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## CONTENTS

# RESEARCH REPORTS

(ISSN 1026-0862)

**34.** *M. Samad and Douglas Vermillion*
**Assessment of Participatory Management of Irrigation Schemes in Sri Lanka: Partial Reforms, Partial Benefits** (Forthcoming)

**33.** *R. Sakthivadivel, S. Thiruvengadachari, and Upali A. Amarasinghe*
**Intervention Analysis of an Irrigation System Modernized with Structured System Concept** (Forthcoming)

**32.** *Upali A. Amarasinghe, Lal Mutuwatta, and R. Sakthivadivel*
**Water Scarcity Variations Within a Country: A Case Study of Sri Lanka** (Forthcoming)

**31.** *Elena P. Bastidas*
**Gender Issues and Women's Participation in Irrigated Agriculture: The Case of Two Private Irrigation Canals in Carchi, Eucador** (Forthcoming)

**30.** *S. A.. Prathapar and Asad S. Qureshi*
**Mechanically Reclaiming Abandoned Saline Soils: A Numerical Evaluation**

1999, 32pp., ISBN 92-9090-202-7
US$5.00, US$2.50 (developing countries)

In arid and semiarid regions, large tracts of land developed for irrigation are being abandoned each year due to secondary salinization from saline water tables. The objective of this report is to test the hypothesis that timely surface cultivation and monsoon or winter rains in semiarid and arid areas will assist reclamation of abandoned saline soils.

*/ water quality / groundwater / simulation models / water table / water balance / hydraulics / soil reclamation / soil water / soil properties / salinity / calibrations / flow / Pakistan / Punjab / Sindh /*

**29.** *D. Renault and G. G. A. Godaliyadda*
**Generic Typology for Irrigation Systems Operation**

1999, 32pp., ISBN 92-9090-372-4
US$5.00, US$2.50 (developing countries)

This report presents a methodology for identifying the main characteristics (constraints and opportunities) of gravity-fed irrigation systems, which influence management and operation of the system for the purpose of water delivery. It presents the development of a generic typology for improving irrigation system operations. A case study of 64 irrigation systems in Sri Lanka is presented illustrating the practical application of the proposed typology.

*/ irrigation management / irrigation systems/ water use efficiency / canals / operations / water delivery / irrigation effects / hydraulics / gravity flow / resource management / typology / case studies / constraints / water supply / networks / Sri Lanka /*

**28.** *R. Sakthivadivel, S. Thiruvengadachari, Upali Amerasinghe, W. G. M. Bastiaanssen, and David Molden*
**Performance Evaluation of the Bhakra Irrigation System, India, Using Remote Sensing and GIS Techniques**

1999, 32pp., ISBN 92-9090-375-9
US$5.00, US$2.50 (developing countries)

In this study, satellite remote sensing and geographic information system (GIS) techniques were used to analyze the agricultural performance and sustainability of the Bhakra Irrigation System in India. The results demonstrate the synergy possible from applying satellite remote sensing and GIS to evaluate trends in rising water tables and salinity, which are two important threats to the sustainability of irrigation systems, and the cost-effectiveness of these techniques as diagnostic tools for irrigation system improvement.

*/ irrigation systems / irrigation scheduling / performance evaluation / remote sensing / GIS / irrigated farming / satellite surveys / agricultural sustainability / productivity / groundwater / salinity / crop yield / rice / food production / surface irrigation / India / Bhakra irrigation system /*

**27.** *W. G. M. Bastiaanssen, D. J. Molden, S. Thiruvengadachari, A. A. M. F. R. Smit, L. Mutuwatte, and G. Jayasinghe*
**Remote Sensing and Hydrologic Models for Performance Assessment in Sirsa Irrigation Circle, India**

1999, 36pp., ISBN 92-9090-374-0
US$5.00, US$2.50 (developing countries)

Studies of irrigation system performance are often restricted by practical limitations on the amount of data that can be collected in the field. Consequently, researchers tend to focus

in detail on parts of an irrigated area or to make a less-detailed investigation of a whole system. Advanced information technologies support the analysis of irrigation performance by facilitating in-depth studies of large irrigated areas. This report describes the results of an irrigation performance evaluation using remote sensing techniques, GIS procedures, and hydrologic modeling at a regional scale. The study area was the Sirsa Irrigation Circle within the Bhakra Irrigation System in northwest India.

*/ irrigation management / irrigation systems / irrigation canals / performance evaluation / remote sensing / GIS / models / irrigated farming / hydrology / satellite surveys / irrigation scheduling / evapotranspiration / India /*

**26.** *W. K. B. Elkaduwa and R. Sakthivadivel*
**Use of Historical Data as a Decision Support Tool in Watershed Management: A Case Study of the Upper Nilwala Basin in Sri Lanka**

1999, 44pp., 92-9090-377-5
US$5.00, US$2.50 (developing countries)

Watershed analysis provides a framework for ecosystem management, which is currently the best option for conservation and management of natural resources. The current methods of assessing hydrologic impacts of land use transformation at the watershed scale, particularly in the tropics, are impaired by technical, financial, and time constraints. This study provides an alternative approach to ascertain the actual changes in hydrologic response of a particular watershed to land use transformations made in the past.

