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INDIA - WATER RESOURCES MANAGEMENT SECTOR REVIEW

REPORT ON

THE IRRIGATION SECTOR

September 10, 1998

Rural Development Unit
South Asia Region
World Bank

In Cooperation with:
Ministry of Water Resources
Government of India

CURRENCY EQUIVALENTS AND UNITS

Currency Unit	=	Rupee (Rs)
US$1.00	=	Rs36.2 (Oct 97)
Rs 1.00	=	US$0.028
1 Lakh	=	Rs 100,000
1 Crore	=	Rs 10 Million

WEIGHTS AND MEASURES

1 hectare	=	2.47 Acres

The metric system is used throughout the report.

FISCAL YEAR

Government of India
April 1 to March 31

Vice President	Mieko Nishimizu
Country Director	Edwin R. Lim
Sector Managers	Michael Baxter/Ridwan Ali
Task Managers	Keith Oblitas/Christina Wood

ABBREVIATIONS AND ACRONYMS

AD	Agriculture Department
APERP	Andhra Pradesh Economic Restructuring Project
DOWR	Department of Water Resources
GDP	Gross Domestic Product
GOI	Government of India
HA	Hectare
HRD	Human Resource Development
I&CADD	Irrigation and Command Area Development Department
ID	Irrigation Department
ISP	Irrigation Sector Policy
IMT	Irrigation Management Transfer
MIS	Management Information System
MKVDC	Maharashtra Krishna Valley Development Corporation
MOA	Ministry of Agriculture
MOF	Ministry of Finance
MOWR	Ministry of Water Resources
MT	Million Tons
NABARD	National Bank for Agriculture and Rural Development
NGO	Non-Governmental Organization
NWP	National Water Policy
O&M	Operations and Maintenance
P&B	Planning and Budgeting
POM	Plan of Operations and Maintenance
PSP	Private Sector Participation
RBI	Reserve Bank of India
RIDF	Rural Infrastructure Development Fund
SIFT	Systems Improvement and Farmer Turnover
UWSS	Urban Water Supply and Sanitation
WALMI	Water and Land Management Institute
WCRC	Water Charges Review Committee
WRCP	Water Resources Consolidation Project
WRRITP	Water Resources Research Innovation and Training Program
WRM	Water Resources Management
WSA	Water Service Agency
WTB	Water Tariff Board
WUA	Water Users Association

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ACKNOWLEDGMENTS

This report was prepared by a team of World Bank staff and consultants led by Keith Oblitas and Christina Wood (Task Managers), and in collaboration with the Ministry of Water Resources, Government of India. Report preparation was undertaken by Keith Oblitas, Christina Wood, Meena Munshi, and Keegan Eisenstadt, based on a preliminary report by Jose Olivares and Maria Saleth, and report processing was handled by Andrea Ruiz-Esparza. A mission in February 1997 comprising J. Olivares (consultant team leader) and M. Saleth (consultants), joined by C. Wood, G. Spencer and K. Oblitas (World Bank), and material provided by the Ministry of Water Resources/Central Water Commission (MOWR/CWC) Sub-Group on Irrigation, served as the primary material and field work for the analysis. This was further supplemented by review of relevant international experience and various other programs under implementation in India.

A National Workshop to discuss the preliminary version of this report was held in June 1997. The workshop was chaired by the Ministry of Water Resources and had broad representation from state governments and central government ministries and agencies involved with irrigation, academics, NGOs and the World Bank. These discussions and the advice provided by participants have been invaluable in further developing and finalizing the report.

The report has benefited from a broad array of contributors from India (both government and civil society) and the Bank. Particular debt is owed to the Secretaries and Chairmen of MOWR/CWC and the GOI Sub-Group on Irrigation and their staff, in particular to Messrs. Mata Prasad, Arun Kumar, Z. Hasan and R. S. Pathak from MOWR/CWC and B. N. Navalawala of the Planning Commission. Reviewers and contributors from the World Bank included M. Baxter, R. Ali, S. Barghouti, J. Briscoe, H. Plusquellec, A. Subramanian, J. Simas, R. Zagha, G. Spencer, S. Rajagopal, N. Bandyopadhyay, E. Jagannathan, M. Shah, J. R. Malhotra, R. K. Malhotra, H. Eisa, M. Balasubramanian, B. Dhar, B. Blarel, R. Nelson, O. Myint, J-P. Baudelaire, T. K. Balakrishnan, S. Salman, K. Jensen, J. Mohammadi and D. Groenfeldt.

This report is one of five reports under the "India - Water Resources Management (WRM) Sector Review", and specifically deals with the irrigation service. The other reports in the series cover: (i) Inter-Sectoral Water Allocation, Planning and Management; (ii) Groundwater Regulation and Management; (iii) Urban Water Supply and Sanitation; and (iv) Rural Water Supply and Sanitation. A synthesis report, weaving together all five subject areas in an integrated framework, is also being issued.

The World Bank
INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT
INTERNATIONAL DEVELOPMENT ASSOCIATION

1818 H Street N.W.
Washington, D.C. 20433
U.S.A.

(202) 477-1234
Cable Address: INTBAFRAD
Cable Address: INDEVAS

PREFACE

INDIA - Water Resources Management Sector Review
Irrigation Sector Report

Expansion of irrigation has, without question, played a pivotal role in India, having provided the backbone to India's "Green Revolution". It enabled the introduction of high yielding crop varieties, and pulled India from risk of famines to food security, and an increasingly diversified agriculture. Yet today there is serious concern over the sector's poor performance and its ability to ensure India's food security and improved agricultural growth in the future. It is, thus, heartening to note the sense of urgency in this report, which was prepared collaboratively by India and the Bank.

