A Year of Change, Discovery and Impact

ANNUAL REPORT 2003-2004

Improving water and land management for food, livelihoods and nature

CORE VALUES: *Excellence* *Impact –orientation* *Partnerships* *Teamwork* *Knowledge sharing* *Respect for Diversity*

Photographs from left to right;
Water scarcity in Africa. Photo credit - courtesy IWMI South Africa.
IWMI staff attending a Consultative Committee Meeting. Photo credit - IWMI South Africa.
Measuring rainwater evaporation in Karnataka, India. Photo credit - Prisca Chapuis.
African smallholder weeding her irrigated plot. Photo credit- IWMI South Africa.
Indian women selling vegetables at the weekly market in Maharashtra . Photo credit - Prisca Chapuis.
Rural children in the Uda Walawe region, Sri Lanka. Photo credit - Phillipp Stanzel.

Photo Credit: Frank Rijsberman

Remo Gautschi stands before the Narmada dam during a field trip to India.

IWMI Progress Evaluated

In November 2000, the IWMI Board approved an ambitious new Strategic Plan drawn up under the guidance of IWMI's then brand-new Director General for the period 2000-2005. The Center has been aggressively implementing this Strategic Plan and in late 2003 the Board concluded that many, if not most, of the goals were reached or within reach.

IWMI merged its programs with those of IBSRAM and expanded its mandate to water and land management. The Center has more than doubled in size and become strongly decentralized with significant operations in Africa and India. Strategic new initiatives were set up in which IWMI plays a steering role, not least the CGIAR Challenge Program on Water and Food. The IWMI headquarters building in Colombo has been modernized and refurbished and a series of change management processes have jointly overhauled the systems on human resources, financial management, quality management, database management and knowledge sharing. The Board felt IWMI was now well-prepared for whatever challenges lay in store for the organization. It decided to gather feedback on the perception of our stakeholders on IWMI's progress and kick off another strategic planning round.

During 2003, IWMI went through a parallel a) center-commissioned external evaluation of the complete center; and b) highly consultative strategic planning process with emphasis on inputs and feedback from stakeholders outside IWMI as well as from the IWMI staff. We are very pleased to conclude that both processes were very productive and provided the Board with good inputs for its discussions at both Board meetings in 2003. You will find the major outputs of both processes reflected in this annual report.

Evaluation by Our Partners

The external evaluation was somewhat innovative, we believe, because it was conducted by three evaluators drawn from the ranks of our NARES partners. Led by Prof. Alaphia Wright of the University of Harare (Zimbabwe), with Prof. Vaidiyanathan of the Center for Development Studies in Chennai (India) and Dr. Beatriz del Rosaria of PICARD (the Philippines) as members, the mission evaluated three regional offices individually and the headquarters in Colombo jointly. Other inputs into the evaluation were a comprehensive written survey of our key partners and stakeholders (119 responses), six stakeholder workshops in Ghana, India, the Philippines, South Africa, Sri Lanka, and Thailand, and a limited number of in-depth interviews with key stakeholders.

The evaluation provided the Board with a valuable picture of how the stakeholders and partners see IWMI's strengths and weaknesses, as well as its opportunities and strengths.

An Inclusive Strategic Plan for 2004–2008

The Strategic Plan process was equally consultative and focused on communication with our stakeholders. The process allowed IWMI staff ample scope to come together on the new thinking that will provide guidance and direction for IWMI in what are promising to be interesting times. We believe the new Strategic Plan 2004–2008, approved by the Board in March 2004, positions IWMI well for a time that is likely to be characterized by rapid change. We feel the organization is now flexible, responsive to change, nimble enough to take advantage of opportunities and resilient enough to withstand shocks that may occur.

Rapid Change in Our External Environment

The IWMI Board believes that in the coming years further changes and reforms of the CGIAR system are needed to meet the high demands of a rapidly changing environment. We have no doubts that the CGIAR dynamics will cope with these challenges. We believe that the transformation of ISNAR to a program of IFPRI is likely to have triggered a new willingness to consider options that were until now taboo. We are certainly ready to be creative and open in this process of change—with the confidence that we are ready and well prepared to play our part.

Board Accountability

We recognize that these are times that call for greater accountability and we are pleased to introduce, in this report, a new IWMI Board Statement on risk management and internal controls. A format has also been developed for regular reports, by management to the Board, on relevant changes and trends in our most important "asset," our staff, with emphasis on gender and diversity perspectives. Part of this report is included in this Annual Report, in line with the recommendations of the CGIAR Gender and Diversity program.

Ambassador Remo Gautschi
Chair, IWMI Board of Governors

Photo Credit: Frank Rijsberman

IWMI Board Members meet with rural Indian communities during a field trip in 2003.

Photo Credit: Sanjini de Silva

Frank Rijsberman visits the semiarid region of the São Francisco basin, Brazil, March 2004.

IWMI's Ambition: To be a World-Class Knowledge Center

Over the last five to ten years, IWMI with its partners, has contributed a number of key concepts and tools to help understand the "water crisis," particularly at basin level. IWMI, with many partners, has also developed three key initiatives[1] through which it hopes to make a major contribution to both the understanding and the resolution of the water crisis as it relates to agriculture, health and the environment. This is the arena in which IWMI has ambitions to become a preeminent water-and land-knowledge center. At the heart of that endeavor is IWMI's research agenda.

Development of our agenda starts with an analysis of the water- and land-related constraints poor women and men face in the wider context of the river basin. Since we believe that, by and large, the scope for improving the productivity of available resources is greater than that for developing additional resources, the overarching research question for IWMI is: how can we grow more food and sustain rural livelihoods with less water in a manner that is socially acceptable and environmentally sustainable?

IWMI contributes through development of concepts and models, the development of water-and land-resources databases held in trust as global public goods and also by supporting major efforts in capacity building. Going beyond understanding the crisis, IWMI also focuses on research to evaluate and test solutions to overcome the underlying factors. In addition, the key interactions of agriculture with the other main water-using sub-sectors—i.e., urban and industrial use, the environment and energy—have been prioritized and are addressed through the research agenda.

Vision for IWMI in 2008

As stated in our new Strategic Plan, our vision is that in 2008 IWMI is a world-class knowledge resource center on water, food and environment, generating knowledge on better water and land management in developing countries through strategic research alliances with partners in Asia and Africa on the one hand, and advanced research institutes in developed countries on the other. This knowledge is held and maintained as global public goods for the benefit of all mankind.

IWMI's primary research sites and field laboratories are the benchmark basins of the CGIAR Challenge Program on Water and Food, as well as IWMI's own (smaller-scale) benchmark basins. In these basins IWMI is not only generating knowledge and sharing it actively through a capacity-building program, but also working with a range of partners from NARES, to NGOs and to farmer organizations to have this knowledge applied for the direct benefit of poor farmers and their families. In the benchmark basins, IWMI has developed long-term programs and partnerships that enable it to assess the impact that interventions have on key indicators. IWMI's research priorities are developed in close consultation with the key partners in the benchmark basins, as well as with the system of international agricultural research to which it belongs. It is IWMI's responsibility to translate the diverse sets of the partners' priorities into a coherent and focused research agenda with emphasis on achieving impact on sustainable water-and land-resources management, efficiently and effectively.

[1]The Dialogue on Water, Food and Environment, The Comprehensive Assessment of Water Management for Agriculture, The Challenge Program on Water and Food.

By 2008, IWMI expects to have active policies to build the capacity of its highly diverse and closely gender-balanced staff for a number of years. IWMI's impact, performance and service culture are based on a set of policies and procedures that are actively maintained in its Quality Management System.

Strategies to Achieve our Vision

The actions and strategies developed in the 2004–2008 Strategic Plan to achieve the vision outlined above evolve around two key ideas, namely, to become a world-class knowledge center and to further develop an organizational culture that emphasizes impact, performance and service.

Knowledge Roles

IWMI's ambition to become a world-class Water, Food and Environment Knowledge Center, focuses on four key Knowledge Roles. Knowledge Generation, or research, remains IWMI's core business, but its value is enhanced by placing it in the context of the other three knowledge roles: Knowledge Sharing, Knowledge Brokerage and Knowledge Application.

IWMI has adopted a network-based approach to doing collaborative, multidisciplinary research. The research agenda reflects global priorities in our area of competence, based on a process of priority setting with our national and regional partners and stakeholders. Our knowledge brokerage role focuses on engaging national researchers and research organizations in South-South and South-North partnerships. IWMI, as a research organization, needs development partners to enable dissemination and uptake of our knowledge. Developing effective relationships with the appropriate development partners (NARES, local NGOs, INGOs) is our responsibility.

Building an Organizational Culture Based on Impact, Performance and Service

IWMI has instituted a formal impact assessment initiative, designed to improve IWMI's internal management and priority setting process; and to ensure that IWMI's research and capacity-building programs meet the needs of its stakeholders and partners. Indicators and targets are being developed to measure staff performance and the Institute itself in fulfilling its knowledge roles and functioning as a performance-oriented organization.

IWMI's service units provide services primarily within the organization, and to some extent also outside of IWMI. Regular assessment of service needs and the quality of the services provided will be carried out in future.

As outlined by the Chair of IWMI's Board of Governors, we feel that IWMI is well prepared to take advantage of the opportunities offered by our rapidly changing environment. We thank the many people, both inside and outside IWMI who participated actively in the process of evaluation and strategy development for their valuable contributions!

Prof. Frank Rijsberman
Director General

The year in review

Change - Discovery - Impact

Transforming IWMI into a 21st Century Organization

For IWMI, the period from 2000 to 2003 was characterized by rapid change or a "process of deep transformation." Change was necessary, to meet the challenges of the 21st century and to deliver on the promise of "improving how water and land are managed for food, livelihoods and the environment," in a world where the water crisis was deepening and food and livelihood security were increasingly at risk.

The core of IWMI's business is formed by a portfolio of projects with either restricted or unrestricted funding. The first key change was to establish a project-based management system with a continuous rather than an annual project-development cycle and a decentralized budget, planning and monitoring system. A web-based accounting software (EPICOR) was also introduced.

In addition, IWMI effectively reengineered its business processes and systems through a series of change-management projects. These change-management projects which were successfully completed are the Quality Management Project (QMS), Timewriting Project, Intranet, Database Development Project, Human Resources Reform and the Knowledge Management Project.

These organizational projects were designed with the specific intention of creating a more dynamic, efficient and modern organization with a strong culture of service.

Timewriting Project

The Timewriting Project involved the introduction of "TimeTracker"—a web-based time-recording system, which records time spent by researchers on projects. It integrates project planning (budgeting) and project implementation with the financial administration system. All research activities recorded and tracked provide useful information such as monthly figures on the progress and status of each project as well as monthly feedback by region and research theme for the institute.

Intranet Project

The IWMI Intranet is an electronic platform for internal communication linking all IWMI offices around the world. It provides instant access to administrative and financial information, research and project details, data and other useful information that drive the operation of the institute. Staff are able to access the accounting software EPICOR, TimeTracker, Human Resources databases, QMS procedures and information on Management Team decisions. The Intranet has replaced internal memoranda and general e-mail messages to the institute. Future plans include using the Intranet for communication between all offices, video-conferencing and similar applications.

Database Project

The 2000-2003 strategic planning process identified a key need for better data management and data sharing across IWMI research projects and regions. In 2003, the Database Development Project Team built the Integrated Database Information System (IDIS) prototype. This was a web-based information system relying on open-source. It was designed to facilitate input and retrieval of metadata and data according to ISO standards, as well as displaying data on maps. Since December 2003, the project team has continued its efforts on documenting the IDIS Prototype. An anonymous on-line User Requirements Survey helped determine a list of priorities. In the second quarter of 2004, the survey key findings

TimeTracker, a web-based time recording system helps track time spent on research projects, and integrates this data into the finance and administration systems.

IWMI's Intranet provides instant access to a wide range of information for staff. It also facilitates internal communication.

will be applied to propose a second prototype focusing on users' most important requirements. This prototype will feature the IWMI integrated rainfall dataset as an example to demonstrate how IWMI can maximize return over data investments, by bringing together and sharing its data collections across offices. Meanwhile, integration of other datasets will be carried out according to user needs, to increase the availability of high-priority data.

Quality Management Project

The Quality Management Project updated and streamlined IWMI's policies and internal processes and procedures, putting in place a "Total Quality Management System"(QMS) against which all aspects of the Institute's work can be measured and improved. The QMS has documented and effectively reengineered all the internal processes by benchmarking them against best practices as required for ISO certification. At the center of the QMS is the "Research Life Cycle" a module that clearly defines the stages a research project goes through, from concept to completion. This Life Cycle, along with relevant procedures, requirements and worksheets, is available on the Intranet as an active resource for researchers and support staff.

Launch of Quality Management System (QMS) Manual

With the finalization of most of the QMS procedures, the QMS Manual and Research Quality Operating Procedures were launched at IWMI in October 2003 and Non-Research Quality Operating Procedures were launched in February 2004. With the system set up and running IWMI is now looking forward to ISO 9001:2000 certification in the near future.

The QMS will require constant monitoring and continuous improvement. As a part of this monitoring process, theme leaders carried out the first Research Internal Quality Audit at IWMI headquarters in 2003, to assess to what extent the procedures were being used and perceived as useful. Some procedures will be revised to reflect their findings. The first Non-Research Quality Audit is expected to start in March 2004.

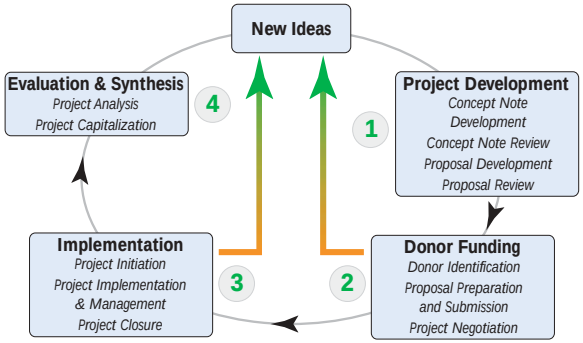
Lessons learnt from the QMS process are being shared with other members of the CGIAR network. All the manuals are available to all staff on IWMI's Intranet.

Knowledge Management Project

A knowledge-sharing initiative in January 2001 led to the creation of IWMI's Information and Knowledge Group (IKG) in 2002, bringing together the communications, scientific publishing, e-library and resource center and information and technology units into one team, to serve the Institute's researchers. A number of practices, information tools and platforms were put together to improve the effectiveness of IWMI's research and build a culture of knowledge sharing. Strong links with partners to reach educational communities and those at field level helped to extend the impact of IWMI's research. As a key partner in programs such as the Challenge Program on Water and Food, the Comprehensive Assessment of Water Management in Agriculture (SWIM 2) and the CGIAR's System Wide Initiative on Malaria in Agriculture, IWMI is well placed to encourage the exchange of experience and solutions between researchers and development professionals and has identified four key knowledge roles* which will take it to its goal of becoming a key knowledge center for land and water management by 2008.

*See Highlights of Strategic Plan 2004–2008 (pages 20 to 21).

IWMI Research Project Cycle



The year in review

Change - **Discovery** - Impact

HR Reform

In 2001, a Center Commissioned External Review was carried out. Based on the recommendations of this review, IWMI completely reorganized its HR functions. In summary, the following key actions were implemented:

1. The development of a modernized, single personnel policy for all staff in all locations.
2. The creation of a new "regional" staff category to bridge the national-international divide.
3. The introduction of a revised staff-classification system, which created a transparent, objective set of job families and grades that described explicitly the skills and abilities required for every position in IWMI. These positions were graded and mapped onto a set of salary bands with well-defined and publicly known upper and lower boundaries. This was finalized at headquarters in 2002 and in other locations by 2003.
4. The introduction of a new annual-performance review and development planning tool.
5. The introduction of a major IWMI-wide training program including a Leadership Development Program (LDP) targeting high potential individuals, a program of "soft skills" training on four modules: communication, presentation skills, project management, and leadership and team building, and lastly, expanded technical skills training.
6. A staff-induction program to help new staff settle in, get to know the institute, the staff and the different services provided by IWMI.

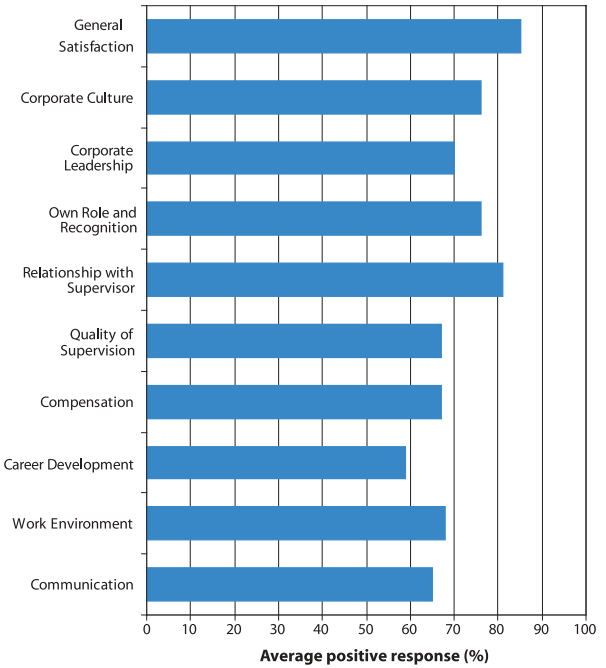
Employee Satisfaction Survey

In October 2003, the first Employee Satisfaction Survey was conducted. The survey indicated that staff satisfaction was high in a number of key areas such as job satisfaction, employee-supervisor relationships, corporate culture, corporate leadership and clarity of roles and recognition. The survey helped IWMI identify areas for improvement such as internal communication, career development and better implementation and follow-up on the performance appraisal system. These improvements will be assessed through regular Employee Satisfaction Surveys in the future.

Customer Satisfaction Survey

IWMI carried out a Customer Satisfaction Survey (CSS) of eleven of its principal services units in late 2003. The primary purpose was to develop a set of actionable strategies, performance criteria and practical performance indicators that will help IWMI improve the services provided by the different service units within the institute. This survey will also help to further enhance a "service culture" within IWMI's service departments in line with the new Strategic Plan. The CCS provided each unit with an overall satisfaction rating, together with ratings for various service functions within the unit. It clearly identified for each unit, specific areas which are a high priority for improvement. As a result of this feedback, each service unit manager has prepared detailed action plans for improving the quality of service in his or her particular areas of responsibility. The CCS data provides a baseline at 31 December 2003 against which future improvements in services can be evaluated. The Institute will undertake periodic surveys to evaluate changes in satisfaction levels against this baseline.

