conservation. The elite cultivators are the most likely group in basin-wide fora to protect the water rights of their schemes as a whole. It is also in the direct interests of the poor users that these negotiations are successful. But within the schemes the elite probably take the scarce water for themselves, gradually forcing the poor out of irrigated agriculture. The rural poor who once found work in irrigation-related occupations will find less, as agencies stop building new infrastructure and larger farm operations become more mechanized.

Any future claims, then, of a positive relationship between irrigation and poverty alleviation, let alone eradication, will have to be empirically tested and proven.

These issues should be taken into account in a new perspective of water management contributing to poverty eradication in the future. By prioritizing the multiple water needs of poor women and men, protecting their current water rights, and targeting new infrastructure development and other support services to the poor, governments and NGOs can make the critical difference.

Barbara Van Koppen, Gender Specialist and Leader of IWMI's Gender, Poverty and Water Project.

BOOK REVIEW

More jobs per drop: Targeting irrigation to poor women and men. 1998. Barbara van Koppen. The Netherlands: Royal Tropical Institute.

"On the one hand, irrigation has important positive effects on the well-being of poor smallholders and landless people while on the other, the exclusion of poor men and especially poor women from owning rights to irrigated land and water is still widespread," writes Barbara van Koppen in her thesis on the role of external support agencies in irrigation performance. "This limits their control over the benefits and continues deprivation. Governmental and nongovernmental irrigation agencies often reinforce this exclusion."

Barbara van Koppen's thesis sets out to contribute to better understanding of the links between poverty alleviation, gender issues, and agency approaches to irrigation development. In doing so, she draws instructive comparison between the needs of poor people in rice schemes in different social and cultural settings, and points out how the irrigation agencies can contribute towards poverty alleviation in the rural areas in developing countries.

Under many conditions, poor smallholders who are endowed with rights to irrigated land and water, achieve higher land productivity than larger farmers. Similarly, women are often as efficient farm managers as men, provided they have access to productive resoures. "Endowing poor women and men with rights to irrigated land and water," argues Barbara van Koppen, "will help alleviate poverty and can induce a viable pattern of agricultural growth."

Van Koppen's arguments are drawn from an extensive literature review and two in-depth case studies she undertook in Bangladesh and Burkina Faso. Her literature review documents the effects of irrigation development on both poverty alleviation and productivity, and traces inclusion and exclusion processes undertaken by irrigation agencies. Those agencies that bear most of the investment costs of infrastructure, or transfer the rights and obligations in these publicly financed schemes to users, are found to have ample opportunity to vest resource rights in poor women and men. "Few agencies use this potential," writes van Koppen. "Instead, a further skewing of the division of resource rights is widely reported."

The selected case studies provide two contrasting scenarios; the one in Bangladesh supplying targeted support to the poor, and the other in Burkina Faso showing exclusion processes through public irrigation interventions. In spite of the initial project aims in Burkina Faso—which fully recognized women's role as rice cultivators and future title holders to improved plots—women were categorically excluded, and some men endowed with land rights they traditionally never had.

In Bangladesh, where irrigated rice cultivation is predominantly a male activity, the poor were organized into groups by local nongovernment organizations. Support for various activities, including irrigation, was provided to poor people through these groups. Where empowerment of women was the aim of the nongovernment agencies, women have risen to positions where they fully participate in the managerial functions of irrigation enterprises—enterprises that were, traditionally, exclusively managed by males. "This shows," concludes Barbara van Koppen, "how proper targeting of irrigation support in water development leads to the inclusion of individuals and groups who would otherwise have remained excluded."

Felicity Chancellor, HR Wallingford, UK.