The report recognizes that, with increasing constraints regarding both land and water, and a still rapidly increasing population most of whom are still rural based, agricultural production must significantly expand. Irrigation, the base for two-thirds of agricultural output, will be pivotal to success. The report discusses the need for a paradigm shift of emphasis; from a primary reliance on expansion, to particular focus on the *productivity* of irrigated agriculture. Further, the analysis shows that marginal changes in institutions, financial management and technology will not be enough. This means finding very different approaches, and creating an incentives structure for reform. This will entail: irrigation management transfer to farmers; reforming irrigation departments to autonomous irrigation service agencies funded by and accountable to farmers' water user associations; achieving financial viability both for water user associations and service agencies; upgrading irrigation systems; and, improving agricultural support services. Indeed, both the report and Government's preface emphasize the need for a *"Second Irrigated Agriculture Revolution"*. The report's Reform Agenda discusses the energetic policy reforms and actions required to achieve this.

This is an ambitious yet practical agenda, and it will be up to the states to muster the political will to commence and sustain the reform program. Several states are already commencing this process. The Bank and other agencies should give their full support to such states, and to the Indian Government and civil society in their key roles as guides and enablers of change.

Michael Baxter

Michael Baxter
Rural Development Sector Manager
South Asia Region

RCA 248423. WUI 64145 FAX (202) 477-6391

PREFACE

The irrigation sector has served the nation well; it has allowed India to move from the brink of famine to food self-sufficiency and now to be a net exporter of agricultural commodities. It has, in addition, made major contributions to poverty alleviation, employment, income and rural and regional development. The nation is facing new challenges and opportunities today in feeding a growing and increasing urban population, and the irrigated sub-sector must reposition itself to enable the agricultural sector to rise to the major challenges and seize the opportunities open to it.

The main problems and issues involved are well known but few States have tackled them comprehensively. The report emphasises that what is needed is a total revolution in irrigated agriculture balancing expansion with quickest possible development of ultimate irrigation potential alongwith much more focus on the improvement of the performance of existing irrigation facilities and provision of a client-focused irrigation service. The irrigation agencies need to be modernized and made more autonomous and accountable. Systems needs to be improved and farmers organised to take up operation and management responsibilities. Irrigation financing needs to be reformed, expenditures reprioritized and water rates rationalised. A system of water rights needs to be progressively pilot-tested for its possible introduction and some needed legal reform adopted. Only such a revolution can see us safely through the new century.

To this end, the World Bank and the Government of India worked jointly to analyse the new performance improvement strategy; quantify the benefits which could accrue from it; and identify the required actions, activities and responsibilities to implement it. This Report is the outcome of this joint endeavour. I would like to thank the Government's Inter-Ministerial Working Group, the World Bank team and the officials in this and other Ministries for the effort they made in carrying out this exercise and preparing the proposals for action. The key messages the Government would like to deliver, and which are reflected in the Report, are highlighted below. They are critical, since without them the sector will not be able to move forward effectively.

First, the nation must face the fact that water is becoming increasingly scarcer. All sectors are demanding more water. From now onwards, the key issue will be more that of water transfers between current users and sectors,

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than one of allocating "new" water resources to new claimants. In particular, the productivity of water and irrigated agriculture must be emphasised. Such scarcity must also be reflected in what is charged for water. Rationalising water charges should reflect water's scarcity value and the central need for irrigation agencies to be financially self-sufficient, at least for operation and maintenance.

Second, farmers must play an active role in operating, managing and maintaining the irrigation distribution systems. We strongly support the formation of Water Users' Associations at the minor and distributary levels, and their federation to provide advice on water management at higher hydraulic levels. This process must be established in partnership with the agricultural departments. We should like to encourage the State Governments to set up the necessary non-subsidy incentives for such associations to form and thrive.

Third, State Irrigation Departments need to be made financially self-sufficient, water charges rationalised, collection rates improved and Irrigation Departments allowed to retain them. Their investment of expenditure programmes also need to be reprioritised to emphasise full funding of maintenance works, rehabilitation and modernisation of irrigation systems, and not forgetting the needs for staff training, equipment and institutional capacity building. Also, financial management needs to be upgraded and financial viability achieved so that private sector investments and finance can be attracted. Furthermore, transforming of Irrigation Departments into autonomous utility-like irrigation service agencies, each covering the State's different river basins needs to be given serious consideration. Such autonomy should include authority to set and collect water charges, develop non-irrigation revenues and raise funds from financial markets. Autonomy should be matched with accountability and transparency. Some States have experiences in this matter which are worth drawing upon and several countries internationally.

Fourth, States should launch carefully planned programmes, linked with irrigation management transfer to Water User Associations (WUAs) and participations in decisions and investment costs by WUAs, to rehabilitate and then progressively modernise the irrigation systems. This needs to be accompanied by enhancement of agricultural support services to the WUAs; and the entire programme needs to be intensively supervised and monitored to ensure its effectiveness so that intended benefits result.

Fifth, sustainable development and management of the irrigation sector invariably throws up environmental concerns such as proper resettlement and rehabilitation of project affected persons; arresting water logging and soil salinity in irrigation commands and soil degradation. These environmental concerns will have to be met effectively and adequately.

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And finally, research, development and innovation should be given a high priority in developing improved irrigation and irrigated agriculture in implementing the new strategy. Funding for these activities has been rather sparse, but the expenditure reprioritisation should lead to additional resources being devoted to them at both the hydraulic side and the hydraulic/agriculture/farmers interface.

In short, we must make a revolution in irrigated agriculture. Without it, India will not be able to feed its people at current levels, let alone provide them with the higher-value commodities that their increasing incomes demand. Only our active commitment and perseverance can make such revolution happen.

(ARUN KUMAR)
SECRETARY-IN-CHARGE
MINISTRY OF WATER RESOURCES
GOVERNMENT OF INDIA
NEW DELHI.

24th June, 1998.