Employee Satisfaction Ratings



In IWMI's Employee Satisfaction Survey, 10 categories were identified. "General satisfaction" and "relationship with supervisor" received the highest ratings, followed by "corporate culture", "leadership" and "own role and recognition."

Partnerships through Collaborative Research

Over the past three years, IWMI rapidly expanded in size, more than doubling its number of researchers recruited from both the North and the South. Sizeable new operations were set up in Africa and India. Around 60 percent of IWMI's research staff now work outside of headquarters under a decentralized system of management with a matrix structure. IWMI's approach is to build partnerships through collaborative research, drawing on the strengths of partners from the North and South through research networks and consortia. Today, IWMI not only contributes to changing the way water and land are managed in agriculture but also the way international agricultural research on water, food and environment is conducted.

Impacts of the IWMI-IBSRAM Merger

IWMI's merger with the International Board for Soil Research and Management (IBSRAM) in 2001 brought a new dimension into the Institute's knowledge base, while opening the doors for land-resources management programs in Southeast Asia. As a result of the merger, a more integrated land and water-resources strategy was also implemented. The Management of Soil Erosion Consortium (MSEC) and the Asialand network (both programs initiated by IBSRAM) were successfully continued under IWMI. Associated research networks between these two programs cover nine countries in Asia, and IWMI is expanding land-management projects into Africa where a similar network is being set up.

New Initiatives

The Institute has developed and expanded programs on groundwater management and the environment. Significant new international initiatives, such as the Dialogue on Water, Food and the Environment, The Comprehensive Assessment on Water in Agriculture (CA), the Challenge Program on Water and Food (CP) were launched. These initiatives fitted into the emerging global water-food-environment nexus. IWMI also became a partner in the System-wide Initiative on Malaria and Agriculture (SIMA) and an Advisory Center for the Global Water Partnership (GWP).*

*See pages 14 to 15.

The year in review

Change - Discovery - **Impact**

Significant Impacts

The WaterDome—Putting Water High on the Global Development Agenda

IWMI, on behalf of the Africa Water Task Force organized the "WaterDome" a parallel event to the 2002 World Summit on Sustainable Development held in Johanessburg, South Africa. Inaugurated by Nelson Mandela, the WaterDome attracted some 15,000 visitors, including over 100 ministers from the water, agriculture and environment sectors, heads of state, international-development agencies and the media. The Dome's Water and Food Security Day, organized by IWMI, drew global attention to the need for better water management in agriculture, which takes up most of the developing world's water supplies. Several transboundary agreements were ratified at the WaterDome and new initiatives launched, including the CGIAR Challenge Program on Water and Food. Apart from issues on sustainable development, water received the most amount of international media coverage at the Summit.

Photo Credit: Courtesy-Waterdome

The symbolic inauguration ceremony at the Waterdome. Left to right: Ronnie Kasrils, Water Resources Minister for South Africa; Nelson Mandela, former President of South Africa; Ambassoador Salim Ahmed Salim and HRH the Prince of Orange.

Facilitating a Ministerial Roundtable on Water-Sector Challenges in Asia

In May 2002, IWMI, the Asian Development Bank (ADB), the Economic and Social Commission for Asia Pacific of the United Nations (ESCAP) and the National Water Resources Committee Office of the Thai Government brought together ministers from 10 Asian countries to address water and sustainable development issues in Asia. The discussions, held in Bangkok, identified key areas for regional cooperation. In concluding, a joint statement on shared water priorities and points for action was issued. The need for investing in water infrastructure development and agricultural management was a high priority area.

Photo Credit: Courtesy-Waterdome

The Waterdome drew the world's attention to a number of critical water issues in Africa and other developing countries and attracted over 15,000 visitors from the water, agricultural and environmental sectors as well as from the general public.

The Hyderabad Declaration on Wastewater Use in Agriculture

The Hyderabad Declaration on Wastewater Use in Agriculture was the outcome of a workshop held in 2002 in Hyderabad, India, sponsored by IWMI and the International Development Research Centre (IDRC). Several NARES from Africa, Asia and the Middle East signed the Declaration, which has now been translated into three languages (Spanish, French and Arabic) and widely disseminated. Its underlying principles, together with IWMI's related research, are already influencing WHO and USEPA/USAID public-health guidelines.

3rd World Water Forum

Over 24,000 participants from 180 countries attended the 3rd World Water Forum in Kyoto, Japan in March 2003.

IWMI and the Dialogue on Water Food and Environment organized 13 sessions under the theme "Water, Food and Environment." The sessions highlighted both the potential for improved food production and agricultural management and the need to ensure that enough water is allocated for nature. The sessions acknowledged the importance of providing key tools, methods and guidance to the actors engaging a dialogue process or willing to strengthen an ongoing initiative.

The Comprehensive Assessment on Water in Agriculture also held a special session at the WWF. The opening session looked at the benefits of the past 50 years of water development for agriculture and examined the water management challenges communities face and what solutions have been developed. Among other issues discussed were the extent to which managing water for agriculture in irrigation and rainfed systems sustain livelihood security, and the trade-offs and synergies between producing food and ecosystem services.

Photo Credit: Sanjini de Silva

Issues arising from the global water-food-environment nexus were the focus of several sessions at the WWF, which examined the potential for better food production and management of agriculture.

Expected Impacts

IWMI intends that its projects and programs will ultimately have a lasting and global impact on water and land management for the benefit of food production, livelihoods and nature. However, it is unrealistic to expect that IWMI's impact at this level could be easily measured or attributed to its research. While maintaining a vision towards our overall mission, we have created a typology of seven intermediary impacts that IWMI, together with its partners, can reasonably anticipate, track and measure. These are:

- Raised awareness of new research
- Application of new knowledge
- Employment of improved tools, technologies and techniques
- Employment of improved policies/institutions
- Enhanced capacity
- Strengthened partnerships
- Improved livelihoods (within project locality)

The typology is used to identify the range of impacts, direct and indirect, that any one project or group of projects might have. Further, for each impact type a series of vehicles has been identified for achieving impact, supported by a set of sample indicators and measurement tools. While the focus of the impact typology is at the project level, progress toward the achievement of these intermediary impacts will help IWMI and its partners better gauge their contributions toward the Institute's ultimate goal of improving the lives and livelihoods of poor rural communities.

Ex-post impact-assessment pilot studies to test this methodology are being carried out on three projects: Water Accounting Methodology, Water Management for Malaria Control and Shared Control of Natural Resource (SCOR)—a USAID-funded project carried out in Sri Lanka in the mid-1990s to "intensify sustainable productivity of land and water resources through novel watershed management models." A combination of quantitative and qualitative techniques are now being employed to systematically assess the anticipated impacts of the three projects.

Photo Credit: Courtesy IWMI-Ghana

The achievement of several intermediary impacts will help IWMI and partners assess their contributions towards improving the lives and livelihoods of poor rural communities.

In addition to impacts, IWMI is also concentrating on other employee and institutional measures of performance. For example, IWMI established a standard set of criteria to evaluate research staff performance including research output, capacity building and outreach. At the Institute level, we are utilizing the recently developed World Bank indicators to measure center performance.

Institutional Performance: Areas of Assessment

- The production and dissemination of knowledge as public goods
- Capacity building and partnerships to produce public goods
- Diversity balance
- Financial health

Impact Case Study:

Controlling Malaria without Drugs or Pesticides

Malaria is still one of the biggest public-health problems in Sri Lanka. Over the past 50 years there has been a shift from controlling malaria through environmental management to reliance on drugs and pesticides. However, drugs and pesticides are proving to be ineffectual against the spread of the disease.

Research by IWMI, the University of Peradeniya (Sri Lanka), the Ministry of Irrigation and Water Management and the Anti-Malaria Campaign (AMC) shows that environmental practices such as clearing streambeds of debris can significantly reduce the spread of malaria by eliminating breeding habitats for mosquitoes.

The main malaria mosquito in Sri Lanka, *Anopheles culicifacies,* uses isolated sunlit pools in streambeds to breed. Researchers tested a number of interventions on an 8-km stretch of the Yan Oya in the Anuradhapura district—clearing the streambed of debris, repairing upstream tanks, flattening the streambed and straightening curves. As a result of these interventions, the number of pools in the streambed significantly decreased.

In the 18-month period since the interventions were applied hardly any *An. culicifacies* were found in the rehabilitated streambed and no cases of malaria have been reported in the area. A five-year monitoring program is underway.

Photo Credit: Eline Boelee

Clearing the streambed of rocks, fallen branches and other debris eliminates mosquito-breeding habitats.

The year in review

Change - Discovery - **Impact**

Communicating for Impact via IWMI's Website

The website is one of many ways IWMI communicates with existing and potential customers and partners. It offers free access to all IWMI's research and published materials and provides introductory links to associated programs, including the Challenge Program on Water and Food, Comprehensive Assessment of Water Management in Agriculture, IWMI-TATA Water Policy Program, Global Water Partnership Advisory Center, and Dialogue on Water, Food and Environment.

During 2003–2004 five new sub-webs were introduced:

- Smallholder solutions
- Environmental interventions for malaria control
- Multiple uses of water
- Drought assessment
- Water User Associations in Central Asia

Web usage reports show that, on average, *every day* on IWMI's website there were:

- 899 visitor sessions
- 5,860 page views

Most Frequently Downloaded Files

Total no. of downloads from Jan.2003 – Dec.2003

IWMI Research Reports	-	107,011
IWMI Working Papers	-	36,936
SWIM Papers	-	26,388
Water Policy Briefings	-	10,038

Water Productivity in Agriculture: Limits and Opportunities for Improvement

Edited by J. W. Kijne, R. Barker and D. Molden

In a large number of developing countries, policymakers and researchers are increasingly becoming aware of conflicting demands on water, especially between agricultural, environmental and domestic uses. Improving productivity of water in agriculture—obtaining "more crop per drop"—is critical for a sustainable water future.

Focusing on both irrigated and rain-fed agriculture, Water Productivity in Agriculture presents a state-of-the-art review of the limits and opportunities for increasing water productivity. It analyzes and identifies actions that can be taken at multiple levels: farm, irrigation system, river basin and national policy.

This title represents the first in a new series of volumes, based on the findings of the Comprehensive Assessment of Water Management in Agriculture Program.

The Comprehensive Assessment of Water Management in Agriculture is the first international research and capacity-building program to take stock of the costs and benefits of the past 50 years of water management and development. The result will be better-quality decisions on water investments and management, and better targeting of development funding to meet food and environmental security targets in the near future and over the next 25 years. The Comprehensive Assessment is conducted by a coalition of partners, convened by the International Water Management Institute, including 11 CGIAR agricultural research centers, supported by the Consultative Group on International Agricultural Research (CGIAR), the Food and Agriculture Organization of the United Nations (FAO), and partners from some 40 research and development institutes globally.

New Program Office

Project management is a key organizational change project for IWMI. As part of this change-management initiative, we determined that a single office was needed to provide the overall coordination and support for IWMI's research project lifecycle—from concept formulation to project implementation to evaluation and impact assessment. As such, in 2004 we are launching a new Program Office to be housed within the Office of the Director General, and led by the Research Coordinator.

Photo Credit: David van Eyck

Staff of the new Program Office—*left to right:* Julie, Upeka, Meredith, Sanjiv and Natalia.

The Program Office will be responsible for coordinating the IWMI research life-cycle, developing supporting tools and guidance for researchers and managers, fostering cross-theme linkages, organizing theme/subtheme synthesis reports, and, together with the Director General and Management Team, providing strategic direction for IWMI's overall research agenda.

The functions of the Program Office will be organized around five primary roles

- Matrix management
- Project portfolio development
- Project management
- Project evaluation and organizational learning
- Impact assessment

Staff Perspectives on HR Reform at IWMI

The following viewpoints are the result of interviews conducted with three members of staff from a research, non-research and regional background.

Intizar Hussain, senior researcher in Colombo, has been with IWMI for over 4 years. His overall impression is positive. According to him, there is much more transparency in HR processes at IWMI now, leading to a better feeling within the organization and greater efficiency. Clearer salary bands, job classifications, and routes for progression have particularly helped spread the feeling of transparency.

According to Intizar, the on-line HR database is very useful, particularly for having access to staff information, including their CVs. The new emphasis on staff training is very positive, and shows commitment to helping staff develop their career paths. He feels that the sensitive area of performance appraisal could do with further revision. "The new system is better than before but it is too subjective. A better mix of subjective and objective criteria in the appraisal is needed, particularly as some appraisers are not direct work-related supervisors."

Pavithra Amunugama joined IWMI 17 years ago. She is now Administrative Officer of the Information and Knowledge Group in Colombo, having joined as a clerk/typist when IWMI was in Kandy. Pavi finds that there have been major changes within IWMI over the last few years, and the changes in HR policies and procedures were necessary because of so many more staff.

With so many changes it is often difficult to tell how good they all are immediately. Most of them feel good—it is useful to be able to check the personnel data held on the HR database. Pavi has been on the communications and team building training courses organized by IWMI, as well as on periodic software training. "Overall, I feel the human resources team has expanded and is doing a good job but, of course, there is still room for more improvement."

Ian Makin is Regional Director of IWMI Southeast Asia. When he joined IWMI 8 years ago he felt he had stepped into a time warp as the internal management system seemed archaic. He believes clarifying and unifying job descriptions and staff classification were an important step in implementing the IWMI one-staff policy, and now it is clear that there are opportunities for advancement open to everyone.

The annual performance reviews encourage staff and supervisors to focus on career development rather than on a simple review of performance, but a priority for 2004 is more training for supervisors and staff, to ensure the tools used are understood and used effectively. All levels of staff are now involved in some form of skills development through in-house and external training. The HR database looks like it will be an important central resource for staff, project leaders and supervisors.

When asked if changes at IWMI are finished, Ian responded, "No! IWMI works in a rapidly changing environment and our HR policies and activities will continue to evolve, to ensure we are at the leading edge of our work. We must continuously seek to make the systems more transparent and easier for all of us to understand and use."

The year in review

Partnerships

The Challenge Program on Water and Food—from Inception to Implementation

The CGIAR Challenge Program on Water and Food, one of the first Challenge Programs to be approved by the system in late 2002, completed its inception phase last November and has fast progressed into its implementation phase. In addition to increasing water productivity, IWMI sees the Challenge Program as a way to change the way the CGIAR does business—it is not only innovative and dynamic, but also opens up the CGIAR-system, increases partnerships, and gives those new partners an opportunity to interact on a level playing field.

A major funding effort in 2003 was the development of a very significant competitive grant funding process. The first call was published in December 2002. This resulted in the submission of 342 concept notes in April 2003. A total of 98 full proposals were submitted in September 2003. In October, a portfolio of 50 projects worth about US$50 million, with an additional US$35 million offered in matching funds, was approved. From current commitments about 20 of these projects are being funded immediately. The other 30 are being actively promoted as opportunities for investment. Fifteen CGIAR centers, 162 NARES, 20 NGOs and 31 ARIs are participating in the 50 approved projects, which are led by 13 different CGIAR centers, 9 NARES and 1 ARI. The process delivers on the program's aim of opening up international agricultural research to new ideas and partnerships.

Also during the one year inception phase, stakeholder workshops were held in all nine basins. Steps were taken to develop basin profiles and theme priorities, a state-of-the-art web database system (IDIS), as well as sets of indicators and targets. Taken together, this constituted a major effort to develop on-the-ground partnerships in all 9 basins.

The inception phase was completed, and the program formally launched, at the Baseline Conference in Nairobi, November 2003.The conference brought together approximately 200 CPWF stakeholders. Posters of approximately 55 CPWF research projects and partner exhibits were displayed. The conference gained extensive international and local media coverage.

Photo Credit: Sanjini de Silva

Challenge program theme posters on display at the CP Baseline Conference in Nairobi.

Photo Credit: Sanjini de Silva

The CP Baseline conference brought together over 200 stakeholders.

Photo Credit: Sanjini de Silva

African dancers performing outside the exhibition area.

Funding

Financial commitments have now been received from the World Bank, Netherlands, France, Germany, Switzerland, Denmark, Norway and Sweden. Eleven million Euros (US$12.5 million) from the Netherlands and France are additional to the regular CGIAR budget. The International Fund for Agricultural Development (IFAD) Rome, is now considering funding commissioned research in theme 3—Aquatic Ecosystems and Fisheries and theme 5—Global and National Food and Water Systems, as well as several projects.

The Challenge Program on Water and Food will help IWMI achieve its goal of becoming a world-class knowledge center on water, food and environment by 2008; generating knowledge on better water and land management in developing countries through "strategic research alliances with core partners throughout Asia and Africa on the one hand, and advanced research institutes in developed countries on the other."

Dialogue on Water, Food and Environment

In 2000, ten of the main international actors[1] in the fields of water-resources management and research, environmental conservation and health formed a consortium to foster a global Dialogue on Water, Food and Environment. The Dialogue is a process aimed at building bridges between agricultural and environmental communities on water management issues, by improving the linkages between sectoral approaches.

The Dialogue Secretariat is hosted by IWMI. It loosely coordinates dialogues on the ground, building up the knowledge base, awareness-raising and communication.

The first phase of the Dialogue ends in 2004 with a workshop at the Stockholm Water Week.

[1]*Food and Agriculture Organization, Global Water Partnership, International Commission on Irrigation and Drainage, International Federation of Agricultural Producers, International Water Management Institute, The World Conservation Union, United Nations Environment Programme, World Health Organization, World Water Council, World Wide Fund for Nature*

The Dialogue is an action-research and learning program, working through an extended network of organizations. There are 36 ongoing projects: 9 knowledge-based, 8 at national policy level, and 19 at basin or local level. It adds the human dimensions of conflict resolution, consensus building and social learning to the principles of Integrated Water Resources Management (IWRM).

Photo Credit: Ronald Loeve

Building a field dam in the Uda Walawe district, Sri Lanka.

Global Water Partnership (GWP) Advisory Center

GWP is an international network that fosters Integrated Water Resources Management (IWRM). IWRM promotes the coordinated development and management of water, land and related resources in order to maximize economic and social welfare—without damaging vital ecosystems.

IWMI is one of three Advisory Centers for GWP. This partnership combines IWMI's research expertise and action research with the GWP network's ability to reach policymakers. IWMI supports GWP's extensive network of partners in Asia and Africa in implementing their respective GWP work program.

During 2003, the GWP Advisory Center at IWMI supported dialogues, helped establish new partnerships, and disseminated knowledge of good IWRM practices. The Centre supported the launch of Cap-Net Lanka, the Sri Lanka branch of the global International Network for Capacity Building in IWRM (Cap-Net).

In 2004, the Advisory Center will help ensure that processes are in place for preparing national IWRM and water-efficiency plans (Millennium Development Goal implementation target). It will also develop case studies from IWMI's research findings for the GWP ToolBox, and support Cap-Net by turning IWMI research into appropriate training material.