*/ watershed management / hydrology / land use / flow / catchment areas / water balance / case studies / runoff / water yield / rainfall-runoff relationships / forestry / decision support systems / data collection / Sri Lanka / Nilwala basin /*

**25.** D. Vermillion and Carlos Garces-Restrepo
**Impacts of Colombia's Current Irrigation Management Transfer Program**

1998, 43pp., ISBN 92-9090-364-3
US$5.00, US$2.50 (developing countries)

This report deals with the results of a study conducted by the International Water Management Institute in collaboration with the National Institute for Land Development (INAT) to assess the impacts of the current national irrigation management

transfer program in Colombia. The report examines the context of transfer, the basic transfer strategy, the impacts of transfer, and the powers and functions devolved in the transferred districts. The need to use the transfer process to create local management self-reliance is also stressed.

*/ privatization / irrigation management/ irrigated farming / policy / costs / economic aspects / operation / maintenance / agricultural production / Colombia /*

**24.** *C. J. Perry and S. G. Narayanamurthy*
**Farmer Response to Rationed and Uncertain Irrigation Supplies**

1998, 28pp., ISBN 92-9090-362-7
US$ 5.00., US$ 2.50 (developing countries)

Managing irrigation systems for maximum productivity under conditions of shortage and uncertainty is a critically important challenge to irrigated agriculture. This report explores the theoretical and actual responses of farmers faced with irrigation supplies that are limited in relation to available land and labor resources, and where the actual schedule and available volume for delivery are uncertain.

*/ water resources management/ water use efficiency / evapotranspiration / agricultural production / irrigated farming / irrigation scheduling / water allocation / water supply / water scarcity / water delivery / reservoirs / uncertainty / yield / India/ Haryana /*

**23.** *G. Levine, A Cruz, D. Garcia, C. Garcés-Restrepo , and S. Johnson III*
**Performance of Two Transferred Modules in the Lagunera Region : Water Relations**

1998, 24pp., ISBN 92-9090-357-0
US$ 5.00, US$ 2.50 (developing countries)

The study of the performance of transferred system is an important feature of the research program of the International Water Management Institute. (IWMI). This report evaluates the degree of success of water users in managing water allocations and deliveries in two irrigation district modules in the Lagunera Region of Mexico where O&M responsibilities were transferred to the users in 1993.

*/ water policy/ performance / privatization / irrigation systems/ operation/ maintenance / irrigation / efficiency / water user association / water rights / water allocation / water supply / Mexico /*

**22.** *Wim H. Kloezen and Carlos Garces-Restrepo*
**Assessing Irrigation Performance with Comparative Indicators: The case of the Alto Rio Lerma Irrigation District, Mexico**

1998, 52pp., ISBN 92-9090-359-7
US$ 5.00, US$ 2.50 (developing countries)

This report describes and evaluates the application of IWMI's minimum set of comparative performance indicators to the Alto Rio Lerma Irrigation District (ARLID), located in the Mexican State of Guanajuato, and compares this with the application of a small set of process performance indicators.

*/ irrigated management / irrigation scheduling / water allocation / water distribution / case studies / institutional constrains / operation / monitoring / indicators / performance indexes / water rights/ economic aspects / data collections / environmental affects / performance evaluation / water use efficiency / Mexico /*

**21.** *D. J. Bandaragoda*
**Need for Institutional Impact Assessment in Planning Irrigation System Modernization**

1998, 28pp., ISBN 92-9090-201-9
US$ 5.00, US$ 2.50 (developing countries)

This report cites a case study of the institutional implications of remodeling an old irrigation system in northern Pakistan, and draws the attention of donors and project planners to the institutional implications of current project preparation methods and concludes that the institutional constraints in modernizing old irrigation systems can be foreseen at the planning and design stages.

*/ irrigated management/ irrigation systems / water allocation / rehabilitation / modernization / case studies / institutional constraints / operation / maintenance / irrigation canals / irrigation effects / Pakistan /*

**20.** *David J. Molden, R. Sakthivadivel, Christopher J. Perry, Charlotte de Fraiture, and Wim H. Kloezen*
**Indicators for Comparing Performance of Irrigated Agriculture Systems**

1998, 36pp., ISBN - 92-9090-356-2
US$ 5.00, US$ 2.50 (developing countries)

This report presents IWMI's external and other comparative performance indicators that will allow for comparative analysis of irrigation performance across irrigation systems. It also

presents the experience with their use, based on application across several irrigation systems. At this stage, it is hypothesized that through the use of these indicators, we are able to document and compare key performance attributes of irrigation systems. If so, then it should be possible to compare performance across irrigation systems in a number of settings to understand where we presently stand with respect to productive utilization of land and water, to compare relative performance of systems, and to identify where performance can be improved.