EXECUTIVE SUMMARY

Background and Issues

i. India's irrigated agriculture sector has been fundamental to India's economic development and poverty alleviation. Some 28% of India's GDP and 67% of employment is based on agriculture, and, in turn, irrigation is the base for about two-thirds, possibly more, of total agricultural output. The rapid expansion of irrigation and drainage infrastructure has been one of India's major achievements. From 1951 to 1997, gross irrigated area (includes double cropping) expanded four-fold, from 23 million ha to 90 million ha. Coupled with introduction of associated high yielding varieties and fertilizer, the higher productivity and reliability of irrigated lands enabled the "Green Revolution" commencing in the 1960s. As a result, India has moved from the specter and actuality of food imports and periodic famines to self sufficiency, food exports and progressively more diversified production.

ii. The major expansion of irrigated area has occurred on all fronts. Major and medium surface schemes have increased more than three-fold from 1951 to 1997, while groundwater irrigation, largely through private investment, has expanded seven-fold. Today, groundwater irrigation comprises 39% of irrigated area, canal irrigation 47%, and other irrigation (mainly tanks) 14%. The resource commitment to irrigation and drainage has been huge; since independence, over Rs600 billion or US$80 billion in constant 1980 prices have been invested by government. Together with China, India's irrigated area now far exceeds that of other countries.

iii. The major emphasis on development has, however, been achieved at a cost. The emphasis on new construction has diverted attention from the need to ensure the quality, productivity and sustainability of the services. Further, a governmental and subsidy based approach has been used. This has resulted in irrigation and drainage services which, while enabling significantly higher productivity than from unirrigated lands, are well below their potential.

iv. The typology of irrigation and drainage management issues facing India is common to many developing countries. Most of these relate to the public sector managed surface irrigation systems. They comprise physical, institutional and financial/economic constraints. These must be seen and tackled primarily at the levels of the states as, in India's federal structure, irrigation management is handled separately by each state. While state situations vary, there is substantial commonality in the constraints encountered. The differences are primarily in the degree of impact, rather than in the issues themselves.

v. Common physical constraints include, in particular, inadequate maintenance, resulting in progressive deterioration of the surface irrigation systems, and poor water management due to ineffective control structures for surface irrigation and inappropriate incentives for groundwater use. The institutional constraints start most importantly with the persistence of purely public sector management without accountability to the client, i.e., the farmers. Further, there is no

direct link between the irrigation service provided, revenues generated, expenditures, and staff incentives. The state Irrigation Departments (IDs) are traditional government departments which in most cases have changed little over time. Administration is centralized, lacks the accountability, corporate management skills and client focus of the private sector, and tends to be remote, top-down and with minimal contact with farmers. Staff structures are dominated by civil engineering skills, with limited presence of other disciplines; and coordination with other government departments, especially agriculture, usually needs strengthening. The main financial constraints are, firstly, very low water charges, requiring continual subsidization by state governments of operations and maintenance (O&M), and the entirety of construction, and, secondly, partly as a consequence of the weak revenue generation, persistently inadequate allocations for O&M, most of which go to staff salaries leaving negligible amounts for actual maintenance works. Finally, incentives for efficient water use are largely absent. Surface water charges are, in addition to being low, based on area rather than charged volumetrically, and electricity for groundwater pumping is also heavily subsidized and on a fixed rate basis.

Directions for Future Growth

vi. India's primary reliance on irrigated agriculture as the main engine of agricultural growth is likely, based on the current still low growth of rainfed agriculture, to continue. India's historic agricultural growth rate of about 3% has come primarily from the irrigated sector. Under the Ninth Plan, the targeted objective is to raise agricultural growth to 4.5% per annum. Such a challenge would require a 112% increase in agricultural output by 2015. Even continuing with 3% growth would mean a 65% increase by 2015. If most of the growth must come from irrigation, the production growth from irrigated agriculture would need to be even higher than these figures.

vii. There are two main, and not mutually exclusive, options for achieving continued or higher growth from the irrigated agriculture sector: expansion of irrigated area, as done in the past; and, enhancing the productivity of existing irrigated agriculture. The first option, area expansion, is encountering increasing constraints. Already, India has developed over 70% of its surface irrigation potential, and the districts with full or over-exploitation of groundwater are also mounting. In a number of states and river basins, surface and groundwater resource constraints are already serious. Further, environmental constraints are becoming more acute, and demands for water from other sectors are increasing rapidly. Another issue is the fiscal constraint. Irrigation's share in Plan budgets has fallen from 22% in the First Plan to 7% in the Eighth Plan. Since 1986, irrigation expenditures have been stagnant in real terms, while the average costs of investment in new irrigation have increased due to the progressively more difficult engineering solutions that must be found as the easier development options are used up. Targeted prioritization of government funds, as well as generating revenues from within the sector and attracting private sector financing are increasingly needed.

viii. The second growth option is to exploit the hidden irrigation and agricultural potential within the existing irrigation development, through productivity enhancement. This has much larger potential than area expansion. The "yield gap" between Indian demonstration farms and

actual Indian yields, and between Indian yields and yields in other countries shows significant room for improvement. Similarly, while only a few comprehensive programs have been mounted in India focused on productivity enhancement, and most of these only recently, the results beginning to come through are encouraging. Results from other countries that have embarked on irrigation improvement programs also illustrate the potential, and, together with India's own experience, illuminate the paths to follow.

ix. Several conclusions may thus be drawn. The first is that a paradigm shift in emphasis is required. From the past almost exclusive reliance on area expansion through new investment, emphasis must shift strongly towards improving the performance of existing irrigated agriculture. This change applies to all states. While in those states and basins where development potential still exists area expansion can also continue, even in these situations, the likely larger impact will come from performance improvement. Enhancing the productivity and sustainability of irrigated agriculture should move to the front of the state agenda. Second, radical change will be required. Marginal changes in irrigation practices will not achieve the performance impact required. To achieve, for instance, 4% growth in irrigated agriculture, productivity per unit area of irrigation will need to double by 2015. The Green Revolution was based on a radical transformation of the production function; from rainfed conditions to irrigated conditions linked with use of improved seed and fertilizer. A "Second Revolution in Irrigated Agriculture" is required now, but the technology change of the first revolution is largely exhausted. The new revolution must instead tackle the indigenous constraints in the irrigated agriculture sector. Primarily, these relate to how the sector is managed, from which higher productivity and sustainability can be achieved. And they substantially depend upon institutional transformation and establishment of an incentives framework enabling change. Third, a comprehensive and interlinked approach is required, tackling the institutional, financial and technical constraints together to achieve the full potential of irrigated agriculture.