Working with the Consortium for Spatial Information (CGIAR-CSI)

IWMI is currently the lead center for the Consortium for Spatial Information (CGIAR-CSI), the CGIAR's global network of research laboratories using geographic information systems (GIS) for land-use management, sustainable agriculture and poverty alleviation.

Dr. Robert Zomer, Senior Landscape Ecologist at IWMI's Global Research Division, is the current Chair and Coordinator of CSI. CSI comprises scientists from all fifteen Future Harvest Centers (including the Challenge Program, System-wide Initiatives, and Inter-Center Working Groups). It provides a network for CGIAR scientists, and their partners working with advanced geo-spatial technologies, including GIS, remote sensing, and other spatial data.

Currently, CSI is embarking on a three-year strengthening project, funded by the CGIAR ICT-KM Program. Over the next three years, the CSI will build on existing efforts to facilitate increased networking and collaboration, and develop infrastructure for geo-spatial data sharing and common spatial data management. It will provide a high-profile platform for the widespread dissemination of CGIAR geo-spatial science, based on international standards and global data-sharing initiatives. The CIS is dedicated to providing improved mechanisms for the global sharing of information, dialogue, and inter-center collaboration.

The year in review

Research and Regional News

New IWMI Offices in 2003

New Delhi

IWMI opened a South Asia Liaison Office in New Delhi in November 2003. This office complements the work of IWMI's South Asia Regional Office in Hyderabad, as well as that of the IWMI-TATA Water Policy Program Office in Anand. It also facilitates the sharing of research findings and recommendations with key policy planners and members of parliament. Research activity carried out by IWMI New Delhi, focuses on water-management issues in rice-wheat cropping systems in the Indo-Gangetic basin, and drought-mitigation strategies in Southwest Asia.

Dr. Bharat Sharma is Senior Researcher/Liaison Officer at IWMI Delhi.

Tehran

To increase collaborative activities between IWMI and the Government of Iran, represented by the Agricultural Research and Education Organization (AREO), a memorandum of understanding was signed on 13 May 2003 in Tehran and an IWMI office was established on 10 December in AREO Karaj. The main responsibility of IWMI-Iran is to identify promising fields of research, design joint-research projects and coordinate their financial and operational implementation. The core project is a basin-wide research program to identify the constraints and opportunities for increasing water use and productivity in the Karkeh river basin.

Dr. Asad Qureshi is Head of Office at IWMI Iran.

Addis Ababa

IWMI signed an MOU with the Ministry of Water Resources of the Government of Ethiopia on 7 November 2003. The agreement covers cooperation in research and capacity-building activities and establishes a formal mechanism for cooperation through the newly established Research and Development Department of the Ministry. IWMI has established a subregional office for the Nile basin and Eastern Africa, located at the International Livestock Research Institute (ILRI) campus in Addis Ababa. A small project office is also maintained at the International Center for Research in Agro-Forestry (ICRAF) campus in Nairobi.

Dr. Seleshi B. Awulachew is Head of Office at IWMI Ethiopia.

Research Focus for IWMI Ethiopia 2004

- Improving performance of small-scale irrigation in Ethiopia and Kenya
- Enhancing the positive impacts of small dams on health and environment with a special focus on malaria in Ethiopia
- Identification of effective strategies and tools for the sustainable intensification of rain-fed agriculture and scaling up of micro-irrigation
- Integrated approach to minimizing malaria on a major rice irrigation scheme in Kenya (Mwea)
- Support to the Soil and Water Management Network (SWMNet) of ASARECA
- Examination of future options for improved land and water management

Photo Credit: Courtesy-IWMI Nepal

Threshing paddy with the help of oxen in the hills of Nepal.

IWMI Research in Nepal

IWMI's subregional office in Nepal has been overseen from Hyderabad since 2003. It now has an emphasis on water-resources management, as opposed to the earlier exclusive focus on irrigation management.

Current Activities

- Studying socioeconomic and ecological implications of groundwater irrigation in Nepal Terai
- Study of water management between the National Park and people living in the buffer zone
- Study in two catchments in western Nepal, identifying community-based strategies for resource management by a Water Users Group and Forest Users Group, and exploring possible linkages between the two
- Introducing irrigation benchmarking in irrigation systems implemented by Nepal's Department of Irrigation
- Documenting experiences in community-based electricity management in Nepal and its application for promoting community-managed electric tube-wells
- Policy dialogue on water use, food grain production and environmental protection issues in East Rapti river basin. A subsequent seminar with policymakers discussed issues arising from the dialogue

Sustainable Livestock Development for Watershed Management Strategies

The importance of livestock in livelihood strategies is gaining recognition around the world, but many developing countries lack environmentally sustainable livestock-development policies in their watershed-management programs.

IWMI is helping to identify, research and document livestock-environment interactions in water-scarce watersheds in semiarid areas of India, as part of the Livestock Environment and Development (LEAD) initiative of the Food and Agriculture Organization (FAO). IWMI works in partnership with five local NGOs in this project.

Ms. Ranjitha Puskur, IWMI scientist and project leader says: "Environments supporting animal production also need protection. Unfortunately, because of a greater focus on grain production for food security, there has been no meaningful policy or applied research to improve sustainable livestock production in watershed programs in India. The rapid depletion of natural resources, a growing population and unsustainable livestock development have seriously affected poor, marginalized communities, especially women, who depend on animal husbandry for their livelihoods."

Livestock—The Insurance of the Poor

Studies show that two-thirds of the world's domestic animal population is found in developing countries and around 90% of the livestock is owned by rural smallholders. Poor communities in rain-fed semiarid and arid regions of India depend on cattle, goat and sheep to support livelihoods. In India, smallholder crop-livestock mixed systems account for 64% of the area and support 67% of the population. Livestock provides farmers with food, transport, and manure to fertilize crops and income from dairying, while acting as a form of "insurance" against unexpected disasters. However, high livestock intensities have negative impacts on land and water resources.

Photo Credit: Prisca Chapuis

Poor communities depend on cattle for their livelihoods, but high livestock intensities have negative impacts on land and water resources.

Photo Credit: Copurtesy - ICRISAT

In India, smallholder crop-livestock mixed systems account for 64 percent of area and support 67 percent of the population.

IWMI Joins CGIAR Systemwide Livestock Program

From November 2003, IWMI joined the CGIAR Systemwide Livestock Program (SLP)—a vehicle for enhancing the contribution of animal agriculture for food production, reducing poverty and protecting the environment. This partnership adds a new dimension to research at IWMI in light of the close cooperation between IWMI and the International Livestock Research Institute (ILRI), which convenes the SLP and has 11 CG centers participating. IWMI and ILRI have together identified an interesting gap in scientific knowledge related to water and livestock. There is increasing cooperation between South Asia and Africa—two regions which both institutions have identified as high-priority areas.

The year in review

Research and Regional News

Improving Water Savings in Agriculture to Save the Aral Sea

The Aral Sea basin in Central Asia, suffers from severe water stress and environmental degradation. Most of the water from the rivers that feed the Aral Sea—the Amu Darya and Syr Darya—is withdrawn for irrigation. This has caused the sea itself to shrink by 50%. A thriving fishing industry that employed 60,000 people has disappeared. Salt deposits carried over long distances by the wind damage crops in other parts of the basin. This has resulted in food shortages, health problems and livelihood insecurity for the region's inhabitants.

A "Best Practices" project for farmers, cooperatives and water user associations in the Aral Sea basin, generated innovative water-saving methods. Over the past three years these practices have been evaluated at field, farm and system levels in pilot areas by scientists from IWMI and the Scientific Information Center of the Interstate Commission on Water Coordination. IWMI identified and documented a series of "Best Practices." Researchers found that a basin-wide application of water-conservation strategies could save as much as 36 km^3 of water per year. According to FAO data, this would be enough to stabilize the sea at its 1990 level but would not address the continuing environmental degradation of the exposed seabed.

IWMI research also stresses the need to impose restrictions on how conserved water is used. "There is a danger that the conserved water might be used to increase the irrigated area," says Dr. Iskandar Abdullaev, a Water Management Specialist with IWMI's Central Asia office. "The risk to the Syr-Darya basin is that upstream savings will merely mean more water for downstream irrigators and not for the Aral Sea."

Photo Credit: Iskander Abdullaev

Pilot plot in Tajikistan. Field staff measure discharge into furrows.

"Best Practices"

Alternate dry furrows
The application of dry and wet furrows alternately can increase field- and farm-level water productivity by 8 to 10 percent and reduce water supply rates by 20 percent.

Short furrows
Irrigation with short furrows gives a better distribution of water and reduces deep percolation and runoff.

Reuse of drainage water
Drainage water can be captured and reused for irrigation at field level.

Change of crop pattern
Farmers grow drought-tolerant and high-value cash crops in the middle and tail reaches of the Aral Sea basin.

Soil surface leveling
Leveling the soil surface leads to a more uniform distribution of water.

Night irrigation
Night irrigation improves water availability for tail-end farmers.

Partial rehabilitation of irrigation-drainage infrastructure
The rehabilitation of irrigation-drainage infrastructure includes the lining of canals, cleaning of drainage systems and installing regulation equipment within irrigation systems.

Photo Credit: Dr. Mukhamedjanov Shukhrat Shakirovich.

A pilot plot in the Fergana Province where field staff, IWMI and SIC researchers are taking soil samples.

Using Untreated Wastewater for Agriculture in Pakistan

A nationwide assessment in Pakistan conducted by IWMI shows that the direct use of untreated wastewater for agriculture, particularly vegetable production, is common in most urban and peri-urban cities. Wastewater is the only source of irrigation water for many poor farmers and their livelihoods depend on it. However, wastewater does carry health risks and ideally should be treated to make it safe for agricultural and domestic use. Unfortunately, developing countries like Pakistan cannot afford to build treatment facilities. It is estimated that only 2% of the 388 cities in Pakistan have wastewater treatment plants. Almost a third of the wastewater produced daily is used in agriculture and vegetables grown with wastewater cost nearly 50% less in the market than those grown away from urban areas. The study showed that farmers had higher incomes and effectively jumped the poverty line, through savings in fertilizer and higher yields as a result of wastewater use. Policymakers need to develop comprehensive strategies for managing wastewater, tailored to local socioeconomic and environmental conditions, while analyzing short-term and long-term risks and benefits of all available options.

Why Farmers Use Wastewater

- There is no alternative water source
- The reliability of supply lets them irrigate whenever necessary
- Higher crop yields because of nutrient-rich sewage
- Reduced fertilizer costs
- Higher incomes on high-value crops
- Wastewater allows cultivation of perishable crops close to urban markets

Recommendations

A flexible and creative approach to risk reduction is needed to ensure that farmers can maintain their livelihoods, while reducing health risks.

- Encourage those exposed to wastewater to use footwear and gloves through farmer and water users' associations
- Encourage mixing of freshwater and wastewater sources
- Wash produce in clean water before sending it to local markets
- Treatment programs with anti-parasitic medication for those exposed to wastewater
- Where possible, use irrigation techniques that limit contact with wastewater

For more information, see 'A nation-wide assessment of wastewater use in Pakistan: an obscure activity or a vitally important one?' Jeroen H.J. Ensink et al. (Water Policy, in press)

Fact File

Total estimated area under wastewater irrigation in Pakistan:	32,500 hectares
No. of households depending on wastewater for livelihoods:	19,250
Proportion of Pakistan's vegetable yield grown with untreated wastewater:	26%

One-third of Pakistan's wastewater is reused directly in agriculture without treatment.

Collecting a sample of wastewater for
Wastewater is the only source of irrigation for many poor fa

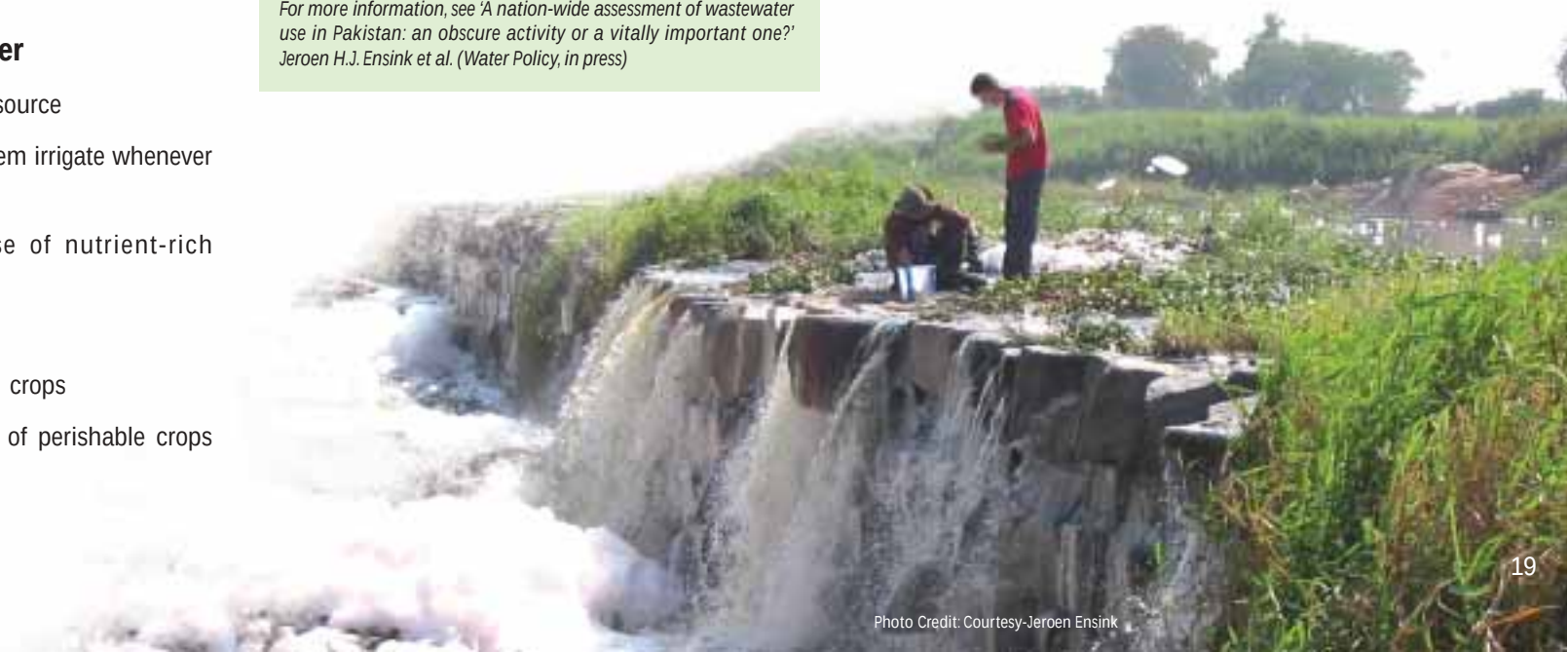


Photo Credit: Courtesy-Jeroen Ensink

The year in review

Focusing on the Future

Highlights of the Strategic Plan 2004 to 2008

IWMI's proposed strategy for 2004 to 2008 builds on the changes set in motion by the 2000 to 2005 Strategic Plan. Many of the changes outlined in this plan were accomplished by 2003, making it necessary to formulate a new strategy to propel the Institute into the future. An External Review was commissioned, with stakeholder participation and inputs from IWMI staff, to map out the new directions of the Institute. A series of workshops and a SWOT analysis with different user groups helped identify areas of weakness and strength and give insights on how external audiences perceived IWMI. These findings helped shape the new Strategic Plan.

The 2004 to 2008 Strategy Focuses on Two Long-Term Goals:

1. To make IWMI a world-class Water, Food and Environment Knowledge Center by the year 2008, building research excellence in a corporate and professional manner. IWMI will also develop four key knowledge roles as part of its knowledge philosophy.
2. To build and maintain an organizational culture based on impact, performance and service.

Photo Credit: Prisca Chapuis

NGO partners in Karnataka, India are trained by IWMI in recording hydrological data. They in turn train local volunteers to carry out this task.

IWMI's Knowledge Roles

Knowledge Generation through applied policy-oriented research on 5 priority themes in 5 priority geographic areas (benchmark basins). IWMI is adopting a network-based approach to doing collaborative, multidisciplinary research, based on priority setting with national and regional partners as well as with stakeholders.

Knowledge Sharing, which internally involves building a learning organization and externally entails taking responsibility for making the knowledge generated accessible and available. Key strategies for knowledge sharing are:

a) Building capacity for generating knowledge outside of IWMI.

b) Developing and maintaining global public goods.

c) Developing and communicating secondary knowledge products based on primary knowledge, for example, newsletters and policy briefs.

Knowledge Brokering by opening a window on the world for national researchers through the development of international research alliances through South-South and South-North partnerships.

Knowledge Application by developing the Institute's relationship with development partners, such as NARES, local NGOs and INGOs, will help the knowledge generated by IWMI to be implemented.

Moving towards Impact, Performance and Service

A formal impact assessment initiative was designed to accomplish three primary goals:

- Improve internal management and priority setting
- Ensure that IWMI's research and capacity building programs meet stakeholder and partner needs
- Acknowledge and learn from both positive and negative impacts

Photo Credit: Sanjini de Silva

Leadership Development Program sessions underway.

Performance Indicators

A number of indicators are being developed and targets identified to measure the performance of IWMI staff members and the organization overall, in fulfilling its knowledge roles and internal functions as a performance-oriented organization.

A Better Synthesis of Research Findings

The 2004 to 2008 strategy will focus on achieving better integration between IWMI's 5 research themes and ensuring a clearer synthesis of research results across projects, themes and regions. This works through a matrix structure. Research priorities will evolve further and where required will accommodate stakeholder priorities and future needs. The Comprehensive Assessment of Water Management for Agriculture (CA), a major research and capacity-building program managed by IWMI also addresses topics beyond the present focus areas of IWMI's 5 research themes. This identification of future issues and research gaps will assist IWMI in setting strategic research priorities for the future.

The incorporation of gender issues in research will be monitored to ensure better mainstreaming of gender in future. Data made available through this monitoring will be compiled, synthesized and used for advice on future project design.

Capacity Building

The new strategy will focus on professional and institutional capacity building. The current Ph.D. Scholarship Program will become more demand-driven, for example, by creating awareness of IWMI's research in areas where Ph.D. research prospects are available. New PostDoctoral positions will be built into project budgets. Sabbaticals and fellowships will be offered to scientists from NARES and private-sector organizations to join IWMI as visiting scientists for short periods ranging from 6 to 12 months. IWMI will also act as a resource for training programs for water professionals and will provide inputs for developing modules and/or curricula.

Photo Credit: Prisca Chapuis

Measuring rainfall using a rain gauge in the Kanakanala watershed in Karnataka, India. Tools and equipment were installed with support from IWMI.