*/ irrigated farming / irrigation system/ indicators/ performance/ indexes / land / water / financing/ crop production /*

**19.** *David Seckler, Upali Amarasinghe, David Molden, Rhadika de Silva, and Randolph Barker*

**World Water Demand and Supply, 1990 to 2025: Scenarios and Issues**

1998, 52pp., ISBN 92-9090-354-6
US$ 6.00, US$ 3.00 (developing countries)

Appropriate policies and projects need to be implemented to deal with severe water shortages that are expected to affect many countries. The international Water Management Institute (IWMI) has launched a long-term research program to improve the conceptual and empirical basis for analysis of water in major countries of the world. This study is the first step in this country research program.

*/ irrigation management / water balance / river basins / basin irrigation / water use efficiency / water supply / water requirements / domestic water / water scarcity / water demand / water shortage / irrigated farming / productivity / food security / recycling / rice /*

**18.** *Upali A. Amarasinghe, R. Sakthivadivel, and Hammond Murray-Rust*

**Impact Assessment of Rehabilitation Intervention in the Gal Oya Left Bank**

1998, 32pp., ISBN 92-9090-348-1
US$ 5.00, US$ 2.50 (developing countries)

This report presents the results of an impact assessment of rehabilitation interventions on irrigation system performance in the Left Bank of the Gal Oya irrigation system in Sri Lanka. The method of analysis was based on time series intervention analysis. The irrigation system performance indicators used as dependent variables in the analysis are irrigated area, irrigation

supply per unit area, total irrigation supply, productivity per unit of land, and productivity per unit of irrigation supply.

*/ irrigation management / water management / irrigation systems / productivity / rehabilitation / models / project evaluation / rain / reservoir storage / Sri Lanka / Gal Oya Project /*

**17.** *D. J. Bandaragoda*
**Design and Practice of Water Allocation Rules: Lessons from *Warabandi* in Pakistan's Punjab**

1998, 36pp., ISBN 92-9090-200-0
US$ 5.00, US$ 2.50 (developing countries)

Warabandi, an irrigation water allocation method, has been practiced in Pakistan and Northern India for more than 125 years, and covers an area of about 24 million hectares of irrigated land in the two countries. This report, which is based on intensive field work, focuses on the existing gap between the traditional design concepts of warabandi and its actual practice. Within this focus, it also outlines some institutional implications of the present practice of warabandi and identifies further research and policy needs.

*/ water management / irrigation management / water allocation / watercourse / water distribution / design / irrigation scheduling / social aspects/ economic aspects / water users / distributary canals / Pakistan / Punjab /*

**16.** *Sam H. Johnson III*
**Irrigation Management Transfer in Mexico: A Strategy to Achieve Irrigation District Sustainability**

1997, 40pp., ISBN 92-9090-347-3
US$ 5.00, US$ 2.50 (developing countries)

This report details the process of transfer of public irrigation districts in Mexico from public ownership to joint management, where responsibility for irrigation O&M is shared between the public irrigation agency and the water user associations. The case of Mexico is very important as the country has demonstrated that it is possible to quickly transfer large public irrigation systems to groups of users. The success of the Mexico transfer program and its reputation have attracted visiting study tour groups from all over the world.

*/ irrigation management / privatization / participatory management / agricultural production / sustainability / private sector / public sector / economic aspects / water user associations / investment /*

*agricultural policy / irrigated farming / water law / user charges / landownership / Mexico /*

**15.** *Wim H. Kloezen, Carlos Garcés-Restrepo, and Sam H. Johnson III*
**Impact Assessment of Irrigation Management Transfer in the Alto Rio Lerma Irrigation District, Mexico**

1997, 44pp., ISBN 92-9090-350-3
US$. 5.00, US$ 2.50 (developing countries)

The economic crisis of Mexico in the 1980s led to radical and extensive reforms in its agriculture sector. Among the most significant institutional reforms was the program to transfer irrigation management responsibilities for large-scale irrigation districts from the sole control of the public sector irrigation agency to a joint management arrangement with newly created water user associations (WUAs). This study reports on the findings of a two-year field research study started by IIMI late in 1995 in the 112,772-hectare Alto Rio Lerma Irrigation District (ARLID) in Mexico.

*/ irrigation management / privatization / economic aspects / legal aspects / data collection / water rights / water allocation / water distribution / groundwater / financing/ maintenance / operation / agricultural production / water user associations / farmer participation / Mexico /*

**14.** *C. J. Perry, Michael Rock, and D. Seckler*
**Water as an Economic Good: A Solution, or a Problem?**

1997, 20 pp., ISBN 92-9090-351-1
US$. 5.00, US$ 2.50 (developing countries)

Water serves many different objectives and has properties that make it both a private and a public good. The appropriate blend of values and facts in proper policy formulation for water requires a much more sophisticated form of analysis than that allowed by the simpleminded dogmatism of proponents, either of basic needs or of free markets. Water policy must be formulated in terms of multi-objective decision making, recognizing that the relevance and importance of various values and facts will vary substantially over different conditions of time and place.