The Framework for Reform

x. The physical, institutional and financial problems which affect the Indian irrigation sector are operationally inter-related. Problems in one area affect others and, in turn, are affected by others. From the policy reform perspective, they can be articulated as a "vicious circle", where the different facets of the irrigation problem interact with each other and mutually reinforce themselves, keeping the irrigation sector at a low level of performance.

xi. The frequently found *poor quality of the irrigation service* can serve as a starting point. Combined with *inadequate agricultural technology*, it leads to low yields and then low incomes, which in turn lead to *farmer dissatisfaction* with the irrigation system. Under this condition, water rate revisions are resisted, leading to low cost recovery and *political pressure not to pay* for the service. *Low cost recovery*, in turn, is linked to *underfunding of the operation and maintenance* of the conveyance systems which adds to the *poor quality and state* of most systems, and compounded by the inappropriate structure, policies and staff skills of many *state IDs*, closes the circle by perpetuating the *poor quality service*.

xii. This circle needs to be changed to a "virtuous circle", where mutually reinforcing influences build on each other to create conditions for the sectors productivity growth and sustainability. The key need is to change the incentives structure, both at the level of the service provider (the present government monopoly) and the client (farmers). At present, neither has incentives for change. For government, the lack of accountability to the client means that all incentives are internal to the government department. There are no external incentives to be cost efficient, to be financially self-sufficient, to improve the quality of services, or to link up with other government services, the private sector and civil society. For the farmer, there are also no incentives to improve the service as they are detached from decision making and feel they have little influence. Their only leverage is through political pressures resisting to pay for surface water irrigation and electricity charges for ground water pumping.

xiii. This incentives gap for both service provider and user must be tackled. A first need is to bring the farmers into the management of irrigation systems and to create client driven pressures on the service provider to improve performance. A second and parallel need is to change the role, structure and financing of the Irrigation Department; to become fully accountable to the client, and funded by the client, so that the farmer is in the driver's seat. The third need is to upgrade the irrigation service and agricultural extension, so that benefits from institutional and financial change can be realized. This needs to be done in a partnership with water users associations, and in a demand-led process involving cost sharing in investment, with as much work as possible implemented by the Water Users Associations (WUAs).

The Reform Agenda

xiv. Three broad action areas need to be tackled: (a) institutional reforms to involve farmers and restructure IDs to client-driven commercially operated and autonomous entities; (ii) restoring the sector's financial viability and cost effectiveness including measures to enable private sector financing; and (c) improving technical performance through upgrading irrigation systems and agricultural extension.

Institutional Reforms

xv. **Irrigation Management Transfer:** This would be at the heart of the reform agenda. As found in countries such as Mexico and Chile, and beginning to emerge in India (Andhra Pradesh and Orissa), farmer organizations can better manage and maintain surface systems than government and have the direct incentive to do so. Similarly, groundwater irrigation should remain privately managed for small wells, and management of large public tubewells should be transferred to community management as successfully done in West Bengal. The main needed change is in the entirely public sector surface irrigation schemes. Typical past approaches used in India for water user associations, involving small, disparate support to individual WUAs, need supplanting by the kind of systematic and comprehensive approaches successfully applied in countries such as Mexico, and being piloted or underway in Orissa, Andhra Pradesh, Tamil Nadu and Rajasthan. Key features required include: a grass-roots and democratic base; a demand and client-led approach including participation in planning right from the outset and cost sharing for

investments; early achievement of financial self-sufficiency; a clear legal framework, usually requiring new legislation; a whole-command approach, through establishing farmer organizations and an apex body for the entire system rather than isolated parts of it; strong technical support and provision of access to funds for self-improvement; features in the election process and administration to ensure equal participation of women, tail-enders, and smaller farmers; and concurrent establishment of water rights. The proposed new approach, borrows both from the more recent initiatives and lessons learned in India and from international examples adapted for India's circumstances. The likely most suitable structure in India based on experience to date is a pyramidal organization with base level WUAs at tertiary (minor) level, federated to distributory, then system level entities. As applied in Mexico, Turkey, and India's Andhra Pradesh, a major drive is recommended. This requires detailed working out by each state of the approach to be used, and subsequent major effort in public awareness, training and support to the new institutions.

xvi. **Restructuring the State Irrigation Institutions:** The core need is to establish a commercially operated service agency specifically for O&M, funded by farmers and answerable to them. This will generally require unbundling the existing ID into such a "Water Service Agency" (WSA), or a number of WSAs in larger states. Another need, with growing importance as private sector investment opens up, is to establish an independent regulatory entity for regulation of prices and costs, as present in Orissa's power sector or the UK water sector. An initial start could be establishing a formal state water pricing committee, but this should be given wider and more autonomous powers over time. The ID would become a smaller entity with functions reduced to such areas as policy formulation, design, investment funding, and legislation. Associated with such restructuring, multisectoral capabilities for water planning, allocation and management should also be established. A second need is to mount a sustained drive to upgrade the institutional capabilities of the ID, WSA(s) and other institutions. The main needs are decentralizing management to basin levels, reorganizing to create internal specialization, including in corporate management skills, staff training, broadening skill mixes by bringing in other specializations, and improving staff incentives. Thirdly, a partnership culture needs to develop, most importantly a tripartite partnership between WUAs, ID and agriculture departments (ADs) (starting, for instance, with joint walkthroughs at planning stages, regular coordination meetings, joint offices in the field) but also between government and civil society as a whole. Finally, private sector involvement can be significantly increased, as already underway in India's urban water supply and power sectors. Options include contracting out of discreet activities, management contracts for irrigation schemes with local agribusinesses, and contracts with private firms to assist with or manage WSAs or part of ID activities.