Photo Credit: Hilmy Sally

A demonstration on the use of a treadle pump in rural Africa.

Funding Prospects

IWMI has a broad funding base which it will continue to develop while exploring new opportunities. Gaps in IWMI's PR strategy will be reviewed in terms of how IWMI is profiled and which funding agencies are approached. Emphasis will be placed on showing impacts and defining how IWMI has evolved into an organization with a flexible, networked management system. IWMI will demonstrate to donors that the efficiency of rural-development projects can be enhanced by using IWMI databases and expertise. Private-sector multinational organizations have so far been a largely untapped resource which can be approached for future funding.

Center Board Statement on Risk Management

There have been a number of efforts in recent years to develop more effective approaches to risk management for organizations operating in both the public and private sectors. In line with this IWMI's Board of Trustees acknowledge their responsibility for ensuring that management has in place an ongoing process for identifying, evaluating and managing significant risks and a system of internal control which mitigates these risks to an acceptable level. These range from operational to legal, financial, safety and security risks. IWMI's risk management strategy is documented and management has reported on its results to the Board. The IWMI Board of Trustees, with the assistance of the CGIAR internal audit unit, has prepared a public statement on risk assessment and internal control within IWMI. This statement is found on page 37 of this annual report.

Research Program

Comprehensive Assessment of Water Management in Agriculture

Groundwater Depletion: Conservation versus Intense Cultivation

While groundwater is crucial to the livelihoods of many poor communities in the developing world, the sustainable use of this resource continues to be a critical challenge for policymakers. Research shows that intensive agriculture is a threat to groundwater resources in certain regions and that water-saving technologies are unable to cope in such contexts. The way forward is to introduce rational land-use planning that minimizes negative impacts on livelihoods, while ensuring the sustenance of the resource for future use.

Governments spend scarce resources on improving irrigation efficiency by lining canals and investing in drip and sprinkler irrigation systems. Groundwater pumping is drastically reduced—in some instances by 50 percent. Yet, the water table continues to drop sharply. This is not fiction or fantasy, but the true story of the 320,000 km^2 North China Plain, which produces 50 percent of China's wheat and 25 percent of its maize. This scenario also applies to South and Central Asia, North Africa, the Middle East and the High Plains of the United States. Though geographically and politically disparate, all these regions sustain vast expanses of cropland by pumping water from shallow, unconfined, alluvial aquifers. The question is why does groundwater decline continue, despite water-productivity improvements?

The reason is simple—though water use or withdrawals are taken into account, actual consumption by crop evapotranspiration is rarely quantified or understood. Pumping more does not deplete more if this water is not used and returns to recharge the aquifer. Plants need a certain amount of water and regardless of whether they receive more, they will only consume that specific quantity.

As a recent IWMI study in Luancheng County in the North China Plains revealed, despite significant decreases in pumping, the groundwater table under the County continues to drop at a rate of 1 meter per year. As agriculture in Luancheng grew and people began to cultivate more land and moved to a more water-demanding cropping pattern, rain-fed irrigation had to be boosted by irrigation. This additional water came from the aquifer beneath Luancheng. With no additional source of water to replenish the depletion from the aquifer, the only way to halt groundwater depletion in Luancheng is to reduce the area under cultivation and to move to a different land-use pattern. Water-saving technologies like drip and sprinkler irrigation can reduce water extraction and pumping costs and increase yields, but will make little difference to the quantity *consumed* by plants.

Groundwater pumping in the Luancheng Province, China. Desp
significant decreases in pumping, the groundwater table conti
to drop at the rate of one meter per year.

Research sources:

Kendy, E.; Molden, D. J.; Steenhuis, T. S.; Liu, C.M.; Wang, J. 2003. *Policies drain the North China Plain: Agricultural policy and groundwater depletion in Luancheng County, 1949-2000*. IWMI Research Report 71.

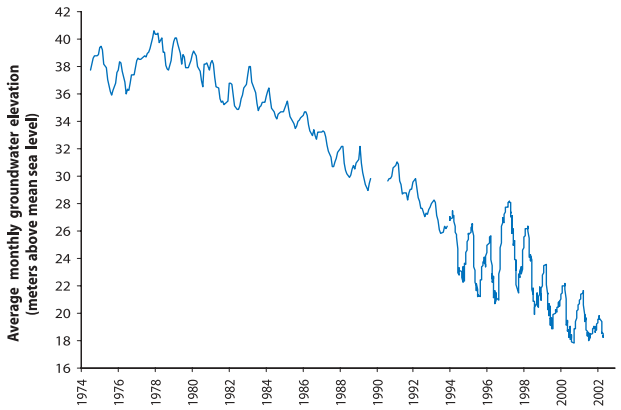
Kendy. E. 2003. The false promise of sustainable pumping rates. *Ground Water* 41(1):2-4.

In this scenario the best way forward is a rational land-use policy that limits cultivation. Given Chinese opposition to fallowing, IWMI researchers modeled various crop and land-use patterns to identify the best combination for maximum water savings with minimal fallowing. Limiting traditional winter wheat cultivation, mulching wheat and maize, increasing the urban land area and leaving some areas totally fallow, emerged as options.

Groundwater management in future needs to look at:

- Water consumption rather than water use (however, water consumption data are not readily available and this data gap needs to be filled)
- Effective irrigation efficiency at the basin scale rather than classical irrigation efficiency at field scale
- Achieving a realistic understanding of both regional and local water balances, and the hydrologic impacts of past and future policies
- Though politically and socially unappealing, limiting cultivation must be seen as an option

Water table elevations beneath Luancheng Agro-Ecological Research Station, Luancheng County, Hebei Province, 1974–2002



A Need for Policy-Level Intervention

Zeng Jianghai, retired Director of Luancheng Agro-Ecological Research Station, recalls irrigation pumps running 24 hours per day in the mid-1970s, causing water to flow across the roads because the soil was saturated beyond capacity. But, as people and authorities realized that this kind of pumping was unsustainable, there was a major move to reduce pumping through drip and sprinkler irrigation and other types of water-saving technologies. While there was a dramatic 50 percent drop in pumping rates, the aquifer continued to decline. Sixty-one-year old farmer Liu Xin Sheng, when asked about this problem responded: "That's not up to me to decide. That is a government decision." This highlights the typical attitude of people in Luancheng. Accustomed to a centrally-controlled economy, where all decisions were made for them, these people are reluctant to be involved in any decision making. Thus, to make a difference in water depletion, a policy-level intervention is a must.

Irrigation history of Luancheng County, 1949–1999—estimated pumping for irrigation

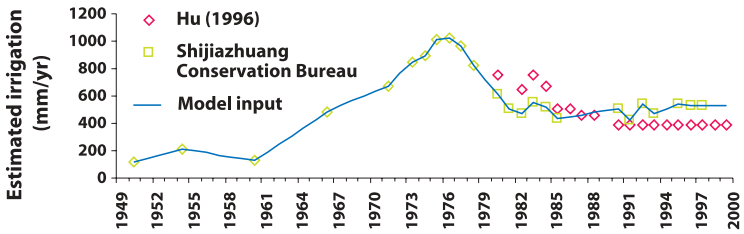


Photo Credit: Ian Makin

Power is provided by a tractor connected by a belt to the pump in the well; water flows into a canal for irrigating crops.

Photo Credit: Ian Makin

Research Theme

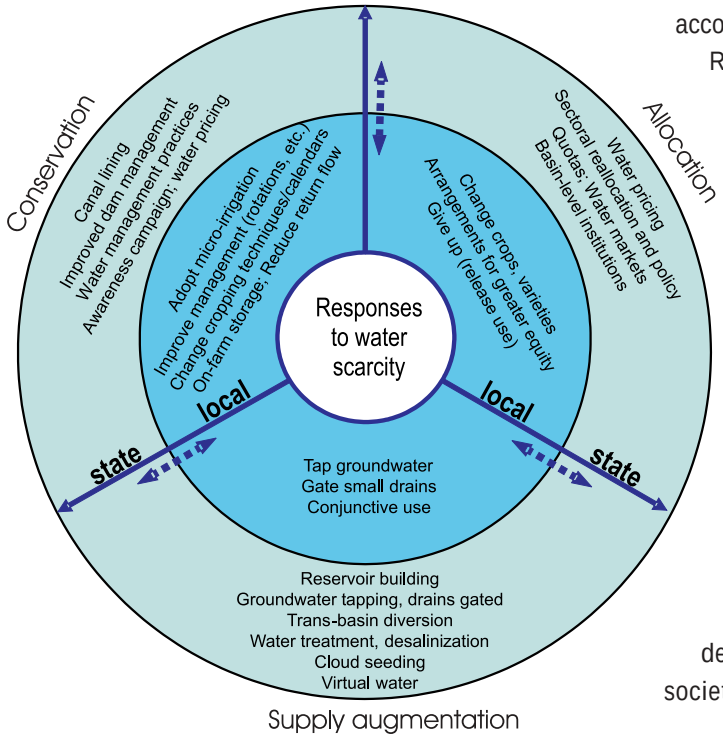
Integrated Water Management in Agriculture

Development Trajectories of River Basins: A Conceptual Framework

The development of societies is shaped to a large extent by their resource base, particularly water resources. Access to and control of water depend primarily on the available technology and engineering feats. As growing human pressure on water resources brings actual water use closer to potential ceilings, supply-augmentation options get scarcer, and societies usually respond by adopting conservation measures and by reallocating water towards more beneficial uses.

Several frameworks and diagrammatic representations of great value have been proposed to conceptualize the development of river basins. They usually distinguish between three successive phases, whereby supply, conservation and allocation-oriented strategies are elicited by growing water scarcity. They forcefully convey the crucial phenomenon of basin closure, making it much clearer and understandable. The downside of these approaches is that their simplicity does not always fully capture the geographical and historical diversity of river-basin development.

Water Scarcity—supply augmentation, conservation and reallocation



IWMI is developing a broader conceptual framework to account for the evolution of a wide variety of river basins. Research shows that societal responses to scarcity of resources at both the local and state level must be understood not only on the basis of hydrological, physical or economic constraints, but within a wider political economic framework that considers the distribution of human agency and power among actors, as well as their respective interests and strategies.

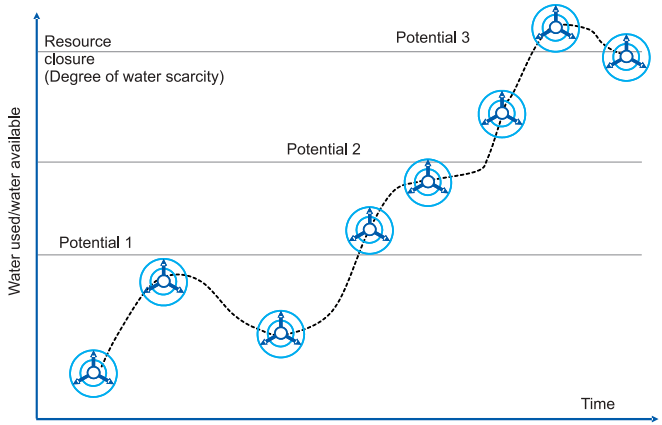
IWMI synthesizes different types of responses to water scarcity as shown in the diagram on the left. This shows how the three phases of supply augmentation, conservation and reallocation can be broken down into two sublevels.

The second diagram represents a river-basin-development trajectory, acknowledging the variety of societal responses to water scarcity and complexity of

Research source:
Molle, F. 2003, *Development trajectories of river basins: A conceptual framework*, IWMI Research Report 72.

determining which response appears when. The diagram retains the general evolution towards basin closure, while recognizing that a basin can be "reopened." It allows for a possible (albeit transient) breakdown of the system, and indicates successive potential ceilings toward "resource closure." The successive circles correspond to the first diagram. Which strategies have been implemented when, and what options are more suitable, can only be determined by a sound analysis of all the relevant physical, economic and societal factors.

River-Basin Development Trajectory



evelopment of societies is shaped by their resource base, particularly water resources.

Photo Credit: IWMI-South Africa

Key Messages

- Disaggregate different types of water sources (rainwater, stream water, regulated surface water and underground water) to understand how actual and potential uses of different sources of water relate to each other.
- Develop a typology of societal responses to water scarcity, distinguishing between responses devised by the state and the national level and those of individual farmers and small groups or communities.
- Breakdown macro and micro responses into three conventional types—supply augmentation, conservation and reallocation. Because of the interconnectedness of users, these responses are not simply cumulative. They are also not necessarily sequential.
- Identify critical elements shaping basin development, such as the nature of the state and state/citizenry relationships; the political economy of water resource development; "shock events," such as floods, famines or droughts; the influence of regional politics and claims for "spatial equity;" the degree of agrarian pressure and the pattern of agrarian transition.

Photo Credit: IWMI-South Africa

Access to, and control of, water depend on available technology. Photo shows a traditional weir built across a stream.

Research Theme

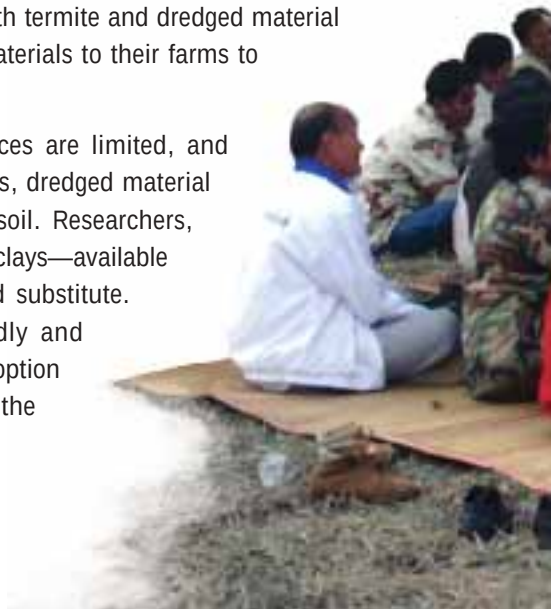
Smallholder Land and Water Management

New Hope for Poor Farmers: Increasing Soil and Water Productivity through Low-Cost Innovative Traditional Practices

Chronic poverty and poor soils are twin maladies overshadowing the lives of many poor farmers in the developing world. Inappropriate land management practices yield poor agricultural returns, and farmers who cultivate these soils do not have the financial muscle or the knowledge to rejuvenate these soils on a continuous basis. However, traditional, low-cost soil productivity enhancing methods using locally available material have come to the aid of poor communities in some instances. Research suggests that traditional practices like these, refined through scientific research, offer fresh hope for poor farmers.

Declining soil fertility is a major problem encountered throughout tropical Asia. This problem is especially acute in upland areas on soils that are naturally light and sandy in texture. Intense cultivation in such areas degrades the nutrient-holding and water-retention capacity of soil, leading to poor crop production. In Northeast Thailand, farmers traditionally use cattle manure and compost derived from household refuse and leaves to rejuvenate soil. However, this practice has limited success and the effect is short-lived. As a better alternative, particularly for the production of high-value crops close to the household, farmers use locally found termite mound clay and dredged material from lake beds—which are abundantly available because Thai authorities are dredging lakes to increase their water-retention capacity. IWMI research in Thailand found that this practice significantly increases soil fertility and that the fertility increase is long-lasting. It also significantly increases the water-retention capacity of the soil, thus improving water productivity in these rain-fed farming systems. Both termite and dredged material are low cost and farmers are willing to make the effort to transport these materials to their farms to realize enhanced agricultural returns.

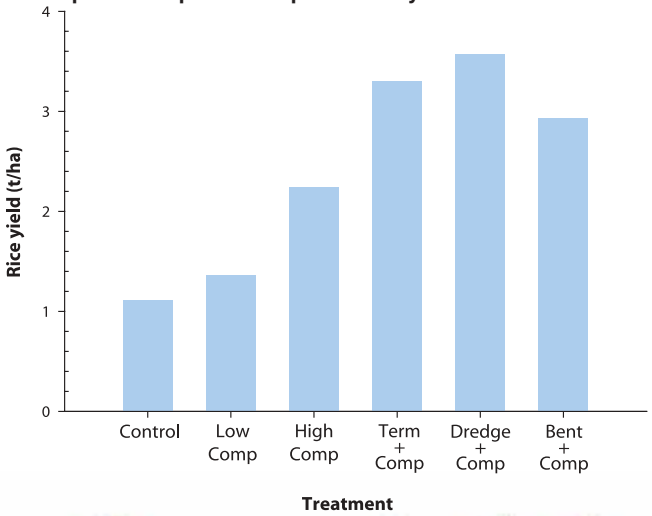
However, mining termite mounds is ecologically unsustainable, and sources are limited, and dredged materials will become scarce once dredging declines. In some cases, dredged material also contains high levels of iron pyrite which can cause acid buildup in soil. Researchers, therefore, investigated alternative sources for rejuvenating soil, and bentonite clays—available in plenty either naturally or as a waste product—were found to be a good substitute. Combined with limited amounts of lime, bentonite offers an eco-friendly and sustainable option for rejuvenating soil. Farmers are also likely to accept this option because they already recognize the potential of adding clays to soils and the very high benefit/cost ratios involved.



Research source:
Noble, A.D.; Ruaysoongern, S.; Penning de Vries, F.W.T.; Hartmann C.; and Webb, M.J. 2004. Enhancing the agronomic productivity of degraded soils in Northeast Thailand through clay-based interventions. (In Press).

Low-cost, locally accepted and practiced technologies refined by scientific input can make a significant contribution to the sustainable management of poor communities' livelihoods. IWMI is in the process of globally identifying such "bright spots" where local action or external intervention has reversed soil degradation with a view to helping these practices grow and spread.

Increases in organic rice production associated with the application of a range of soil improvement practices implemented by farmers in Northeast Thailand



Control = Standard practice
Low Comp = Low amount of compost
High Comp = High amount of compost
Term + Comp = Termite mound materials and low compost
Dredge + Comp = Lake-dredged material and low compost
Bent + Comp = Locally available bentonite clay and low compost

Improving Yields through Soil Remediation Practices

Over the past year the outcomes of field research in rejuvenating degraded soils using clay-based technologies have taken a further step into farmer fields through the efforts of Prof. Sawaeng Ruaysoongnern of Khon Kaen University and grassroots-based farmer networks in Northeast Thailand. Using a participatory action research approach and integrating activities through learning alliances, a number of networks, ranging in interests from integrated farming systems to organic rice growing, designed and tested a range of locally available soil remediation materials in their fields, with positive results.

For example, yields of organic rice increased dramatically through the introduction of organic composts and clay-based materials. Activities such as these make farmers more aware of the positive impact of innovative traditional soil amendments, and they are increasingly willing to adopt these practices. Prof. Ruaysoongnern and his team are currently engaged in promoting these practices both within Thailand and elsewhere.