*/ water resource management / water as an economic good / economic aspects / economic analysis / irrigated farming / water rights / pricing / privatization / marginal analysis / water market / water policy /*

**13.** *R. Sakthivadivel, Nihal Fernando, and Jeffrey D. Brewer.*
**Rehabilitation Planning for Small Tanks in Cascades: A Methodology Based on Rapid Assessment**

1997, 42pp., ISBN 92-9090-345-0
US$5.00, US$2.50 (developing countries)

This report presents a methodology for planning the rehabilitation and improvement of small-scale irrigation systems within the context of the water basin when information on hydrology and water use is inadequate. It was developed for planning the rehabilitation and improvement of small tank systems in the dry zone of Sri Lanka. The methodology is useful to those undertaking irrigation rehabilitation projects in similar circumstances, and it may also be extended to water resources planning in many other circumstances.

*/ irrigation system / rehabilitation / tank irrigation / small-scale systems / reservoirs / conflict / farmer participation / river basin development / water resources development / Sri Lanka /*

**12.** *Jeffrey D. Brewer, R. Sakthivadivel, and K.V. Raju*
**Water Distribution Rules and Water Distribution Performance: A Case Study in the Tambraparani Irrigation System**

1997, 44pp., ISBN 92-909-343-0
US$5.00, US$ 2.50 (developing countries)

The relationship of water distribution rules to water distribution performance is explored in the Tambraparani Irrigation System. The report argues that if the water distribution rules are inconsistent, define a pattern of water delivery that does not match technically feasible irrigation services desired by the users, the users subvert the rules to provide the water deliveries they require. This adversely affects water distribution performance and equity, and raises the cost of irrigation. It is proposed that, a periodic review of the distribution rules should be made but the process involved in changing the rules should make it sufficiently difficult to ensure that only the necessary changes are made.

*/ irrigation management / irrigation systems / performance / operation / water distribution / water allocation / water delivery / water user associations / legislation / large-scale systems / bananas / India / Tamil Nadu /*

**11.** *Douglas L. Vermillion*
**Impacts of Irrigation Management Transfer: A Review of the Evidence**

1997, 44pp., ISBN 92-9090-340-5
US$5.00, US$2.50 (developing countries)

Data from 29 different studies on irrigation management transfer are drawn together and evaluated to assess the impacts of transfer on various aspects of irrigation system management. Twelve guiding principles to ensure a more systematic approach to research on the impacts of management transfer are proposed, and a number of key research propositions identified on the conditions which should prevail if management transfer programs are to succeed.

*/ irrigation management / irrigation systems / policy / privatization / case studies / performance evaluation / irrigated farming / economic aspects / financing / operation / environmental sustainability /*

**10.** *Margreet Zwarteveen*
**A Plot of One's Own: Gender Relations and Irrigated Land Allocation Policies in Burkina Faso**

1997, 20pp., ISBN 92-9090-338-4
US$5.00, US$2.50 (developing countries)

In the Dakiri irrigation system of Burkina Faso, the effects of allocation of plots on productivity labor contributions, and intra-household distribution of income derived from agricultural activities are compared when men are the sole owners of plots, and when both men and woman within the same household own irrigated plots. In households where both men and woman own plots, land and labor productivity are higher, the income received by woman increases sharply, and the proportion of labor contributed by woman to the plots owned by men remains unchanged.

*/ irrigation management / land management / policy / gender / women / agricultural production / irrigation systems / caste studies / households / income distribution / labor allocation / West Africa / Burkina Faso /*

**9.** *S. Thiruvengadachari and R. Sakthivadivel*
**Satellite Remote Sensing Techniques to Aid Irrigation System Performance Assessment: A Case Study in India**

1997, 32pp., ISBN 92-9090-337-6
US$7.00, US$3.50 (developing countries)

Satellite remote sensing and geographic information system techniques are applied to a rice irrigation system in the Bhadra project, India, to obtain information on primary agricultural productivity and irrigation system performance under disaggregated conditions. This study demonstrates the potential and cost-effectiveness of SRS techniques for making inventories and monitoring agricultural productivity in a large rice irrigation system in India. Effective integration of GIS with SRS techniques is shown to enhance diagnositic analysis and performance evaluation of irrigation systems.

*/ irrigation management / irrigated farming/ agricultural production / irrigation systems / food production / rice / cropping systems / crop yield / remote sensing / GIS / models / policy / case studies / satellite surveys / performance evaluation / India / Bhadra Project /*

**8.** *Douglas J. Merrey*
**Institutional Design Principles for Accountability in Large Irrigation Systems**

1997, 36pp., ISBN 92-9090-335-X
US$5.00, US$2.50 (developing countries)

This report argues that single irrigation systems managed by autonomous system-specific organizations accountable to their customers, perform better and are more sustainable than those managed by agencies dependent on the government, or by agencies responsible for multiple systems. Selected cases are reviewed and the plausibility of this hypothesis established. Several suggestions are made for further research, but it is suggested that the arguments are sufficiently persuasive to be used by policy makers in the design of reform programs.