Achieving Financial Viability and Sustainability

xvii. The sector's financial crisis needs to be broken: (a) seriously deficient funds going to O&M and still lower funds generated within the sector for O&M, thus creating perpetual reliance on government subsidies which for decades have proven inadequate; (b) inefficient use of government money due to lack of appropriate expenditure prioritization; and (c) a sector so unviable that the obvious remedy when government funds are short, accessing private investment, is effectively precluded.

xviii. **Achieving Financial Self-Sufficiency:** The unavoidable need is to raise water charges to the level required to at least cover the full needs of O&M. This will generally require a several-fold increase in water charges, and would best be done in one step, or along a pre-announced time-bound path over three to four years. The bolder single-step or very short-term approach is generally preferable and has been initiated in Andhra Pradesh, with its three-fold increase in 1997, and more recently in Orissa (150% increase in 1998). Coverage of O&M needs is the core requirement as it enables financial self-sufficiency for operations of the ID/WSA and WUAs. Beyond this, consideration should be given to building financial capacity of WUAs and WSA through additional contributions to a 'renewals fund." Linked to this, transition is needed from collection by the revenues department to collection by WUAs and the ID/WSA. As in Mexico and planned in Andhra Pradesh, the farmer organizations would retain their share to cover their O&M expenses, passing on agreed portions to the ID/WSA to cover the service agency's O&M costs. Transition to volumetric pricing is also needed for both electricity for pump-sets and for surface water. For the latter, charging could be for bulk sales by the ID/WSA at the whole WUA level. Other needed measures include: improving collection rates, exploiting additional revenue sources through appropriate charging for ID/WSA bulk water services to municipalities and industries, cost monitoring and cost-efficiency measures, computerized billing including transparent information on service costs and cost structures, and piloting of water markets.

xix. **Expenditure Prioritization:** The past dominance of construction in government expenditure has been an influencing factor on the slowdown of surface irrigation expansion in recent years. With funding of maintenance generally neglected, effectively irrigated area may have declined in some states. Further, the frequently found spread of expenditures across a large number of construction sites slowed completion on any one site. The relatively small but still crucial needs for institution building have also tended to be neglected. A critical review of priorities is now required. First and foremost, until ID/WSAs and WUAs become fully self-sufficient, maintenance needs must be secure. Similarly, the smaller but also essential requirements for institutional capacity building (training, equipment, consultancy), particularly for the new government and WUA institutions, need full funding. The next priority should be the needs for rehabilitation and modernization of existing schemes, essential for improving performance and effective irrigated area. Remaining funds then need to be prioritized at any one time to a limited number of construction sites, with emphasis on short-term completion. "Drivers" to help achieve these priorities can be introduced by the states: cost sharing and requirements for community participation in investment would provide a built-in self-selection and demand-led process; annual expenditure reviews need to be introduced; and investment analysis tightened, both through introduction of discounted cost-benefit analysis for all investments, and enhanced technical evaluations. The limited existing government funds would thus be much more effectively used.

xx. **Accessing Credit, Private Sector and Capital Markets:** Irrigation's share in Plan funding has eroded over time, to about 7% between 1990 to 1995. Given the increasing demands from other sectors, limited public funds for irrigation are likely to be a continuing reality in the future. Alternative funding needs to be explored, but requires, as a precursor, financially viable irrigation sector entities, including a return on capital. Several bond issues have been made in

recent years (Maharashtra, Karnataka, Andhra Pradesh, Gujarat), but closer analysis raises questions about the intrinsic viability of such bonds. Thus, Maharashtra has successfully issued bonds with government backed guarantees for its new Krishna Valley Development Corporation. However, until the corporation achieves commercial viability, the issues, while secure for the investor under the government guarantee, are, for government, essentially an alternative way of building government debt, and at high interest rates. The potential for both private sector direct investment in irrigation and for access to capital markets based on viable corporatized WSA and WUA institutions is, nevertheless, present. Private sector investment has been used in other countries and is commencing in other sectors in India. As recently done for the urban infrastructure sectors, these opportunities and how to access them should be developed. Credit and microfinance provide another opportunity, with particular relevance to private investment by farmers or WUAs: for groundwater irrigation and on-farm water management improvements (e.g., improved tertiary networks, drip irrigation, land leveling).

Technical Actions to Improve Performance

xxi. Paralleling the institutional and financial reforms, a concerted effort needs to be applied to upgrade the irrigation systems and improve access to more productive agricultural technologies.

xxii. **System Improvements:** O&M both need to be significantly upgraded, and based on individual scheme diagnostics and a Plan of Operations and Maintenance (POM), prepared jointly between WUAs, ID/WSA and AD. Maintenance activities need increased professionalization, based on detailed annual maintenance plans and performance monitoring. In most states, a major rehabilitation program will be required to restore infrastructure to operational status. Further modernization for still higher productivity is also possible. All of these actions are now being piloted by several states, and this experience can be supplemented by review of programs in other countries. Essential elements in these actions would be to ensure demand-led improvements and WUA "ownership" through their central involvement in planning, appropriate cost sharing in investment, and maximum implementation of works by the WUAs themselves. For the ID/WSA, attention also needs to be paid to improved design, construction quality and environmental assessment and mitigation.

xxiii. **Agricultural Technology:** For both groundwater and surface irrigation, on-farm water management and improved agricultural practices also offer scope for significantly improving water productivity and agricultural yields, and diversifying to more remunerative crops. The prime need is to provide upgraded agricultural, water agronomy and technology advice to farmers and WUAs. The great majority of farmers have limited access to advice, training and demonstrations in these areas due to the difficulties encountered by AD staff in both accessing farmers and state-of-the-art technology. The development of WUAs will provide a new forum for access by ADs, and a means for farmers to express their specific needs. Targeted incremental funding of ADs, linkage with universities and research agencies, and close partnership between AD, ID/WSA and WUAs could enable significant improvement and would complete the key features required for the "virtuous circle."