Research Theme

Sustainable Groundwater Management

Managing Irrigation and Energy Rationally: The Energy-Irrigation Nexus

Groundwater economies around the world have grown rapidly during the past two decades. China has an estimated 4.5 million agricultural tube-wells, while in South Asia the figure is likely to be 23–25 million now. In South Asia, groundwater irrigation has surpassed surface irrigation making a major contribution to agricultural production and livelihood security in rural areas. However, this growth has been achieved at a tremendous cost to the resource as well as other sectors of the economy. A classic case is the provision of subsidized electricity to farmers in India. An expensive and unsustainable legacy of past development policies, this practice has led to the gross overexploitation of groundwater and wastage of electricity, and threatens the stability of India's energy sector.

At the heart of this problem is an irrational "flat tariff," which allows farmers unrestricted access to power at a minimal cost and allows them unlimited pumping of groundwater, often wastefully. Metering is a popular solution to this problem advocated by many international donor agencies and governments. While metering can ensure that power companies recover their full costs, in a context like India where there are millions of scattered users, the logistical difficulties of metering are immense. In addition, farmers form a major vote-bank in India and they use this political clout to violently oppose metering. Both, India and Pakistan experimented with and abandoned metering in the 1970s. It was reintroduced in Pakistan recently, but meter tampering, power theft and even the chasing away of meter readers were so rampant that metering benefited neither farmers nor the power utilities.

IWMI research recommends that, given this political economy, the second best alternative to metering is a "rational flat tariff," which will both help limit over-pumping and allow the energy sector to recover its costs. Under this system, high-quality power will be supplied to farmers at a flat rate, but with significant rationing. For instance, the state of Gujarat does not need to supply 3,000 hours of power to its farmers per year. Only 1,200 hours are required, provided that farmers get this reliably and when they need it most—during dry periods that coincide with crop demand for water. Making this work would require modifying power supply infrastructure, so that nonagricultural use remains unaffected. Moreover, detailed micro-level analyses would be needed to develop power-supply schedules that match cropping patterns and irrigation requirements of different areas. Some support will also need to be provided to farmers to create small on-farm water storages. But the gains will far exceed the costs.

To Overcome Farmer Resistance to Rationed Power Supply:

- **Enhance the predictability and certainty of supply**—announce the annu schedule for power supply (tuned to match the demand pattern of farmer and stick to it
- **Improve the quality of supply**—supply power at full voltage and frequenc thus minimizing damage to motors and downtime of transformers
- **Match supply with peak periods of moisture stress**—guarantee farmers th power they need to pump during the 6-8 weeks a year of critical moistu stress
- **Invest in upkeep of farm-supply infrastructure**—pass on to farmers th benefits of the additional revenue gained, by ensuring they receive a re able power supply

Research sources:

- Water Policy Briefing 10, *The energy-irrigation nexus*
- **Shah, T.; Scott, C.; Kishore, A.; and Sharma, A.** 2003. *Energy-irrigation nexus in south asia: Improving groundwater conservation and power sector viability.* IWMI Research Report 70
- **Shah, T.** 2003. Governing the groundwater economy. *Water Perspectives*, 1(2003):2-28.

This strategy also holds promise for the indirect management of the groundwater resource. India's groundwater regulatory authorities are weak, ill-equipped and do not have the resources to deal with millions of scattered users. Despite efforts to regulate growth of tube-wells in overexploited areas, groundwater overdraft has continued unabated. A rational flat tariff offers a powerful tool for controlling groundwater extraction while avoiding the often "painful" confrontations involved in metering tube-wells or direct regulation of groundwater draft through legal means. IWMI's first-cut estimates suggest that such a rational flat tariff accompanied by proactive management of agricultural power supply can curtail annual groundwater extraction for irrigation by 12-20 billion m^3/year, and reduce losses of India's state electricity boards by US$1.2-1.8 billion/year.

Transforming the Flat Power Tariff: From Dysfunctional to Functional

- **Restrict the annual supply of farm power**—but schedule that supply so that power is available when farmers need it most. The supply pattern necessary can be deduced by studying farmers with rational pumping behavior—e.g., diesel-pump owners, who pay real prices for their power. This supply management is the key element in the philosophy behind a functional flat-rate tariff
- **Increase the tariff, though gradually and regularly**—towards covering the real cost of the electricity supply
- **Keep the power subsidy, but make it explicit**—specify the total amount the government will spend on subsidizing power at the start of each year, then calculate the number of hours of farm power this sum will buy from the power utility at the flat-tariff rate (taking into account the lower cost of off-peak supply)
- **Use more off-peak power**—increase the percentage of power supplied to the farm sector during off-peak hours (currently around 50%), and factor this into the calculation of the number of hours provided by the subsidy

mer and his family about to switch on the electric bore well pump.

Photo Credit: Ashwin Patel

A rational flat tariff can limit overpumping of groundwater and allow the energy sector to recover costs.

Photo Credit: Ashwin Patel

Making Electricity and Irrigation Viable

In order to improve their financial viability, electricity utilities in South Asia must actively promote strategies to arrest or even reverse groundwater depletion.

The energy-irrigation nexus is a multifaceted issue in South Asia, and working through electricity pricing and supply policies is one facet of the challenge. Another is to achieve greater energy and water-use efficiency through improved comanagement of the two resources at micro and meso levels. The Sircilla Cooperative Electric Supply Society Ltd., in the Karimnagar District, Andhra Pradesh, India, is a community initiative, which began in 1969 with government support. Sircilla purchases power in bulk and retails it to consumers based on a differential tariff structure. Despite limited profits, Sircilla continues to operate, unlike other power utilities which have folded up due to inability to recover costs. An important reason for Sircilla's viability is because the cooperative supplies power not only to the subsidized farm sector but also to light industries. But, Sircilla's success is more importantly linked to their efforts to address the irrigation-energy nexus.

Since revenue from power supply to irrigation is critical to Sircilla's profitability, the cooperative undertakes large-scale recharging of wells. But the long-term sustainability of power utilities like Sircilla depends on a rational approach to power supply (including rationing) and pricing ("intelligent" flat rate, or metered if feasible), which will also help conserve the groundwater resource.

Photo Credit: Ashwin Patel

The overexploitation of groundwater and wastage of electricity threaten India's energy sector.

Research Theme

Water Resources, Institutions and Policy

Can Irrigation Help Poor People?

The era of massive investments in large-scale irrigation-development projects providing water to cultivate vast tracts of land is effectively over. Public-sector investments in irrigation infrastructure are declining as governments take a back seat, while private-sector involvement in management is being encouraged. But, irrigation management continues to face enormous problems. Within this context, it is timely and necessary to ask: Do investments in large-scale irrigation really help reduce poverty? How does inefficient irrigation performance hurt the poor? And, do institutional reforms in irrigation benefit the poorest of the poor and, if so, under what conditions?

Asian countries have heavily invested scarce domestic and foreign funds to achieve remarkable growth in food production. Cereal production alone in Asia has more than tripled, leading to better standards of living for many. However, the benefits of these irrigation developments have yet to reach low-income communities, and the sustainability of these irrigated-agricultural systems is threatened because of continued bad management under weak institutional arrangements, in most countries.

A recently concluded study by IWMI in 26 irrigation systems spread across Bangladesh, China, India, Indonesia, Pakistan and Vietnam identified that irrigation investments could be strongly pro-poor, neutral or even anti-poor depending on a range of factors, which include: the condition of irrigation infrastructure and its management, irrigation water allocation and distribution patterns, access to resource-conserving and production technologies, cropping patterns and crop diversification, access to support measures (e.g., information, input and output marketing), and inequity in land distribution, and land quality.

However, the study revealed that, in China and some parts of Southeast Asia, such as Vietnam—where successful land reforms have led to equity in land distribution and improved access to land for the landless poor—the positive impact of irrigation investments on poverty has been enormous. China and Vietnam have followed a “distribute first” strategy which has been largely successful, while South Asia tried the “grow first” approach and has failed to a great extent. The study clearly shows that South Asia has not reaped the full benefits of past irrigation development—as it could and should have done. For countries like Pakistan and India, the challenge is huge and tough choices need to be made to address inequities in resource distribution.

Research has clearly revealed that irrigation-system performance has a critical impact on poverty. Lack of effective institutions, incentives and accountability mechanisms and inadequate funding resulting from low or inefficient collection of irrigation charges and insufficient budgetary allocation from the government are fundamental causes of weak irrigation-service delivery and ineffective performance of irrigation systems—drastically reducing the potential of irrigation to help the poor. The study indicates that the low irrigation charge policies in South Asian countries, which are often justified by welfare arguments, are not helping the poor but actually hurting them—mostly indirectly through poor performance—but also directly in some cases.

Research sources:

Hussain, I. and Munir A. Hanjra. 2003. Does irrigation water matter for rural poverty alleviation? Evidence from South and South-East Asia. *Water Policy* 5:429-442.

Hussain I. 2004. Pro-poor intervention strategies in irrigated agriculture in Asia: *Poverty in irrigated agriculture in Asia: Realities, issues, and options with guidelines*. Draft Final Report submitted to ADB.

Institutional reform in irrigation was identified as another crucial factor in ensuring that irrigation helps poor communities. The research revealed that reforms are likely to succeed when and where:

- Landholdings are equitably distributed (and farm holdings are not excessively fragmented)
- Socioeconomic disparities between users or groups of users in irrigation systems are minimal and when the communities within a system are fairly homogenous
- Irrigated agriculture is profitable and benefits of irrigation to farmers are significant
- Canal irrigation charges/costs are high, enabling better service
- There are incentives for managers and management organizations to improve on service delivery, and where there is commercial orientation of management, and accountability mechanisms are in place

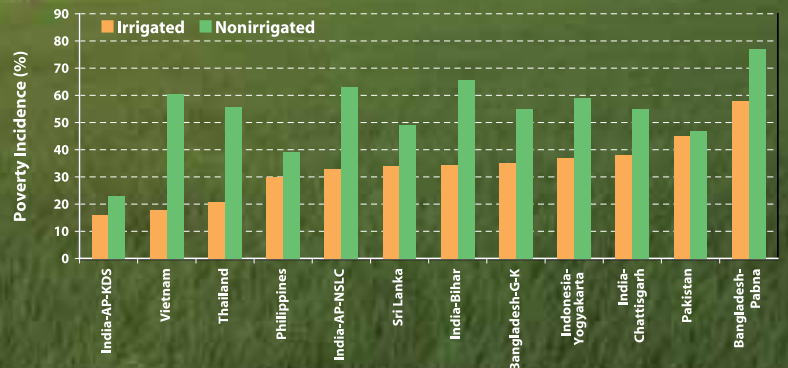
Where these conditions are not present, reforms will take a relatively longer period to succeed and help reduce poverty.

Waiting for Water

Somawathie, a fifty-one-year old woman farmer recalls 1962, the year she and her parents along with another 14 families moved into the Walawe basin in the dry southeast of Sri Lanka: "This was all jungle and we had a hard time eking out a living, but with hard work we made this into a village." However, Somawathie's struggles are far from over. "When there is good rain, we have no problem, but during droughts our small tank dries up and crops die and we have to walk miles to find water for our cattle," she says, implying the importance of a stable source of water.

But soon the Udawalawe project—relocating 200,000 people from the overcrowded wet zone of the country and irrigating some 32,000 hectares of land—began, bringing with it the promise of a better life for Somawathie and her fellow villagers. Unfortunately, Somawathie's village came within the extension area of the project, which means that it will not receive canal water till the left bank canal is extended to reach her village. While those within the reach of Udawalawe water enjoy the benefits of a thriving agro-economy, Somawathie and her village wait patiently and expectantly—till water and, with it, prosperity reach them.

Poverty in irrigated and nonirrigated areas in selected Asian countries.



Research Theme

Water, Health and Environment

Exploring the Links between Irrigation, Cattle and Malaria

Forty percent of the world's population is currently at risk from malaria. Over a million people die annually from the disease—mostly poor people living in low-cost housing, unable to afford proper protection against infective mosquitoes. As traditional pesticides and drugs fail to combat the spread of malaria, finding new approaches for managing the disease is critical. Recent research by IWMI and its partners suggests that a long-term option for malaria control in areas under rice irrigation, would be to manage irrigation, crop and livestock systems in an integrated manner within a broader strategy for rural development.

Irrigation practices such as flooding rice fields have been associated with increases in disease-spreading mosquitoes and waterborne diseases. However, in some areas in China and Africa, irrigation and malaria have shown little correlation. In fact, the incidence of malaria has in certain instances been surprisingly found to be *less* in irrigated than in nearby nonirrigated areas—a situation commonly referred to as the "paddies paradox." Recent research by IWMI and its partners in Kenya has shown that presence of livestock, particularly cattle, has been responsible for naturally keeping malaria at unusually low levels in rice irrigation schemes. This is especially apparent in the more-central parts of the country where the predominant species of malaria-bearing mosquitoes prefer the blood of cattle to that of humans. The protective effect resulting from cattle attracting mosquitoes away from human hosts is scientifically termed "zooprophylaxis." However, the research also showed that although people appreciated the role of cattle in malaria control, livestock was never viewed from such a peculiar health angle. People were happy to develop livestock simply because of its economic benefits. Similarly in China, due to water shortages people were forced to use intermittent irrigation. This alternate wet-dry irrigation practice kills mosquito larvae and controls the spread of the disease.

The key issue in both instances is that malaria-prevention was a "by-product" of economic and other imperatives. In real life it is unlikely that communities acting alone will adopt alternative agro-ecosystem management strategies with malaria as the primary focus. Intermittent irrigation is labor-intensive, while livestock rearing is threatened by diminishing grazing lands. Therefore, in order for these interventions to succeed, local government authorities, non-governmental organizations and trans-disciplinary researchers need to come together with the affected communities to promote these practices by simultaneously highlighting their malaria-control potential and livelihood benefits. For instance, intermittent irrigation does improve rice productivity, resulting in bigger yields. Similarly, livestock rearing can be sustainable if nutrient cycling is enhanced within the crop-livestock systems. Thus, rice straw and milling by-products—simply discarded now—could be incorporated as cattle feed.

The secret to success, IWMI research in the Mwea Division of Kenya suggests, is getting rural communities involved in planning right from the outset. Since any measures taken to control the disease directly impact the stakeholder

Research Source:
Mutero, C.M.; Kabutha, C.; Kimani, V.; Kabuage, L.; Gitau, G.; Ssennyonga, J.; Githure, J.; Muthami, L.; Kaida, A.; Musyoka, L.; Kiarie, E. and Oganda, M. 2004. A transdisciplinary perspective on the links between malaria and agro-ecosystems in Kenya. *Acta Tropica* 89: 171-186.

communities, their involvement in research and policymaking is vital. Participatory management of agro-ecosystem is the key to long-term, sustainable and people-friendly prevention of diseases like malaria. This type of prevention is also important because most of these poor communities are unable to afford insecticide-treated mosquito nets, mosquito coils and other repellent and protection devices. The governments of these countries too, find it difficult to stretch their limited resources to fund prevention campaigns and to cover the massive healthcare bills that accompany diseases like malaria.

IWMI research will continue to explore the multiple links between better agro-ecosystem management and better health. Research will also focus on how a broad perspective, linking different sectors like water management, livestock, health, etc., can find new solutions that are both pragmatic and effective.

Research shows that certain species of malaria-bearing mosquitoes find cattle blood more attractive than human blood.

Photo Credit: Barbara van Koppen

Using Cattle to Control Malaria?

Justus Mwangi, a 53-year-old farmer in Mbui-Njeru, Kenya describes malaria, the number one health problem in his village: "You are disabled because you can't walk. It brings headaches and fatigue and you can't do your farm work." For poor farmers like Mwangi, malaria is a curse that accompanies rice farming. But in Mwangi's village itself lies a potential answer to the problem—cows. Research shows that certain species of malaria-bearing mosquitoes find cattle blood more attractive than human blood.

The key behind this type of research is taking a "wide angle" view. "To be relevant to the communities, one has to strive to see the big picture, beyond the research issue that took you to the field," says Dr. Clifford Mutero who is leading the research in Kenya. Dr. Mutero further adds "…when you get to my stage in life, you want to do something that is of practical relevance….It makes sense to embrace this holistic approach to solve problems."

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Welcoming Dr. Margaret Catley-Carlson "on Board"

IWMI is pleased to welcome Dr.Margaret Catley-Carlson to its Board of Governors. Margaret is actively involved in several organizations that apply science and knowledge to policy. She is Chair of the Global Water Partnership, ICARDA and the Water Resources Advisory Committee for Suez/Lyonnaise of Paris. She is also Vice Chair of the International Development Research Centre in Ottawa. A former career diplomat, Margaret rose to the position of President of CIDA, and also Deputy Minister of Health in Canada. She became Deputy Director of Operations, UNICEF with the rank of Assistant Secretary General of the United Nations as well as President of the Population Council. With eight honorary degrees in hand, she became an Officer of the Order of Canada in 2002.

Margaret has Chaired the Water Supply and Sanitation Collaborative Council, was a Commissioner in the Commission for Water for the 21st Century and has just been named to the Secretary General's advisory panel on water.

To her, changing the way we look at water is crucial, especially as the available water per person diminishes. "There must be more focus on demand management in agriculture, which is of course the biggest water user, and in urban water use" she says. "The biggest challenge for IWMI will be targeting policy change by setting out its research in the most compelling possible ways, and finding allies and partners to use that research to promote policy change. These are not easy tasks for a research organization," she adds.

Margaret also feels that women have as much as men to contribute—and that we need more of them. "Women in research face special challenges, and they have done well. I am very pleased that IWMI is making deliberate efforts to attract women. We need to create a world that is more open to everyone, to capture the energies and contributions of all."

Board Statement on Risk Management

IWMI's Board of Governors has responsibility for ensuring that an appropriate risk-management process is in place to identify and manage high and significant risks to the achievement of the Institute's business objectives, and to ensure alignment with CGIAR principles and guidelines, which have been adopted by all CGIAR Centers. These risks include operational, financial and reputational risks that are inherent in the nature, modus operandi and location of the Institute's activities, and are dynamic as the environment in which the Institute operates changes. They represent the potential for loss resulting from inadequate or failed internal processes or systems, human factors, or external events. They include low impact (and therefore irrelevance) of scientific activities; misallocation of scientific efforts away from agreed priorities; loss of reputation for scientific excellence and integrity; business disruption and information-system failure; liquidity problems; transaction-processing failures; loss of assets, including information assets; failures to recruit, retain and effectively utilize qualified and experienced staff; failures in staff health and safety systems; and failures in the execution of legal, fiduciary and agency responsibilities.