*/ irrigation management / government-managed irrigation systems / large-scale systems / organizational design / water users associations / water user / farmers' associations / farmer participation / sustainability / water rights / performance evaluation / performance indexes / participatory management / privatization / policy / research methods / case studies /*

**7.** *Margreet Zwarteveen and Nita Neupane*
**Free-Riders or Victims: Women's Nonparticipation in Irrigation Management in Nepal's Chhattis Mauja Irrigation Schemes**

1996, 32pp., ISBN 92-9090-334-1
US$5.00, US$2.50 (developing countries)

The Chhattis Mauja irrigation scheme is considered from a gender perspective—making an empirical analysis of the livelihood strategies of farm households, documenting the level and nature of participation of woman and men in the water users' organizations, analyzing women's access to irrigation services, and examining the need and desirability of increasing the participation of women in the scheme organization. The findings are discussed in terms of schemes performance and the responsiveness of the users' organization to the irrigation needs of woman.

*/ irrigation management / farmer-managed irrigation systems / irrigation programs / water users associations / irrigated farming / irrigation canals / water delivery / water allocation / water distribution / maintenance / gender / women in development / farmers / female labor / agricultural manpower / households / family labor / living standards / social aspects / agricultural production / villages / social organization / performance evaluation / Chhattis Mauja irrigation scheme / Nepal/*

**6.** *Jacob W. Kijne*
**Water and Salinity Balances for Irrigated Agriculture in Pakistan**

1996, 28pp., ISBN 92-9090-330-9
US$5.00, US$2.50 (developing countries)

Analysis of water and salinity balances of an irrigation system can yield useful information about the potential impact of current irrigation practices on the sustainability of irrigated agriculture in the system. Such an analysis was conducted in three different areas of Pakistan afflicted by salinity. The results indicated that in each of the three areas the current irrigation and agronomic practices are not sustainable. Several corrective measures are presented.

*/ irrigation management / irrigated farming / water balance / salinity / sensitivity analysis / groundwater management / watercourses / irrigation systems / water table / waterlogging / soil degradation / Pakistan / North-West Frontier Province / Punjab /*

**5.** *C. J. Perry*
**The IIMI Water Balance Framework: A Model for Project Level Analysis**

1996, 28pp., ISBN 92-9090-331-7
US$5.00, US$2.50 (developing countries)

Understanding the water balance at project or command level is a prerequisite to the analysis of the operation of an irrigation system and its performance. Consequently, the IIMI Water Balance Framework—which identifies sources, uses, and reuses of water—will be of interest to those involved in the design of irrigation projects, and in the formulation of improvements to existing infrastructure of operational rules. Managers of irrigation projects will also find it useful for interpreting water use efficiency, or for identifying interventions to improve the efficiency and sustainability of their projects.

*/ irrigation management / irrigation programs / surface irrigation / analysis / water use efficiency / water balance / water loss / seepage / groundwater / pumping / models /*

**4.** *Douglas. L. Vermillion and Carlos Garcés-Restrepo*
**Results of Management Turnover in Two Irrigation Districts in Colombia**

1996, 36pp., ISBN 92-9090-329-5
US$5.00, US$2.50 (developing countries)

In 1976, the government turned over the management of two irrigation districts in Colombia—Coello and Saldaña—to the water user associations. A study was conducted from 1993 to 1995 by IIMI to assess the extent to which the turnover program had made an impact on the cost of irrigation to farmers and the government, the quality of water distribution, the sustainability of irrigation, the productivity of agriculture, and farmer income.

*/ irrigation management / irrigated farming / privatization / farmer participation / farmers' associations / farmer-agency interactions / farmer-managed irrigation systems / social aspects / economic aspects / operation / maintenance / agricultural production / sustainability / water distribution / Colombia / Coello / Saldaña /*

**3.** *Andrew Keller, Jack Keller, and David Seckler*
**Integrated Water Resource Systems: Theory and Policy Implications**

1996, 24pp., ISBN 92-9090-326-0
US$5.00, US$2.50 (developing countries)

Over the past several years, researchers have been developing a concept of integrated water resources systems (IWS) that has substantially changed their own views on this subject. This report attempts to present the concept of IWS as clearly and

simply as possible. It focuses on the irrigation sector, which is by far the largest and most complex user of water in the world.

*/ water resource management / water policy / irrigation efficiency / water demand/ leaching/ water use efficiency/ water supply / evapotranspiration / models /*

**2**. *C. J. Perry*
**Alternative Approaches to Cost Sharing for Water Service to Agriculture in Egypt**

1996, 24pp., ISBN 92-9090-321-X
US$5.00, US$2.50 (developing countries)

Charging users for water and water services is a sensitive issue in Egypt, as it is in many countries, involving political, historical, social, religious, and economic factors. This report combines and interprets results from a number of studies that were designed to help the Egyptian government formulate a rational approach to sharing the costs of water services among the beneficiaries—agriculture and other users—and government.