Implementation and Getting Started

xxiv. The above agenda, detailed in Chapter III and the matrix with the Action Plan for the Reform Agenda in Chapter IV, will need to be individually tailored to each state's circumstances and needs. The diversity in India precludes an absolute blue-print of the approach and the sequence of reforms. It is thus recommended that each state establish a core team to assess the state situation and prepare an Irrigation Sector Policy. This would diagnose the current situation, articulate the long-term vision and detail the short and medium-term steps to get there. The team should include careful assessment of the state situation supplemented by visits to other states and selected international examples. Although a step-wise approach will often be necessary, the best examples of reform--including Mexico, Turkey, and recently commencing in Andhra Pradesh--indicate that a bold and comprehensive agenda would likely be more successful than a gradualist approach. Also emerging from experience is that the reform process is itself adaptive, requires monitoring, evaluation and adjustment as it proceeds, and provides further opportunities as it develops. For the center, a valuable catalysing role can be played through policy and program support, awareness creation, technical assistance, and the sponsoring of workshops. Similarly, encouragement can be given during the review process of state programs, and central Plan financing can be oriented to assisting with financing of state reform programs. Civil society and the private sector (universities, non-governmental organizations, private businesses) should also be encouraged to contribute, and will be an increasingly important source of ideas, technology, institutional support and investment as the reform program proceeds.

I. BACKGROUND AND STRATEGIC ISSUES

A. INTRODUCTION

1.01 The analysis of this Report has found there is need for a major shift in India's irrigation strategy: from the past near exclusive reliance on irrigation expansion to a strategy emphasizing improving the performance of irrigation and irrigated agriculture. The focus--on enhancing productivity and sustainability--mirrors the evolution of policy thinking in India. Reflections for the Ninth Plan have put increased emphasis on productivity enhancement as the limits of area expansion as a long-term strategy have become increasingly apparent (Government of India (GOI), 1996a, 1996b and 1996c). Similar observations were made in the India Irrigation Sector Review (World Bank, 1991), and productivity enhancement approaches are being piloted in various states. There is need, however, to go well beyond this evolving thinking and piloting. Comprehensive actions are needed to achieve results on a much broader and more ambitious scale than so far achieved. To meet India's development goals, a new strategy is required to enable major productive impact in a financially, institutionally and environmentally sustainable manner.

1.02 This report covers the service delivery aspects of India's irrigated agriculture sector[1]. It discusses the issues involved and, based on Indian and international experience, proposes a strategy and action plan. This chapter provides background review of the role of irrigation and drainage in Indian agriculture and of current issues, followed by analysis of the respective agricultural growth prospects from expansion of irrigation and from performance improvement. Chapter II overviews the vision and strategy recommended to meet the constraints and opportunities available. Chapter III provides guidance on detailed implementation actions, and in Chapter IV, the proposed reform strategy is summarized and actions proposed to get the reforms underway.

B. THE ROLE OF IRRIGATION IN INDIAN AGRICULTURE

1.03 Agriculture is of fundamental importance in India's economy. It contributes 28% of GDP (1995/96) and 67% of employment (1990/91), while investments in agriculture amount to some 11% of gross domestic investment. It generates some 10% of total exports, and, following the economic liberalization program commenced in the early 1990s, agricultural commodities are among India's

[1] This Report is one of five specialist reports prepared as part of the "India: Water Resources Management" (WRM) sector work program, undertaken jointly between the World Bank and Government of India. The other WRM reports cover: Intersectoral Water Allocation, Planning and Management (World Bank, 1998a); Groundwater Management (World Bank, 1998b); Rural Water Supply and Sanitation (World Bank, 1998c); and Urban Water Supply and Sanitation (World Bank, 1998d). This Irrigation Sector report is focused on the irrigation service; for discussion of broader water resources management issues, refer to the first two reports cited above. A consolidated report, weaving together all five subject areas in an integrated framework, is also being issued.

fastest growing export sectors.[2] Most crucial of all is agriculture's role as a provider of livelihood for the majority of the population, and food security for the nation as a whole.

1.04 Various analyses of the role of irrigation in India's agriculture[3] have shown that irrigation has played a core role in agricultural production and growth. Although gross irrigated area (currently about 90 million ha, includes double cropping) is a minority--about one-third of total cropped area in India, the production from irrigated lands greatly exceeds the productivity of rainfed farming. In a monsoon-dependent farming system, with rains unreliable and large areas with rainfall less than 1,000 mm per annum, irrigation has been a crucial input for agricultural production. Irrigation enables a higher productive potential from the land, and significant production response from associated use of high yielding varieties, fertilizer and other inputs. Both at the national and regional levels, agricultural growth and rural development have closely followed the growth and regional pattern of irrigation expansion.