The Board adopted a risk management policy in May 2004, communicated to all staff, that includes a framework by which the Institute's management identifies, evaluates and prioritizes risks and opportunities across the organization; develops risk mitigation strategies which balance benefits with costs; monitors the implementation of these strategies; and periodically reports to the Board on results. This process will draw upon risk assessments and analysis prepared by the Institute's staff, internal auditors, Institute-commissioned external reviewers, and the external auditors. The risk assessments will also incorporate the results of collaborative risk assessments with other CGIAR Centers, System Office components and other entities in relation to shared risks arising from jointly managed activities. The risk-management framework seeks to draw upon best practice promoted in codes and standards promulgated in a number of CGIAR member countries, and it is subject to ongoing review as part of the Institute's continuous improvement effort.

Risk-mitigation strategies include the implementation of systems of internal control which, by their nature, are designed to manage rather than eliminate the risk. The Institute endeavors to manage risk by ensuring that the appropriate infrastructure, controls, systems and people are in place throughout the organization. Key practices employed in managing risks and opportunities include business-environmental scans, clear policies and accountabilities, transaction-approval frameworks, financial and management reporting and the monitoring of metrics, which are designed to highlight positive or negative performance of individuals and business processes across a broad range of key performance areas. The design and effectiveness of the risk-management system and internal controls are subject to ongoing review by IWMI's internal audit service, which is independent of business units and reports on the results of its audits directly to the Director General and Board through the Board's Audit Committee.

Donors 2003

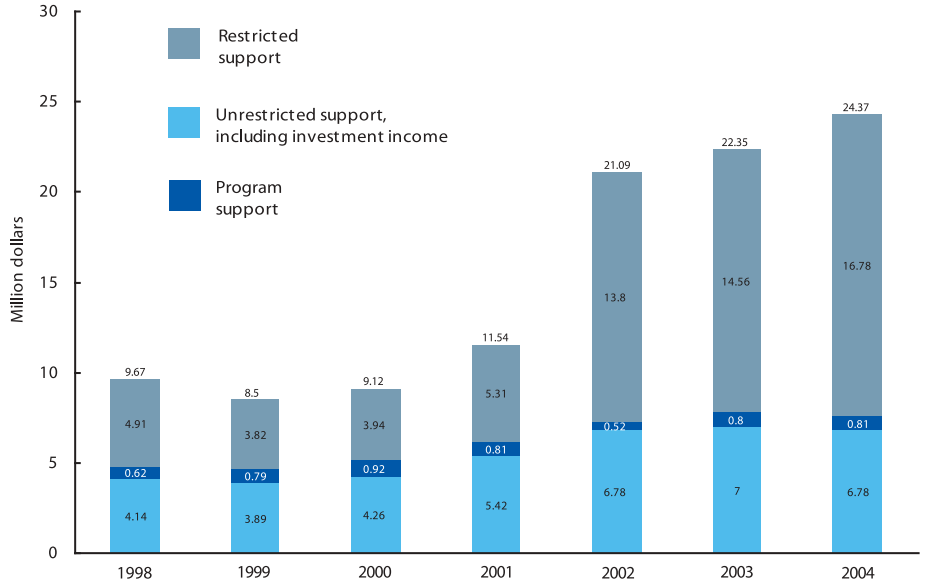
During 2003, IWMI's funding support was provided by the following governments, development banks, agencies and foundations:

- **African Development Bank**
- **Asian Development Bank**
- **Australia (ACIAR)**
- **Belgium**
- **Canada**
- **Denmark (DANIDA)**
- **France**
- **Germany (BMZ, GTZ)**
- **IFAD**
- **International Development Research Center**
- **InWEnt**
- **Ireland**
- **Japan (JBIC, JICA)**
- **National Oceanic Atmospheric Administration**
- **Netherlands**
- **Norway**
- **Sir Ratan Tata Trust**
- **Sweden (SIDA)**
- **Switzerland (SDC)**
- **Taiwan**
- **The OPEC Fund for International Development**
- **United Kingdom (DFID, DES)**
- **United Nations Educational Scientific and Cultural Organization**
- **United Nations Environmental Programme**
- **United Nations Food and Agriculture Organization**
- **United States of America (USAID)**
- **World Bank**
- **World Health Organization**

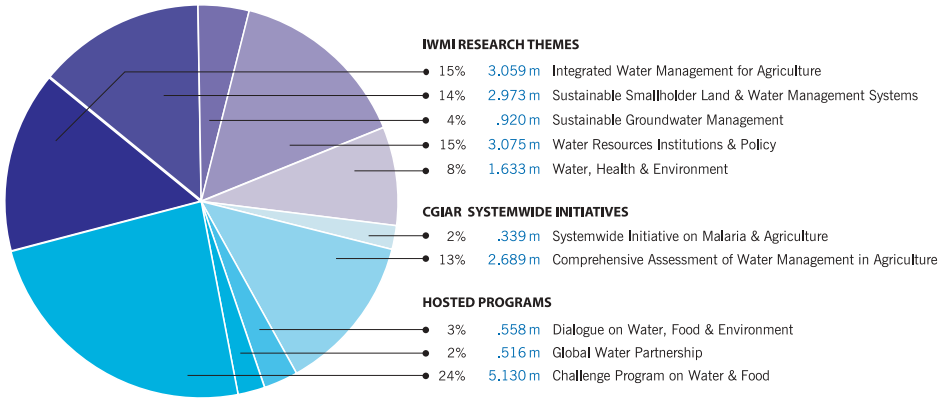
The Governments of Cambodia, China, India, Iran, Nepal, Pakistan, South Africa, Sri Lanka and Thailand provided program support for IWMI-related activities in those countries.

Financial Statement

Income 1998–2004



Direct Research Expenditure by Program, 2003



Financial Comment

2000 to 2003 has been a period of unprecedented growth for IWMI. Expenditure has more than doubled from US$8.8 million in 2000 to US$23 million in 2003—an increase of 260 percent. During the same period, funding to IWMI has kept pace with the increased activities. Income for 2004 is projected at US$24.6 million.

Increased funding is due to a number of reasons. For example, IWMI's expanded mission has opened doors for more funding opportunities. In particular, the growing emphasis on health and environment research has helped IWMI access ODA funding outside traditional CGIAR agriculture "pockets."

IWMI's role in a number of international initiatives, such as the Dialogue on Water, Food and Environment and the Challenge Program on Water and Food, has increased IWMI's reputation as an organization that works actively with others to achieve change. Obviously, this makes IWMI an attractive partner and a more attractive investment for donors.

New donors to IWMI include DFID, Ireland and the TATA Foundation that are providing over US$1.0 million for IWMI activities in India. Some existing donors have significantly increased their contributions, e.g., the Netherlands, the World Bank, SDC, France, Canada, Denmark and Norway.

During this period of rapid growth, IWMI has established a number of long-term regional offices rather than temporary field offices to support specific research projects. IWMI has thus invested heavily in setting up this network of offices. Total capital expenditure was US$2.7 million during the period of 2000 to 2003 of which US$1.0 million was invested in computer equipment. IWMI rents its regional and subregional offices, so capital investments have been limited to investments in computers, vehicles and office equipment. IWMI is also completing the refurbishment of offices at Headquarters in Colombo, Sri Lanka. Refurbishment costs have so far amounted to US$0.9 million.

IWMI's net assets have decreased from US$ 6 million in 2000 to US$5.5 million at the end of 2003. Of this total of US$5.5 million, US$2.5 million is invested in property and equipment. It is planned to increase net assets to US$6.2 million by December 2004.

Auditors' Report

PRICEWATERHOUSECOOPERS

Report of the auditors

To the Board of Governors of International Water Management Institute

1 We have audited the accompanying statement of financial position of International Water Management Institute at 31 December 2003 and the related statements of activities and cash flows for the year then ended together with the accounting policies and notes as set out on pages 3 to 33.

Respective responsibilities of the Institute's management and auditors

2 The Institute's management is responsible for preparing and presenting these financial statements in accordance with the recommendations made in the Consultative Group for International Agricultural Research (CGIAR) Financial Guidelines Series No. 2 - CGIAR Accounting Policies and Reporting Practices Manual. Our responsibility is to express an opinion on these financial statements, based on our audit.

Basis of opinion

3 We conducted our audit in accordance with the International Standards on Auditing, which require that we plan and perform the audit to obtain reasonable assurance about whether the said financial statements are free of material misstatements. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the said financial statements, assessing the accounting principles used and significant estimates made by the Institute's management, evaluating the overall presentation of the financial statements, and determing whether the said financial statements are prepared and presented in accordance with the recommendations made in the CGIAR Guidelines. We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purposes of our audit. We therefore believe that our audit provides a reasonable basis for our opinion.

Opinion

4 In our opinion, so far as appears from our examination, the Institute maintained proper books of account for the year ended 31 December 2003, and to the best of our information and according to the explanations given to us, the said statement of financial position and related statements of activities, cash flows and the accounting policies and notes thereto, which are in agreement with the said books and have been prepared and presented in accordance with the recommendations made in the CGIAR Financial Guidelines Series No 2 - CGIAR Accounting Policies and Reporting Practices Manual and give a true and fair view of the Institute's state of affairs as at 31 December 2003 and of its activities and cash flows for the year then ended.

30 April 2004

CHARTERED ACCOUNTANTS

COLOMBO

partners Ms. S. de Silva FCA, S. Gajendran FCA, Ms. S. Hadgie FCA, V. Kanagasthai FCA, S. Manickavasagar ACA, D.T.S.H. Mudalige FCA, Ms. S. Perera FCA, Ms. P.I.C. Ranasinghe FCA, P.B. Rodrigo FCA, Ms. S. Sivalingam FCA

Restricted Research Contracts over US$50,000 Awarded in 2003

YRB (Yellow River Basin) ABARE (Australian Bureau of Agricultural and Resource Economics) CCAP (Center for Chinese Agricultural Policy) IWMI Project – ACIAR (Australian Center for International Agricultural Research)—US$80,361 (approximately) over 3 years

To develop institutions and policies to improve water allocation and management in the Yellow River Basin, China.

AFDB (African Development Bank) Agricultural Investment—US$500,000 over 1 year and 3 months

To diagnose trends and opportunities for innovative investment in sustainable, cost-effective agricultural water management in sub-Saharan Africa.

Irrigation Impacts and Poverty (Austria)—US$185,237 over 1 year

To study the impact of irrigation development on rural poverty and the environment.

Africa Research Support (Canada)—US$376,393 over 1 year

To concentrate on the special needs of smallholder farmers.

ENCOFOR Land Sustainability for Carbon Sequestration (European Union)—US$103,000 (approximately) over 2 years

To reduce carbon dioxide, and produce oxygen for the environment and for people.

Performance Improvement Irrigation Scheme in Africa – APPIA (France)—US$473,583 (approximately) over 4 years

To analyze performance of limited small/medium-sized irrigation schemes in Ethiopia and Kenya, promote capacity building, dissemination activities and synthesis of research results with partners.

Pan Africa Water Conference – InWEnt (Germany)—US$127,323 over 2 months

To discuss trends and opportunities in agricultural and trans-boundary water management in sub-Saharan Africa within a collaborative program.

Biodiversity of the Uda Walawe Irrigation Project (Netherlands)—US$700,000 over 3 years

To support a research program on bio-diversity in an irrigation system under the Mahaweli Authority of Sri Lanka in the Uda Walawe Area.

Analysis of Impacts of Climate Variability on Malaria Transmission in Sri Lanka and the Development of an Early Warning System. NOAA (National Oceanic and Atmospheric Administration)—US$222,833 over 3 years

To incorporate climate variability and forecast information into malaria risk maps for the malaria-endemic Uva Province in Sri Lanka and other regions in South and Southeast Asia with similar transmission conditions.

CACENA (Central Asia and Caucusus) – GWP—US$200,000 over 2 years

To bring together water professionals, water users, NGOs and other stakeholders from eight countries to promote the implementation of the Integrated Water-Resources Management (IWRM) principles.

Water-Based Livelihood Enhancement Efforts for Tribals – (Sir Ratan Tata Trust)—US$80,743 (approximately) over 10 months

To carry out research into the efforts for water-based livelihood enhancement among tribals.

Smallholder System Innovations in Integrated Watershed Management – SIDA (Swedish International Development Agency)—US$1,614,422 (approximately) over 5 years

To analyze the consequences of upscaling water-system innovations in smallholder agriculture at watershed scale, develop methodologies and tools for improved rainwater management, planning and policy creation, while assisting in capacity building.

Drought Assessment and Potential for Mitigation in Southwest Asia (USAID)—US$350,000 over 2 years

To carry out a rapid scientific assessment of the drought situation in the region and recommend concrete and tangible solutions while seeking to link local and regional efforts of drought management to global networks.

Cost of Irrigation Investments in sub-Saharan Africa (World Bank)—US$150,000 over 1 year

To probe reasons for high per hectare investment costs in irrigated agriculture in sub-Saharan Africa, study reasons for declining donor interest in irrigation development and identify opportunities for reversing this trend.

CA (Comprehensive Assessment of Water in Agriculture)

Intensification of Effective Water-Use Policy (Japan)—US$245,901 over 2 years and 6 months

To analyze future prospects of rice cultivation, in particular water management of world paddy cultivation, water conservation and the price of rice.

(Switzerland)—US$218,372 over 1 year

OPEC Africa Groundwater Study (OPEC Fund for International Development)—US$100,000 over 1 year

Research project that aims at improving barley productivity under small farmers' conditions through scientific adaptation to increase yields and yield stability under stress conditions in low-yielding environments.

Challenge Program

(Denmark)—US$496,730 over 1 year

USDA (United States Department of Agriculture)—US$70,000 over 1 year

To develop a full proposal for the Challenge Program on Water and Food and to assist in the financing of the implementation of IWMI's 2004 work program.

UNRESTRICTED, RESTRICTED, 2003

	Grants 2003 US$'000	Grants 2002 US$'000
Unrestricted		
Australia	269	243
Belgium	106	85
Canada	451	357
China	—	10
Denmark	448	530
France	91	98
Germany	275	239
India	38	38
Iran	97	—
Ireland	511	452
Japan	296	60
Netherlands	869	737
Norway	139	307
Sweden	349	298
Switzerland	157	287
United States Agency for International Development (USAID)	690	805
World Bank	2,039	2,047
Subtotal (Unrestricted)	**6,825**	**6,593**
Other Revenue		
Investment income	44	113
Sundry income	136	73
Subtotal (Other revenue)	**180**	**186**
Total (Unrestricted resources)	**7,005**	**6,779**
Restricted		
African Development Bank	190	132
Asian Development Bank	694	995
Australia/Australian Centre for International Agricultural Research	162	153
Canada	376	—
Center for Environmental Economics & Policy in Africa (CEEPA)	18	—
CEMAGREF	22	21
Denmark	114	64
Food and Agriculture Organization	195	346
France	1,546	1,202
Germany		32
IFAR Nourishing Scientific Excellence through the CGIAR	10	—

(Restricted continued)	Grants 2003 US$'000	Grants 2002 US$'000
India (ICID)	310	54
International Development Research Centre (IDRC)	198	134
International Food Policy Research Institute (IFPRI)	3	41
International Fund for Agricultural Development (IFAD)	10	—
InWENT (former DSE)	127	—
Iran	—	140
Japan	282	260
Japan Bank for International Cooperation (JBIC)	148	122
National Education Commission (NEC)	12	—
Netherlands	4,568	2,545
National Oceanic & Atmospheric Authority (NOAA)	2	—
Norway	347	—
Other Donors	116	15
Royal Government of Cambodia (RGC)	14	13
Rockefeller Foundation	—	16
South Africa	75	70
Sri Lanka	58	73
Sweden	627	755
Switzerland	1,533	842
Taiwan	42	69
TATA Foundation	310	180
United Nations Environmental Programme (UNEP)	38	26
United Kingdom (DFID/DES)	50	276
United Nations Educational Scientific and Cultural Organization (UNESCO)	18	55
United States Agency for International Development (USAID)	408	314
United States Department of Agriculture (USDA)	68	—
Water & Power Development Authority (WAPDA)	51	42
World Bank	2,970	884
ZEF	108	83
ZIL/Switzerland	63	21
	15,881	9,975
AFRICAN WATERDOME	(534)	4,335
Total (Restricted resources)	**15,347**	**14,310**
Total Grants	**22,352**	**21,089**

Statement of Financial Position, December 31, 2003 and 2002

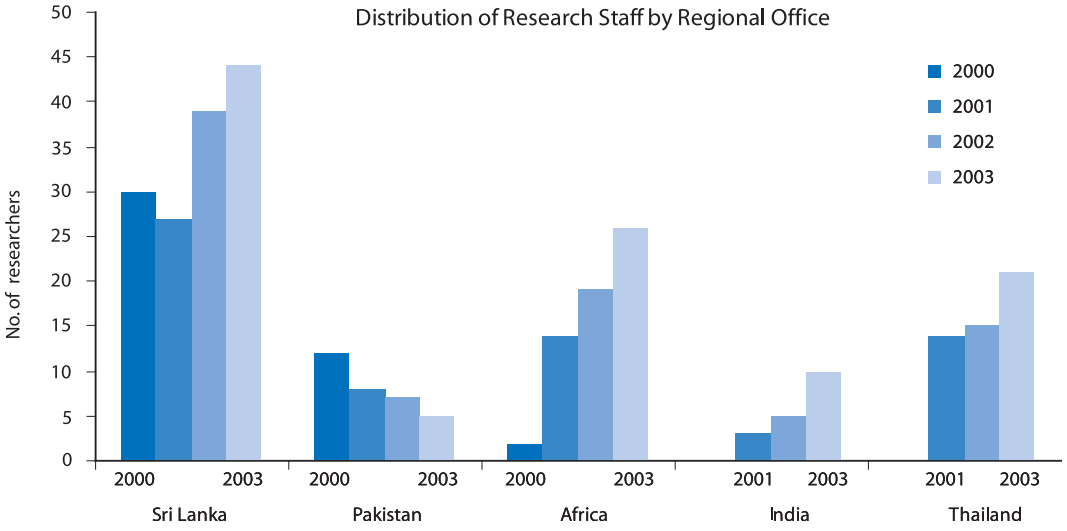
	2003 US$'000	2002 US$'000
Assets		
Current Assets		
Cash and cash equivalents	4,899	1,531
Accounts receivable:		
(Net of US$100,980 allowance for doubtful accounts)		
Donors	2,712	3,813
Employees	195	254
Others	410	757
Inventories	43	33
Prepaid expenses	236	415
Total Current Assets	**8,495**	**6,803**
Noncurrent Assets		
Property and equipment, net	2,231	2,256
Other Assets	**4,424**	**2,993**
Total Assets	**15,274**	**12,082**

	2003 US$'000	2002 US$'000
Liabilities and Net Assets		
Current Liabilities		
Accounts payable		
Donors	5,725	3,624
Employees	207	209
Others	2,247	753
Accruals	43	101
Total Current Liabilities	**8,222**	**4,687**
Long-Term Liabilities		
Accounts payable		
Employees	1,446	1,158
Total Long-Term Liabilities	**1,446**	**1,158**
Total Liabilities	**9,668**	**5,845**
Net Assets		
Unrestricted		
Appropriated	3,270	3,271
Unappropriated	2,212	2,936
	5,482	**6,207**
Restricted	–--	--–
Total Net Assets	**5,482**	**6,207**
Total Liabilities and Net Assets	**15,150**	**12,052**

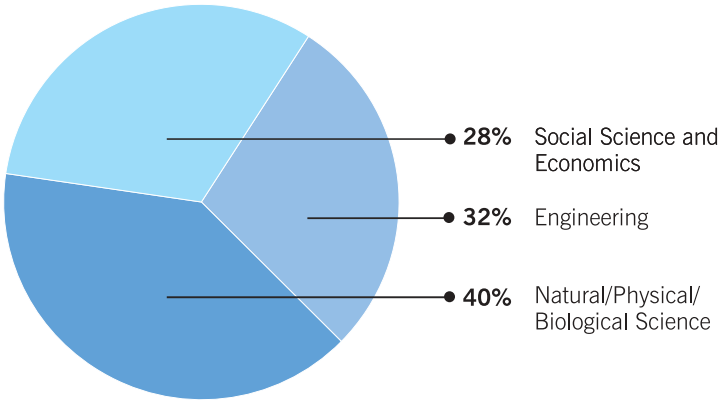
IWMI Staff

On 31st December 2003, the Institute had 106 researchers of whom 89 were internationally and regionally recruited. The latter includes 6 Associate Experts seconded by the Netherlands and Sweden and 15 Post Doctoral Fellows. On 31st December 2003 IWMI total staff numbered 365.