*/ agricultural development / water management / water delivery / benefits / cost recovery / operating costs / maintenance costs / policy / water allocations / user charges / water use efficiency / water shortage / water resource development / Egypt /*

**1.** *David Seckler*
**The New Era of Water Resources Management: From "Dry" to "Wet" Water Savings**

1996, 28pp., ISBN 92-9090-325-2
US$5.00, US$2.50 (developing countries)

This paper addresses recent developments in the field of water resources that have practical implications for water policies, programs, and projects. Procuring additional freshwater supplies is highly problematical. As a result, attention has naturally turned to "demand management." Proponents of demand management contend that physical water use efficiency can be increased by using less water per unit of output. Similarly, economic efficiency can be increased by reallocating water from lower valued to higher valued users.

*/ water resources management / water policy / water use efficiency / water demand / water supply / irrigated agriculture / irrigation efficiency /*

## SPANISH RESEARCH REPORTS

**15-Es Informe de Investigacion**

*Wim H, Kloezen and Carlos Garcés-Restrepo y Sam H. Johnson III*
**Los Impactos de la Transferencia del Manejo del Riego en el Distrito de Riego Alto Rio Lerma, México**

1998, 42pp., ISBN 92-9090-360-0

**16-Es Informe de Investigacion**

*Sam H. Johnson III*
**La transferencia del manejo de la irrigación en México: Una estrategia para lograr la sostenibilidad de los distritos de riego**

1997, 36pp., ISBN 92-9090-368-6

**22-Es Informe de Investigacion**

*Wim H, Kloezen and Carlos Garcés-Restrepo*
**Evaluación del desempeño del riego con indicadores comparativos: El caso del Distrito de Riego Alto Rio Lerma, México**

1998, 52pp., ISBN 92-9090-359-7.

**23-Es Informe de Investigacion**

*G. Levine, A. Cruz Galván, D. García, C. Garcés Restrepo y S. Johnson III.*
**Desempeño de dos módulos transferidos en la región Lagunera: Relaciones del agua. Colombo, Sri Lanka: Instituto Internacional del Manejo del Agua.**

1999, 28pp., ISBN: 92-9090-379-1

**25-Es Informe de Investigacion**

*Douglas L. Vermillion y Carlos Garcés Restrepo*
**Impactos del Actual Programa de Transferencia del Manejo de la Irrigación en Colombia**

1999, 52pp., ISBN: 92-9090-381-3

## SWIM PAPERS

**8.** *Margaretha Bakker, Randolph Barker, Ruth Meinzen-Dick, and Flemming Konradsen*
**Multiple Uses of Water in Irrigated Areas: A Case Study from Sri Lanka**

1999, 56pp., ISBN 92-9090-380-5
US$5.00, US$2.50 (developing countries)

Water is being transferred out of agriculture to meet the growing demand in other areas, often without an agreement of or compensation to farmers with irrigated land and water rights. Furthermore, there is a failure to recognize that irrigation systems supply water not only for the main fields, but also for domestic uses, home gardens, trees and other permanent vegetation, and livestock. Other productive uses include fishing, harvesting of aquatic plants and animals, and a variety of other enterprises such as brick making. In addition, irrigation systems can have a positive or negative effect on wildlife habitats. Thus, the withdrawal of water affects the rural household, rural economy, and the environment in a number of ways. This paper argues that to ensure efficient, equitable, and sustainable water use, to reduce poverty and improve the well-being of the community, irrigation and water resources policies need to take into account all uses and users of water within the irrigation system. The multiple uses of water in the Kirindi Oya irrigation system are examined in this paper. An interdisciplinary group of scientists have investigated a number of areas including water accounting, water quality, household water use, the valuing of water for alternative uses, and the complementarities, competition, and conflicts among uses and users.

*/ water management / water allocation / water use efficiency / irrigated farming / water resources development / water policy / water quality / domestic water / water user associations / water rights / gender / case studies / households / pricing / water costs / Sri Lanka/ Kirindi Oya /*

**7.** *Theib Oweis, Ahmed Hachum, and Jacob Kijne*
**Water Harvesting and Supplemental Irrigation for Improved Water Use Efficiency in Dry Areas**

1999, 52pp., ISBN 92-9090-378-3
US$5.00, US$2.50 (developing countries)

The countries in West Asia and North Africa (WANA) will soon be diverting water from irrigation to supply their domestic and industrial needs, unless, they obtain substantial amounts of water from additional, untapping water resources. Some of these countries are already doing it, and hence agriculture is left each year with less water. The renewable water resource per capita in the WANA region is about one-sixth of the worldwide average. The chance, therefore, of reversing the trend of diminishing supplies to agriculture is extremely small. If agricultural production and livelihoods are to be sustained at current levels, the water available to agriculture will have to be used more productively. The productivity of land and water in rain-fed areas can still be greatly enhanced through water harvesting and supplemental irrigation. Marginal lands with annual rainfall of less than 300 mm can be cultivated if controlled but limited additional water is made available. In many instances, such an incremental water supply can be provided through appropriate water harvesting techniques. However, the past experience with the introduction of water harvesting techniques into semiarid and arid countries has not been very promising. This paper aims to elucidate the likely reasons for these disappointments. The paper reviews the state of the art of both water harvesting and supplemental irrigation technologies in the temperate and subtropical dry lands with a Mediterranean-type climate.