1.05 The production impact of Indian irrigation has occurred through four routes: cultivated area expansion, cropping pattern shifts, productivity enhancement, and increase in reliability. Ascertaining irrigation's precise contribution is, however, difficult. This is in part because there are no official Indian statistical data summaries giving the break-down of agricultural production under irrigated or rainfed conditions. Nevertheless, various estimates point to a contribution from irrigated agriculture to overall agricultural production of about two-thirds, and under some estimates an even higher contribution.[4] Even more difficult is the assessment of irrigated agriculture's contribution to agricultural growth. It is probable, however, that irrigated agriculture has contributed the bulk of past agricultural growth.[5] Today, the average aggregate productivity of irrigated agriculture per unit of land

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2 Agriculture only accounts for 3.4% of total imports, thus leaving a positive sector trade balance of US$1.5 billion at current prices. Overall, the agricultural sector has shown a strong supply response to economic reforms (World Bank, 1997).

3 As reviewed in the India Irrigation Sector Review (World Bank, 1991); and other studies (eg. Dhawan, Daines, Gulati, Bhatia, Saleth) as referred in bibliography.

4 Preliminary estimates were made for this report on the basis of nationwide data on areas, yields and output published by the Ministry of Agriculture and the Centre for Monitoring Indian Economy (CMIE) for eight principal crops (4 major food crops and 4 major non-food crops), which together account for over 70% of the total gross cropped area in India (GOI, 1972, 1984, and 1993; CMIE, 1996). If these estimates are correct, in 1992-93 irrigated agriculture would have contributed 78% of total food production and 95% of non-food production, using one-third of the gross cropped land. Other assessments of irrigation's contribution vary, and are usually lower than this. For instance, the World Bank India Irrigation Sector Review (1991), with less disaggregated data available then, conservatively stated irrigated agriculture's contribution as "over 55%".

5 A rough assessment done for this report points to a probable alarming reliance on irrigation for past growth, possibly of the order of 4% growth of irrigated agriculture (including the impact of expansion in irrigated area) compared with perhaps little more than 1% for rainfed agriculture. Other authors have made such estimates as well. One recent IFPRI Discussion Paper (Fan and Hazell, 1997) gives practically identical growth rates for production and productivity in "rainfed" and "irrigated" areas. But the definition of such categories contains an inherent measurement bias: "rainfed" districts are those with 25% of irrigated areas or less. Since the national average for irrigation is 35%, maybe up to half if not more of the irrigated areas of the country might fall into the Paper's "rainfed" category - and hence the similarity of figures.

would seem to be seven times that of rainfed agriculture (Saleth, 1997)[6] While estimates of impact of irrigation vary, all point to its significance in Indian agriculture; and its importance to past agricultural growth (Dhawan, Daines).

1.06 With nearly all arable land now under cultivation, and limited progress to date with major technological breakthroughs for rainfed crops, irrigated agriculture will likely remain the key contributor to India's agricultural development. Nevertheless, although not the subject of this report, it is clearly of far-reaching importance to enhance productivity from rainfed agriculture. Although probably contributing less than one-third of India's agricultural production, and likely still a marginal contributor to agricultural growth, rainfed agriculture occupies two-thirds of India's cropped area and for most rural communities is still the primary source of livelihood.

1.07 In view of irrigation's pivotal role, the sector has not surprisingly received a high priority in all of India's development plans. With a massive resource commitment of Rs.613 billion at 1980-81 prices (equivalent to US$78 billion; see Table A5.6), the gross irrigated area increased four-fold from 23 million hectare in 1951 to 90 million ha in 1997, a growth rate of 3.1% per annum over the period (Table A5.1). Together with China, India's irrigated area now far exceeds that of other countries.

1.08 In terms of the relative share in India's created irrigation potential, surface water in canals accounts for 39%, groundwater (with a major private sector involvement) for 47%, and other water sources for 14%. Over the 1951 to 1995 period, the publicly-created and managed major and medium schemes increased three-fold while the privately-created and managed groundwater segment increased seven-fold. Regionally, the major states in terms of irrigation area are Uttar Pradesh, Andhra Pradesh, Madhya Pradesh, Punjab, Rajasthan, Bihar, Haryana, Gujarat, Tamil Nadu, Karnataka, Maharashtra, Orissa, and West Bengal (Table A5.2). In most states, groundwater irrigated area exceeds the surface irrigated area.

1.09 Irrigation's Role in the Green Revolution. By far, the most important contribution of irrigation to Indian agriculture was in facilitating the spread of the Green Revolution. The expansion of irrigation from the mid-1960's provided the enabling environment for use of the new high-yielding varieties and fertilizer, pushing the production frontier to a new height and transforming the rural sector. The major gainers in terms of both productivity and area share were wheat and rice. As a result, foodgrain production increased from 51 million tons (mt) in 1951 to 199 mt by 1997, a compound annual growth rate of 3.0%. Between 1980/81 and 1995/96, the average foodgrain yields nationwide increased from 1.0 tons/ha to 1.5 tons/ha[7]. Irrigation expansion has also imparted a greater degree of stability to farm production (Dhawan, 1988; Rao, et al., 1988). In contrast to the chronic specter and actualities of famines in India during the 1950s and 1960s, the country has been, by and large, self-sufficient in foodgrains since the early 1970s, and in the last decade India has become a net grain exporter.

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6 Irrigation has also induced a substantial shift in crop patterns, especially from rainfed coarse cereals to the two major food staples, namely wheat and rice, which together account for two-thirds of the expansion in gross irrigated area since the 1960s (World Bank, 1991:4).

7 These (low) nationwide figures include rainfed cereals and coarse cereals such s millet, sorghum and maize.

1.10 Employment and Income Impacts. With an estimated two-thirds or more of agricultural production from irrigated agriculture, employment impact is clearly significant. The incremental employment generated by the irrigation potential created during the Eighth Plan has been estimated by Government at 8.7 million person-years. Since irrigation development forges inter-sectoral and inter-regional linkages through output growth and income flow, its employment and income impacts have powerful multiplier effects (World Bank, 1991:5). A 100-rupee worth of irrigation-induced incremental agricultural output is estimated to generate Rs.105 worth of additional output in manufacturing, and Rs.114 in the tertiary service sector, implying an overall non-farm output multiplier of 2.19 (Hazell and Haggblade, 1990).