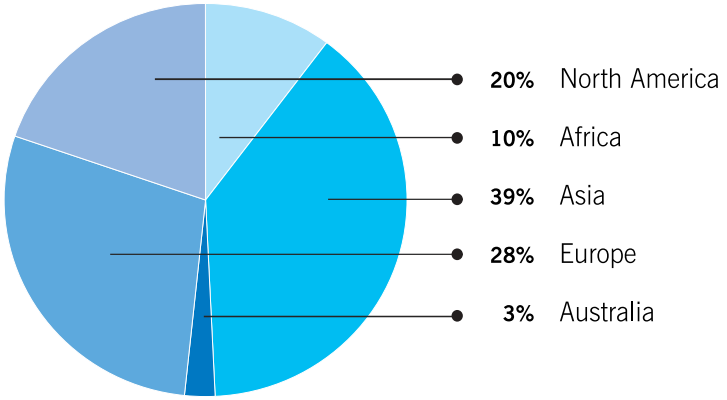
Research Staff 2000–2003



IWMI Researchers
(by Discipline, 2003)



IWMI Researchers
(by Nationality, 2003)



Gender & Diversity Initiatives

Gender & diversity balance is one of IWMI's goals. IWMI's HR Department works closely with the CGIAR Gender & Diversity program to ensure IWMI's policies are in line with best practices. The program has produced a guideline "Monitoring and Evaluating Diversity Goals and Achievements —Guidelines and Tools for CGIAR Board of Trustees." In accordance with the guidelines IWMI's management produces an annual report for the IWMI Board on its efforts and successes in achieving gender and diversity balance within the Institute. At the end of 2003 IWMI had staff from 31 different countries. The proportion of North/South researchers was 50:50. The percentage of female researchers was 22 percent, up from 14 proportion in 2000. The increase in the number of female researchers over the past number of years is a result of the policies put in place by IWMI to ensure that the percentage of female researchers is increased. Policies include "spouse/partner employment," "family work balance and procedures," "anti-harrassment," sponsoring of women in particular from the South in IWMI's capacity-building program, strong internal mentoring and training programs.

In particular IWMI launched a leadership-development program in March 2003. The program's aim was to identify staff members with high potential and through a process of targeted training and mentoring to advance them upwards in the organization in an accelerated fashion. Specifically targeted were female staff members from the South.

The Institute encourages women to look at IWMI as a strong career option. The target set in the Strategic Plan 2004 to 2008 is to attract more female researchers from the South and raise the existing percentage of women in research to 40 by the year 2008.

Diversity at different organizational levels as at 31st December 2003

	Male			Female			Total
	North	**South**	**Subtotal**	**North**	**South**	**Subtotal**	
Board of Trustees	4	2	6	2	5	7	13
	31%	15%	46%	15%	38%	54%	100%
Management Team	8	4	12	2	0	2	14*
	57%	29%	86%	14%	0%	14%	100%
Researchers	35	38	73	10	11	21	94
	37%	40%	78%	11%	12%	22%	100%
Breakup of Researchers							
Principal Researcher -I	10	3	13	0	0	0	13
Senior Researcher - I	8	6	14	3	0	3	17
Senior Researcher - R	0	4	4	0	1	1	5
Researcher - I	9	0	9	4	3	7	16
Researcher - R	1	5	6	0	1	1	7
Researcher - N	1	11	12	0	5	5	17
PostDocs/AE's	6	9	15	3	1	4	19
Research Support (N)	0	71	71	0	18	18	**89**
	0%	80%	80%	0%	20%	20%	100%
Non-Research Staff	1	101	102	2	64	66	168
	1%	60%	61%	1%	38%	39%	100%
Breakup of Non-Research Staff							
Senior Managers/Managers-I	0	0	0	1	0	1	1
Senior Managers/Managers-R	1	2	3	1	0	1	4
Senior Managers/Managers-N	0	11	11	0	3	3	14
Senior Officers/Officers-N	0	36	36	0	35	35	71
Staff -N	0	52	52	0	26	26	78
T o t a l	**44**	**214**	**258**	**14**	**93**	**107**	**365**

* includes 12 researchers for a total 106

Staff from 01.01.2003 to 30.04.2004

HEADQUARTERS

Director General's Office

Prof. Frank Rijsberman, Director General, Mr. Gerard O'Donoghue, Deputy Director General (Operations), **Non-Research:** Ms. Shalini Kumaresan, Senior Secretary, Ms. Coretta De La Zilwa, Senior Secretary, *Ms. Suzuanne Samarawickrema, Coordinator - Management Team

Program Office

Senior Researchers: Dr. Meredith Giordano, Research Coordinator, Ms. Julie Van der Bliek, Senior Adviser - Project Management, **Non-Research:** Mr. Sanjiv de Silva, Program Officer, Ms. Upeka Kariyawasam, Project Leader - Quality Management Systems, Ms. Natalia Abeynayake, Donor Relations Coordinator

Information and Knowledge Group

Mr. Michael Devlin, Chief Knowledge Officer, Ms. Sharmani Gunawardena, Secretary **Communications Unit:** Mr. Patrick Fuller, Senior Communications Advisor, *Ms. Sarah Carriger, Head Writer/Editor, *Mr. Jack Durrell, Writer, Ms. Dawn Rodriguez, Communications Coordinator/Writer, Ms. Sanjini De Silva Dias, Communications Coordinator, Mr. Joseph Perera, Production Editor, Mr. Harshana Rambukwella, Production Editor/Entry-level Science Writer, Mr. David Van Eyck, Intranet and Web Services Coordinator, Mr. Nimal Fernando, Manager, Special Projects, Mr. Kingsley Kurukulasuriya, Consultant Editor, **Services Unit:** Mr. Kithsiri Jayakody, Print Manager, Ms. Nilmini Matthysz, Project Manager, e-Publishing, Ms. Pavithra Amunugama, Administrative Officer, Mr. Surendra Wegodapola, Layout and Graphics Specialist, Mr. Sumith Fernando, Layout and Graphics Specialist, Ms. Shyamine Faleel, Layout and Graphics Specialist, Mr. Nimal Attanayake, Layout and Graphics Specialist, **Electronic Library & Resource Center Unit:** Ms. Ramya de Silva, Head, Electronic Library and Resource Center, Ms. Shanthi Sri Nammuni, Information Management Assistant, Ms. Manik de Alwis, Information Management Assistant, Mr. Chandima Gunadasa, Electronic Library Resources Specialist, Ms. Sandya Suriyarachchi, Information Management Assistant, Mr. Kaushalya Moragaspitiya, Information Management Assistant, *Ms. Dilruskshi Hewagama, Information Management Assistant **Information & Communications Technology (ICT) Unit:** Mr. Sunil Weerasinghe, Head, Information & Communication Technology, Mr. Nirudha Perera, Network Administrator, Mr. G. Rajkumar, Webmaster, Mr. M.Z.M. Riazzi, Database Developer/Administrator, Mr. Nishath Yapa, Database Administrator, Mr. Ranjith Wickremasinghe, Systems Administrator, Mr. M. Sadir, Software Developer, Mr. Shantha Marasinghe, PC Support Technician

Finance & Administration Division

Accounts: Mr. Gamini Halvitige, Financial Controller, Mr. Ranjith Samarakoon, Accountant, Ms. Sanjeevani Perera, Budget Officer, *Mr. Ajith Ratnayake, Senior Accounts Officer, Mr. Kushan Perera, Accounts Officer - Financial Systems, Ms. Chanchala Kariyawasam, Time Management/Administrative Officer, Mr. Tissa Rajanayake, Accounts Officer, Ms. Sriyani G. Seneviratne, Accounts Officer, Ms. Yvonne Weerasinghe, Administrative Officer, Mr. Mahilal Jayawardena, Stores Officer, Ms. Priyanka Rajakaruna, Data Processor, Mr. Kumara Dharmasiri, Cashier, Mr. D.M. Gunasekera, Stores Helper, *Mr. Sithira Weeratunga, Accounts Clerk **Human Resources:** Mr. Sharat Kumar Sadashivpeth, Head, Human Resources, Ms. Shanthi Weerasekera, Training, Career Development & Capacity Building Officer, Ms. Kamani Rajanayake, Personnel Officer, Ms. Anusha De Silva, Secretary, Ms. Thushari Samarasekera, Secretary **Administration:** Mr. Sepala Amarasuriya, Head Corporate Affairs & Administrative Services *Mr. Daya Samaraweera, Manager, Administrative Services, Mr. Upali Karunanayake, Senior Purchasing Assistant, Ms. Shahanaz Makawita, Secretary, Mr. M. Ramraj, Senior Steward, Mr. S.M.H.P. Samarakoon, Steward, **Office Support Systems**: Mr. S.M.B. Seneviratne, Manager - Office Support Systems Office, Mr. Ajith Wijayaratne, Distribution Officer, Ms. Sujatha Dassanayake, Receptionist/Junior Secretary, Ms. Lakmali Wijesinghe, Receptionist/Junior Secretary, Ms. Viranga Kularatne, Receptionist/Junior Secretary, Mr. A. Joseph, Office Aide, Mr. K. Punchibanda, Junior Clerk, Mr. N.S. Ranjithsinghe, Junior Clerk, Mr. S.M. Edirimanne, Production Assistant/Clerk, Mr. Lal Abeykoon, Junior Clerk

Transport & Maintenance: Mr. Eardley De Silva, Acting Manager, Building Engineering Services & Transport, Mr. Kapila Pathiraja, Assistant Manager, Building Engineering Services & Transport, Ms. Thusitha Jayatilleke, Administrative Officer, Mr. Ravi Dissanayake, Transport Assistant, Ms. Iresha Dharmawardhana, Administrative Assistant, Mr. S. Arockiam, Plumber, Mr. P.W. Pathirana, Electrician, Mr. S. Krishnarajah, Office Aide/General Helper, Mr. P.A. Rezel, Electrician, Mr. Sunil Jayatillake, Carpenter/Fitter, Mr. K.G.S. Kumara, Driver, Mr. Priyantha Chandrasena, Driver, Mr. Ajith Perera, Driver, Mr. Ajantha Perera, Driver, *Mr. Mahinda Karandawatte, Driver, *Mr. Y.K.G. Costa, Driver, Mr. K.K.R. Kumara, Driver, Mr. W.D. Upali, General Laborer, **Travel Office:** Mr. Nihal Silva, Visa Coordinator, Ms. Nazreen Yousuf, Conference and Travel Officer

Global Research Division (Sri Lanka)

Principal Researchers: Dr. David Molden, Leader, Comprehensive Assessment of Water Management in Agriculture, Dr. Felix Amerasinghe, Theme Leader, Water, Health & Environment, Dr. Madar Samad, Theme Leader, Water Resource Institutions & Policies, Dr. Francois Molle, Water Management Specialist, Dr. Vladimir Smakhtin, Principal Eco-Hydrologist, Dr. Hugh Turral, Theme Leader, Integrated Water Management for Agriculture, Dr. Francis Gichuki, CP Theme Leader - Integrated Basin Water Management Systems, Mr. Naoya Fujimoto, Principal Researcher/ Deputy Coordinator Comprehensive Assessment, *Dr. Mark Rosegrant, Principal Researcher, *Dr. Wolfgang Flugel, Principal Hydrologist, *Mr. Tissa Bandaragoda, Principal Researcher, **Senior Researchers:** Dr. Sarath Abayawardana, Director Global Research Division/Senior Chemical Engineer, Dr. Deborah Bossio, Theme Leader – Sustainable Smallholder Land and Water Management Systems, Dr. Rathinasamy Maria Saleth, Senior Institutional Economist, Dr. Robert Zomer, Senior Landscape Ecologist, Dr. Charlotte de Fraiture, Irrigation Engineer, Dr. Intizar Hussain, Senior Economist, Dr. Liqa Raschid-Sally, Wastewater Specialist, Dr. Upali Amarasinghe, Senior Statistician, Dr. Mark Giordano, Resource Economist, Dr. Prasad Thenkabail, Senior Researcher, Dr. Chu Thai

Overview of IWMI Staff by Nationality

Research	Research	Research Support	Non-Research
Australia	3	0	1
Bangladesh	1	1	0
Belgium	1	0	0
China	1	0	0
Ethiopia	1	0	0
France	13	0	0
Germany	2	0	0
Ghana	1	3	5
India	7	14	6
Ireland	0	0	1
Japan	2	0	0
Kenya	2	1	1
Mexico	1	0	0
Nepal	4	0	1
Netherlands	10	0	0
Nigeria	1	0	0
Pakistan	5	30	29
Philippines	2	0	0
Russia	1	0	0
Senegal	1	0	0
Sierra Leone	1	0	0
South Africa	6	5	8
Sri Lanka	14	27	98
Sweden	2	0	0
Switzerland	1	0	0
Thailand	2	6	10
United Kingdom	5	0	3
United States	13	0	1
Uzbekistan	1	2	6
Vietnam	1	0	0
Zimbabwe	1	0	0
Total	**106**	**89**	**170**

Hoanh, Senior Water Resources Engineer, Dr. Peter McCornick, Senior Water Resources Specialist, Dr. Karen Villholth, Groundwater Modeling Specialist **Researchers:** Mr. K. Jinapala, Institutions Specialist, Mr. Manju Hemakumara, Benchmark Basin Coordinator, Mr. S.C Piyankarage, Chemist, Ms. Gayathree Jayasinghe, Biometrician (seconded to CGIAR G&D Program at ICRAF, Nairobi from 1/2/2003 to 31/5/2004), Ms. Dilkushi De Alwis, Junior Hydrologist, *Dr. Ximing Cai, Researcher, Ms. Sitara Attapattu, Coastal Zone Ecologist, Mr. Parakrama Weligamage, Economist, Mr. Dhananjaya Niriella, Environmental Engineer, Ms. Rebecca Tharme, Freshwater Ecologist, Ms. Sophie Nguyen Khoa Man, Fisheries Specialist, Dr. Pierre Marchand, Database Architect **Postdoctoral Scientists:** *Dr. Jinxia Wang, Postdoctoral Scientist, Dr. Madhusudan Bhattarai, Applied Economist/Environmental Economist, Dr. Regassa Ensermu Namara, Agricultural Economist/Socio-Economist, Dr. Nicolas Roost, Irrigation and Water Management Specialist, Dr. Francis Canisius, Remote Sensing Specialist, Dr. Mobin-ud-Din Ahmad, Hydrologist and Remote Sensing Specialist, **Associate Experts:** Mr. Olivier Briet, Medical Entomologist, **Research Officers:** Mr. P.G. Somaratne, Sociologist, Mr. B.R. Ariyaratne, Benchmark Basin Coordinator, Mr. Lal Muthuwatta, Remote Sensing/GIS Specialist, Mr. Sunil Thrikawala, Agricultural Economist, Mr. Noel Aloysius, Water Resources Engineer, Mr. Shahriar Pervez, GIS Specialist, Mr. Chandana Gangodagamage, Remote Sensing Specialist, Mr. Neelanga Weragala, Civil Engineer, Mr. Deeptha Wijerathna, Agricultural Economist, Mr. Priyantha Jayakody, Agricultural Engineer, Ms. Shyamalie de Silva, Social Scientist, Mr. Markandu Anputhas, Biometrician, Mr. M.G.S.D. Nilantha, Remote Sensing/GIS Specialist, **Research Support**: Mr. M. Dayananda, Field Data Collector, Mr. Nihal Dayasena, Field Data Collector, Mr. Sarath Lionalratne, Field Data Collector, Mr. D.R.G.S.P. Ranasinghe, Field Data Collector, Mr. N.G. Indrajith, Field Data Collector, Mr. A.D. Ranjith, Digitizing Operator, Ms. Thushari Perera, Research Assistant, Mr. Pradeep Dissanayake, GIS Technician, Mr. D.G.S. Gunasinghe, Digitizing Operator, **Non-Research:** Ms. Sepali Goonaratne, Administrative Officer, Ms. Janitha Godamuduna, Senior Secretary, Ms. Himani Elangasinghe, Secretary, Ms. Ashra Fernando, Secretary, Ms. Samanmali Jayatillaka , Secretary, Ms. Nilupuli Pethiyagoda, Secretary, Mr. D.W. Premachandra, Data Entry Clerk, *Ms. Dhammika de Silva, Conference Coordinator, *Mr. Nedumaran, Balakrishnan, Assistant IT Officer, *Ms. Samudra Mendis, Secretary

Regional Office Southeast Asia (Thailand)

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Subregional Office - Laos

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Subregional Office - Vietnam

Senior Researchers: Dr. Didier Orange, Hydrologist & Geochemist, Dr. Pascal Podwojewski, Soil Scientist

Subregional Office - Cambodia

Research Officers: Mr. L.R. Perera, Social Scientist

Regional Office (Central Asia) Pakistan

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Subregional Office - Iran

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Subregional Office - Uzbekistan

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Regional Office South Asia (Hyderabad)

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Subregional Office - New Delhi

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Subregional Office - Anand

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Subregional Office - Ethiopia

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Dialogue Secretariat

Researchers: Ms. Domitille Vallee, Researcher/Coordinator, Dialogue Secretariat, Mr. Yogesh Bhatt, Local Action Coordinator, Dialogue Secretariat, **Associate Expert:** Mr. Marco Blixt, Knowledge Base Manager, **Non-Research:** Ms. Veronica Lumanauw, Administrative Officer, Ms. Arosha Ranasinghe, Secretary

Global Water Partnership Secretariat

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Challenge Program on Water and Food

Principal Researcher: Dr. Jonathan Woolley, Coordinator, **Non-Research:** Ms. Pamela George, Manager, Ms. Sharon Perera, Executive Assistant, Ms. Mala Ranawake, Administrative Officer, Ms. Priyanka Tissaverasinghe, Secretary, **Research Officers:** Ms. Priyantha Jayasuriya Arachchi, Data Analyst, *Mr. Sean Perera, Research Officer

* Staff who left IWMI during the period 01 Jan 2003 to 30 April 2004.