*/ productivity / water harvesting / water scarcity / agricultural production / poverty / water use efficiency / arid lands / water resources development / rain-fed farming / West Asia / North Africa / India /*

**6.** *Daene C. McKinney, Ximing Cai, Mark W. Rosegrant, Claudia Ringler, and Christopher A. Scott*

**Modeling Water Resources Management at the Basin Level: Review and Future Directions**

1999, 72pp., ISBN 92-9090-376-7
US$5.00, US$2.50 (developing countries)

The world faces severe and growing challenges in maintaining water quality and meeting the rapidly growing demand for water resources. In addition, water used for irrigation, the largest use of water in most developing countries, will likely have to be diverted increasingly to meet the needs of urban areas and industry whilst remaining a prime engine of agricultural growth. Finally, environmental and other in-stream water demands

become more important as economies develop. The river basin has been acknowledged to be the appropriate unit of analysis to address these challenges facing water resources management; and modeling at this scale can provide essential information for policy makers in their decisions on allocation of resources. This paper reviews the state of the art of modeling approaches to integrated water resources management at the river basin scale, with particular focus on the potential of coupled economic-hydrologic models, and concludes with directions for future modeling exercises.

*/water quality / water resources development / agricultural production / river basin development / mathematical models / simulation models / water allocation / policy / economic aspects / hydrology / reservoir operation / groundwater management / drainage / conjunctive use / surface water / GIS / decision support systems / optimization methods / water supply /*

**5.** *L.C. Guerra, S.I. Bhuiyan, T.P. Tuong, and R. Barker*
**Producing More Rice with Less Water from Irrigated Systems**

1998, 36pp., ISBN: 92-9090-369-4
US$5.00, US$2.50 (developing countries)

This paper reviews the literature on irrigation efficiency and on the potential for increasing the productivity of water in rice-based systems. It stresses the continuing confusion over the concepts of irrigation efficiency and water productivity. It identifies the reasons for the wide gap between water requirement and actual water input (both irrigation diversions and rainfall) in irrigated rice production systems and discusses potential opportunities for increasing water productivity both on-farm and at the system level. The paper emphasizes the need to measure the productivity of water at farm, system, and basin levels, and to understand how the productivity at one level relates to the productivity at another. Without water balance studies to measure productivity at these different scales, it is not possible to identify the potential economic benefits of alternative interventions and the most appropriate strategies for increasing irrigation water productivity in rice-based systems.

*/ irrigation management / water use efficiency / crop production / water requirements / water balance / rice / water distribution / irrigated farming / productivity / on-farm research / irrigation scheduling / groundwater / conjunctive use / rehabilitation / modernization / farmer participation / farming systems / irrigation systems / crop-based irrigation / Asia / The Philippines /*

**4.** *Charles Batchelor, Jeremy Cain, Frank Farquharson, and John Roberts*

**Improving Water Utilization from a Catchment Perspective**

1998, 40pp., ISBN 92-9090-358
US$5.00, US$2.50 (developing countries).

The central theme of the System-Wide Initiative on Water Management (SWIM) is "enhancing the productivity of water and agriculture in an environment of growing scarcity and competition." This paper has been prepared as part of the process of planning research that is to be undertaken to improve water utilization in a watershed perspective. The paper includes a historical review of research that has involved the use of catchment experiments and a discussion on hydrological modeling techniques. Options for improving water utilization at the catchment and farm scales are identified and recommendations are made for research that might be undertaken by SWIM. The case is argued for interdisciplinary catchment studies that involve the participation of local communities and other stakeholders.

*/ water management / water scarcity / water use efficiency / catchment areas / calibrations / hydrology / models / river basins / water resources management / participatory management / water balance / case studies / Asia / Africa / South Africa / Zimbabwe /*

**3.** *I. R. Calder*

**Water-Resource and Land-Use Issues**

1998., 32pp., ISBN 92-9090-361-9
US$ 7.00, US$3.50(developing countries)

This paper reviews perceived notions of the relationships between catchment land use and hydrology, and explores whether much of the widely disseminated folklore, so often inextricably linked with issues of land use, is based on myth or reality. Gaps in our knowledge of the underlying processes in relation to land use and hydrology are identified. Our ability to apply this knowledge at different scales, ranging from the plot to the catchment and regional scales, is discussed and specific examples are drawn from Indian and African case studies. Methods for linking spatially distributed land-use hydrological models with economics and ecology through decision support systems are outlined and proposed as a framework for the integrated management of land and water developments at the catchment scale.