Publications

A complete listing of publications for 2003—including working papers, proceedings, chapters in books and papers presented at conferences—is available and access to IWMI Research Reports, Working Papers and Water Policy Briefings is possible on the CD-ROM version of the Annual Report or at www.iwmi.org/pubs

RESEARCH REPORTS

1. **Hannam, I. 2003.** A method to identify and evaluate the legal and institutional framework for the management of water and land in Asia: The outcome of a study in Southeast Asia and the People's Republic of China. Colombo, Sri Lanka: IWMI. v, 33p. (IWMI Research Report 73).

2. **Hundertmark, W.; Abdourahmane, A.T.** 2003. A diagnostic model framework for water use in rice-based irrigation systems. Colombo, Sri Lanka: IWMI. (Research Report 74).

3. **Hussain, I.; Sakthivadivel, R.; Amarasinghe, U.; Mudasser, M.; Molden, D.** 2003. Land and water productivity of wheat in the Western Indo-Gangetic Plains of India and Pakistan: A comparative analysis. Colombo, Sri Lanka: IWMI. vi, 50p. (IWMI Research Report 65).

4. **Kendy, E.; Molden, D. J.; Steenhuis, T. S.; Liu, C.** 2003. Policies drain the North China Plain: Agricultural policy and groundwater depletion in Luancheng County, 1949-2000. Colombo, Sri Lanka: IWMI. v, 45p. (IWMI Research Report 71).

5. **Kikuchi, M.; Weligamage, P.; Barker, R.; Samad, M.; Kono, H.; Somaratne, H. M.** 2003. Agro-well and pump diffusion in the dry zone of Sri Lanka: Past trends, present status and future prospects. Colombo, Sri Lanka: IWMI. v, 48p. (IWMI Research Report 66).

6. **Klinkenberg, E.; van der Hoek, W.; Amerasinghe, F. P.; Jayasinghe, G.; Mutuwatte, L.; Gunawardena, D. M.** 2003. Malaria and land use: A spatial and temporal risk analysis in Southern Sri Lanka. Colombo, Sri Lanka: IWMI. v, 54p. (IWMI Research Report 68).

7. **Molle, F.** 2003. Development trajectories of river basins: A conceptual framework. Colombo, Sri Lanka: IWMI. v, 32p. (IWMI Research Report 72).

8. **Mukherji, A.; Kishore, A.** 2003. Tubewell transfer in Gujarat: A study of the GWRDC approach. Colombo, Sri Lanka: IWMI. vi, 34p. (IWMI Research Report 69).

9. **Murray-Rust, H.; Abdullaev, I.; ul Hassan, M.; Horinkova, V.** 2003. Water productivity in the Syr-Darya River Basin. Colombo, Sri Lanka: IWMI. v, 75p. (IWMI Research Report 67).

10. **Namara, R. E.; Weligamage, P.; Barker, R.** 2003. Prospects for adopting system of rice intensification in Sri Lanka: A socioeconomic assessment. Colombo, Sri Lanka: IWMI. (IWMI Research Report 75).

11. **Shah, T.; Scott, C.; Kishore, A.; Sharma, A.** 2003. Energy-irrigation nexus in South Asia: Improving groundwater conservation and power sector viability. Colombo, Sri Lanka: IWMI. vi, 28p. (IWMI Research Report 70).

IWMI Research Reports

Publications in this series are peer-reviewed and cover a wide range of subjects from computer modeling to experience with water user associations. They vary in content from directly applicable research to more basic studies on which applied work ultimately depends. While some research reports are narrowly focused, analytical and empirical studies, others are wide-ranging and synthetic overviews of generic problems.

IWMI Research Reports are published and distributed in both hard copy and electronically (www.iwmi.org) and where possible, all data and analyses will be available as separate downloadable files. Reports may be copied and cited with due acknowledgement.

Number of IWMI Research Reports Produced from 2000-2003

2000	09
2001	12
2002	07
2003	11
Total	**39**

PEER-REVIEWED JOURNAL ARTICLES

12. **Ahmad, M. D.; Bastiaanssen, W. G. M.** 2003. Retrieving soil moisture storage in the unsaturated zone using satellite imagery and bi-annual phreatic surface fluctuations. *Irrigation and Drainage Systems,* 17: 141-161.

13. **Anputhas, M.; Samita, S.; S. De Z. Abeysiriwardena.** 2003. Multivariate approach in varietal recommendations. *Tropical Agricultural Research,* 15: 207-216.

14. **Barlow, K.; Nash, D.; Turral, H.; Grayson, R.G.** 2003. Phosphorus uptake and release in surface drains. *Agricultural Water Management,* 63(2): 109–123.

15. **Barron, J.; Rockstrom, J.; Gichuki F. N.; Hatibu,N.** 2003. Dry spell analysis and maize yields for two semi-arid locations in east Africa. *Agricultural Meteorology,* 117(1-2): 23–37.

16. **Bastiaanssen, W. G. M.; Ali, S.** 2003. A new crop yield forecasting model based on satellite measurements applied across the Indus Basin, Pakistan. *Agriculture, Ecosystems and Environment,* 94: 321-340.

17. **Bastiaanssen, W. G. M.; Chandrapala, L.** 2003. Water balance variability across Sri Lanka for assessing agricultural and environmental water use. *Agricultural Water Management,* 58(2): 171-192.

18. **Bhattarai, M.; Narayanamoorthy, A.** 2003. Impact of irrigation on rural poverty in India: An aggregate panel-data analysis. *Water Policy,* 5(5-6): 443-458.

19. **Biltonen, E.; Dalton, J. A.** 2003. A water-poverty accounting framework: Analyzing the water-poverty link. *Water International,* 28(4): 467-477.

20. **Boelee, E.** 2003. Malaria in irrigated agriculture. *Irrigation and Drainage,* 52: 65-69.

21. **Briët., O. J. T.; Gunawardena, D. M.; van der Hoek, W.; Amerasinghe, F. P.** 2003. Sri Lanka malaria maps. *Malaria Journal,* 2: 22-32.

22. **Cai, X.; McKinney, D. C.; Lasdon, L. S.** 2003. Integrated hydrologic-agronomic-economic model for river basin management. *Journal of Water Resources Planning and Management,* 129(1): 4-17.

23. **Cain, J. D.; Jinapala, K.; Makin, I. W.; Somaratna, P. G.; Ariyaratna, B. R.; Perera, L. R.** 2003. Participatory decision support for agricultural management: A case study from Sri Lanka. *Agricultural Systems,* 76: 457-482.

24. **Cheverry, P.; Boivin, E.; Vachaud, G.; Valentin, C.; Webster, R. 2003.** Michel Rieu (1943-1999): His vision and his legacy. *European Journal of Soil Science*, 54: 439-442.

25. **de Fraiture, C.; Cai, X.; Rosegrant, M.; Molden, D.; Amarasinghe, U.** 2003. Addressing the unanswered questions in global water policy: A methodology framework. *Irrigation and Drainage,* 52(1): 21-30.

26. **Ekanayake, L.; van der Hoek, W.** 2003. Prevalence and distribution of developmental defects and caries in a high fluoride area in Sri Lanka. *International Dental Journal,* 53: 243-248.

27. **George, B. A.; Malano, H. M.; Tri, V. K.; Turral, H.** 2003. Using modelling to improve operational performance in the Cu Chi Irrigation System, Vietnam. *Irrigation and Drainage,* 52: 1-13.

28. **Giordano, M.** 2003. The geography of the commons: The role of scale and space. *Annals of the Association of American Geographers*, 93(2): 365-375.

29. **Giordano, M. A.** 2003. Managing the quality of international rivers: Global principles and basin practice. *Natural Resources Journal,* 43(1): 111-136.

30. **Giordano, M. A.; Wolf, A. T.** 2003. Sharing waters: Post-Rio international water management. *Natural Resources Forum,* 27: 163-171.

31. **Hemakumara, H. M.; Chandrapala, L.; Moene, A. F.** 2003. Evapotranspiration fluxes over mixed vegetation areas measured from large aperture scintillometer. *Agricultural Water Management,* 58(2): 109-122.

32. **Hoanh, C. T.; Tuong, T. P.; Gallop, K. M.; Gowing, J. W.; Kam, S. P.; Khiem, N. T.; Phong, N. D.** 2003. Livelihood impacts of water policy changes: Evidence from a coastal area of the Mekong River Delta. *Water Policy,* 5(5/6): 475-488.

33. **Horinkova, V.; Abdullaev, I.** 2003. Institutional aspects of water management in Central Asia: Water users associations. *Water International,* 28(2): 237-245.

34. **Huppert, W.; Svendsen, M.; Vermillion, D. L.** 2003. Maintenance in irrigation: Multiple actors, multiple contexts, multiple strategies. *Irrigation and Drainage Systems,* 17(1-2): 5-22.

35. **Hussain, I.; Hanjra, M. A.** 2003. Does irrigation water matter for rural poverty alleviation?: Evidence from South and South-East Asia. *Water Policy,* 5(5-6): 429-442.

36. **Inocencio, A. Sally, H. ; Merrey, D. J.** 2003. Agricultural land and water management for poverty reduction and economic growth in sub-Saharan Africa: Setting the research agenda. *African Water Journal,* December 20-29.

37. **Janeau, J. L.; Bricquet, J. P.; Planchon, O.; Valentin, C**. 2003. Soil crusting and infiltration on steep slopes in northern Thailand. *European Journal of Soil Science,* 54: 543-553.

38. **Jayatilaka, C. J.; Sakthivadivel, R.; Shinogi, Y.; Makin, I. W.; Witharana, P.** 2003. A simple water balance modelling approach for determining water availability in an irrigation tank cascade system. *Journal of Hydrology,* 273: 81-102.

39. **Jensen, P. K.; Ensink, J. H. J.; Jayasinghe, G.; van der Hoek, W.; Cairncross, S.; Dalsgaard, A.** 2003. Effect of chlorination of drinking-water on water quality and childhood diarrhoea in a village in Pakistan. *Journal of Health, Population and Nutrition,* 21(1): 26-31.

40. **Kamara, A.; Sally, H.** 2003. Water for food, livelihoods and nature: Simulations for policy dialogue in South Africa. *Physics and Chemistry of the Earth,* 28: 1085-1094.

41. **Kayam, Y.; Beyazgul, M.; Droogers, P.** 2003. A model approach to evaluate irrigation system water balance: An example from the Gediz basin, Turkey. *International Journal of Water,* 2(2/3): 123-137.

42. **Keraita, B.; Drechsel, P.; Amoah, P**. 2003. Influence of urban wastewater on stream water quality and agriculture in and around Kumasi, Ghana. *Environment and Urbanization,* 15(2): 171-178.

43. **Khanna, M.; Malano, H. M.; Fenton, J. D.; Turral, H.** 2003. Design and management guidelines for contour basin irrigation layouts in southeast Australia. *Agricultural Water Management,* 62(1): 19-35.

44. **Khanna, M.; Malano, H. M; Fenton, J. D; Turral, H.** 2003. Two-dimensional simulation model for contour basin layouts in Southeast Australia I: Rectangular basins. *Journal of Irrigation and Drainage Engineering,* 129(5): 305-316.

45. **Khanna, M.; Malano, H. M; Fenton, J. D; Turral, H.** 2003. Two-dimensional simulation model for contour basin layouts in Southeast Australia II: Irregular shape and multiple basins. *Journal of Irrigation and Drainage Engineering,* 129(5): 317-325.

46. **Konradsen, F.; Amerasinghe, P.; van der Hoek, W.; Amerasinghe, F.; Perera, D.; Piyaratne, M. 2003.** Strong association between house characteristics and malaria vectors in Sri Lanka. *American Journal of Tropical Medicine and Hygiene,* 68(2): 177-181.

47. **Kumar, M. D. ; Singh, O. P. 2003.** Physical choices for integrated water management in Sabarmati. *Journal of Indian Water Resources Society,* 23(2): 27-38.

48. **Lévite, H.; Sally, H.; Cour, J.** 2003. Testing water demand management scenarios in a water-stressed basin in South Africa: Application of the WEAP model. *Physics and Chemistry of the Earth,* 28: 779-786.

49. **Lévite,H.; Faysse, N.; Ardorino, F**. 2003 Resolving water use conflicts through stakeholder participation: Issues and examples from the Steelpoort Basin in South Africa. *African Water Journal*, December 32-44.

50. **Mainuddin, M. A.; Das Gupta, A.; Loof, R.** 2003. Irrigation water delivery performance under parameters' uncertainty. *Journal of Applied Irrigation Science,* 38(2): 211-233.

51. **Matsuno, Y.; Tasumi, M.; van der Hoek, W.; Sakthivadivel, R.; Otsuki, K.** 2003. Analysis of return flows in a tank cascade system in Sri Lanka. *Paddy Water Environment,* 1: 173-181.

52. **McCarthy, N.; Kamara, A.; Kirk, M.** 2003. Co-operation in risky environments: Evidence from Southern Ethiopia. *Journal of African Economies,* 12(2): 236-270.

53. **Molle, F.; Mollinga, P.** 2003. Water poverty indicators: Conceptual problems and policy issues. *Water Policy,* 5(5-6): 529-544.

54. **Mukhtar, M.; Herrel, N.; Amerasinghe, F. P.; Ensink, J.; van der Hoek, W.; Konradsen, F.** 2003. Role of wastewater irrigation in mosquito breeding in South Punjab, Pakistan. *The Southeast Asian Journal of Tropical Medicine and Public Health,* 34(1): 72-80.

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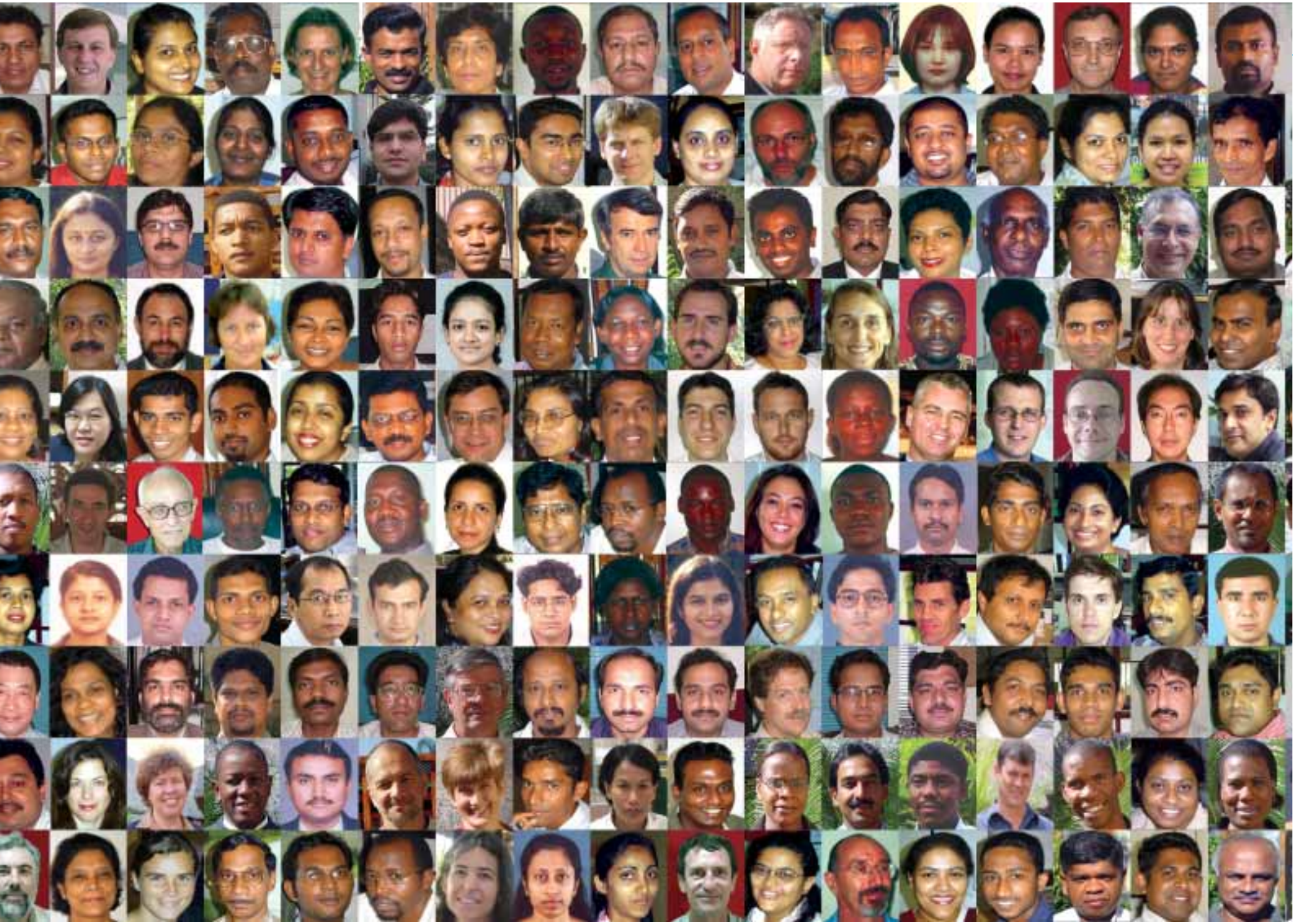

Our vision is that in 2008, IWMI is a world -class knowledge resource center on water,food and environment. It generates knowledge on better water and land management in developing countries, through strategic research alliances with a set of core partners throughout Asia and Africa, and with advanced research institutes in developed countries. This knowledge is held and maintained as global public goods for the benefit of all mankind.

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