*/ Water resource management / water use / case studies / catchment areas / land use /hydrology / models / evaporation / soil moisture / GIS / decision support systems / water use / runoff / flow / forestry / deforestation / erosion control / rain / Africa / India /*

**2.** *Jacob W. Kijne, S. A. Prathapar, M.C.S. Wopereis, and K. L. Sahrawat*

**How to Manage Salinity in Irrigated Lands: A Selective Review with Particular Reference to Irrigation in Developing Countries.**

1997, 42pp., ISBN 92-9090-353-8
US$5.00, US$2.50 (developing countries).

This paper reviews the causes of irrigation-induced salinity, particularly in developing countries. It describes the underlying chemical and physical processes involved in soil and water degradation due to irrigation. The present state of knowledge and the contributions made by modeling these processes are presented. Areas of uncertainty in our current understanding are identified. The paper discusses several remedial management actions, categorized as engineering, agronomic, policy-level and system-level interventions. Special attention is given to the regional management of saline effluent from irrigation systems, including options for its disposal.

**1.** *David Molden*

**Accounting for Water use and Productivity**

1997, 28pp., ISBN 92-9090-349-X
US$5.00, US$2.50 (developing countries)

This paper presents a conceptual framework for water accounting and provides generic terminologies and procedures to describe the status of water resource use and consequences of water resources related actions. The framework applies to water resources use at three levels of analysis: a use level such as an irrigated field or household, a service level such as an irrigation or water supply system, and a water basin level that may include several uses. Water accounting terminology and performance indicators are developed and presented with examples at all the three levels. Concepts and terminologies presented are developed to be supportive in a number of activities including: identification of opportunities for water savings and increasing water productivity; developing a better understanding of present patterns of water use and impacts of

interventions, improving communication among professionals and communications to non-water professionals; and improving the rationale for allocation of water among uses. It is expected that with further application, these water accounting concepts will evolve into a robust, supporting methodology for water basin analysis.

*/water management/ irrigation management / water supply / terminology / performance indexes / water use/ water allocation / productivity /*

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**Expanding the Frontiers of Irrigation Management Research: Results of Research and Development at the International Irrigation Management Institute, 1984 to 1995**

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US$ 30.00, US$ 15.00 (developing countries)

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**Remote Sensing in Water Resources Management: The State of the Art**

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US$25.00, US$12.50 (developing countries)

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**The Dilemmas of Water Division, Considerations and Criteria for Irrigation System Design**

1998, 138pp., ISBN 92-9090-363-5 (Hard cover)
US$30.00, US$15.00 (developing countries)

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**Designing Irrigation Structures for Mountainous Environments**
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1999, 96pp., ISBN 92-9090-373-2
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**Health and Irrigation Proceedings of the Copenhagen workshop on Health and Irrigation held in Eigved's Pakhus, Ministry of Foreign Affairs, Asiatisk Plads 2, DK, 1448 Copenhagen, Denmark 18–20 August 1997**

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Rajendra Pradhan, Franz von Benda-Beckmann, Keebet von Benda-Beckmann, H.L. J. Spiertz, Shantam S. Khadka, and K. Azharul Haq (Editors)

**Water Rights, Conflict and Policy**
***Proceedings of a Workshop, Kathmandu, Nepal, 22 to 24 January 1996***

1996, 268pp., ISBN 92-9090-185-3

*D. Merrey and Shirish Baviskar (Editors)*

**Gender Analysis and Reform of Irrigation Management: Concepts, Cases and Gaps in Knowledge. Proceedings of the Workshop on Gender and Water, 15–19 September 1997. Habarana, Sri Lanka**

1998, 284pp., ISBN 92-9090 367-8
US$20.00, US$10.00 (developing countries)

*Yutaka Matsuno, Wim van der Hoek, and Mala Ranawaka (Editors)*

**Irrigation Water Management and Bundala National Park**

*Proceedings of a Workshop on Water Quality of the Bundala Lagoons. Colombo, Sri Lanka, 03 April 1998.*
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4. *Dr. Zenete Peixoto Franca*
   **Irrigation Management Training for Institutional Development: A Case Study from Malaysia**

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**El Manejo de la Irrigación en América Latina**

*Mark Svendsen y Douglas Vermillion*
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*Lecciones Y Connotaciones Internacionales*

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**The Emergence of FEDERRIEGO: The Colombian Federation of Irrigation Districtsra**

*La Transferencia en Colombia: El Papel de la Federacion Colombiana de Distritos de Riego*

**Transferencia en Colombia:**

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**Instituto Internacional del Manejo de la Irrigación**
**IIMI Vision General**

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# AUTHOR INDEX

## A



## B

## C



## D



## E

## F



## G



## H

## I



## J



## K

## L



## M



## N

## O



## P



## Q



## R

## S

## T



## U



## V

## W



## X



## Y



## Z

# SUBJECT INDEX

## A



## B



## C



## D

## F



## G



## H



## I

## K



## L



## M

## N



## O



## P



## R

## S



## T



## U



## W

## Z

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