1.11 Poverty Alleviation Impacts. Irrigation has also played a role in poverty alleviation. Between 1964 and 1994, the national average prices of rice and wheat, the major Indian food staples, declined by 2.2% and 3.3% per annum in real terms, respectively (Kumar et al., 1995). A significant inverse relation between the incidence of poverty and the extent of irrigation development has been found in several cross-sectional studies based on both districts and agro-climatic sub-zones (Rao, et al., 1988; Saleth, 1997). While the incidence of poverty is as high as 69% in districts with less than 10% of cropped area under irrigation, it is about 26% in districts where irrigation covers more than 50% of cropped area, and just 10% in Punjab and Haryana with over 70% of their cropped area under irrigation.

C. Issues in Irrigation Management

1.12 The critical issues India faces in the irrigation sector are common to many developing countries. These are: **physical constraints** due to poor maintenance and inadequate water control structures; **institutional constraints** due to public sector monopoly, weaknesses in the government agencies and minimal farmer participation; and **financial and economic constraints** due to inadequate cost recovery and provisions for operation and maintenance, and poor incentive structures. Although there is considerable variation between states in India, for most states the following issues have total or at least partial relevance.

Physical Constraints

1.13 Poor Maintenance. Most surface irrigation and drainage infrastructure is in a severe state of disrepair and in urgent need of maintenance. The problems are due in part to poor design and construction quality, but the primary factor is the cumulative effects of deferred maintenance over many years. Canals and drains are heavily silted, and the structures are eroded and collapsing, limiting the capabilities of the irrigation and drainage systems as reliable water capture, storage, delivery and disposal mechanisms. Poor maintenance of irrigation facilities has severely hampered scheme management, reduced irrigation efficiency, led to excessive irrigation in head reaches, to unpredictable service to all farmers, and particular inequalities to tail-end farmers. The extent of the irrigated area

being lost due to broken down distribution systems, storage siltation, waterlogging, and salinization is largely neutralizing the additional area being brought under irrigation through new projects[8].

1.14 Ineffective Control Structures. The physical deterioration of the hydraulic systems leads to considerable water waste through conveyance losses, unreliable or untimely deliveries, and application losses. Due to the lack of enough effective control structures, inappropriate operational plans, and limited contact with farmers, canal operators are unable to deliver water in the right amount at the right time and to the intended command area. The end result of such ineffective water distribution arrangements is loss of agricultural output, farm income, and employment.

Institutional Constraints

1.15 A Public Sector Approach without Accountability. India's state IDs are traditional large government departments incorporating the inherent disadvantages found in most such structures. The most critical problem is the sole involvement of the public sector as a monopoly agency, without accountability to users and without any direct link between irrigation service quality provided, revenues generated and staff incentives. Compounding this constraint, the administration of IDs is highly centralized rather than decentralized, with inadequate monitoring and cost accounting. Incentives for linkage with farmers are not present, typically resulting in a remote, top-down approach with minimal client orientation.

1.16 Limited Specialization and Staff Skills. The existing staffing and organizational structure of most state IDs are still primarily oriented to construction activities. Even within these traditional activities, some weaknesses are found in construction and design capacities, but the major gaps are in nearly all functions supporting performance improvement and water resources management. The institutional structure and staff capabilities to carry out operations and maintenance are particularly weak. There is a dearth of skills in corporate and financial management; for instance, in financial planning, economics, farmer and public outreach skills. Similarly, skills in basin planning, environmental management, hydrology, on-farm water management and resettlement and rehabilitation are also in short supply. Nearly all ID professional staff are civil works engineers by origin. Acquisition of specialist skills beyond construction engineering is hampered by frequent job rotations, limited career growth opportunities, and lack of incentives favoring specialization.

1.17 Lack of Coordination Among Public Sector Agencies. In a number of states, groundwater development, canal projects, and lift irrigation schemes are dispersed among different departments. Important managerial functions like water resources planning, monitoring, management, and environmental assessment are also dispersed, and the departments concerned lack clear responsibility

8 Some states, for instance, Andhra Pradesh, have even commented on such declines in irrigated area. On many commands in India, effective irrigated area has declined due to the deterioration of the distribution infrastructure. Waterlogging and salinization have also led to decline. Official estimates reckon the command area lost to waterlogging and salinity to be about 3 to 4 million ha, while a study by the Centre for Science and Environment (1988) estimates that 7 million ha have already gone out of farm production, and 6 million ha are being seriously threatened.

and accountability. These problems constrain a focused and functionally-oriented treatment of irrigation and water resources management issues by the state governments.

1.18 Weak Agriculture-Irrigation Linkages. The various agencies located in the irrigation-agriculture interface (irrigation departments, agricultural departments, credit and input delivery networks, and extension and training systems) operate mostly in isolation from each other, trying to achieve their individual goals but missing, in the process, the opportunity of synergistically achieving the collective goal of enhancing agricultural production. Agricultural extension itself needs strengthening; typically, farmers have little contact with the extension agents, who, moreover, are seldom specialized in irrigation agronomy and on-farm water management.

1.19 Minimal Involvement of Farmers in Irrigation Management. The exclusively public sector approach means the absence in most Indian irrigation and drainage systems of significant farmer involvement in irrigation sector management. This translates into poor operation and maintenance as the public sector agencies have limited staff capacity and inadequate finances to carry out such critical functions. The age-old perception of farmers as *recipients* or *beneficiaries* rather than as *clients* and *users* of irrigation services has changed little despite the often-stated policy on farmers' participation since the initiation of the Command Area Development Program in 1974. The consequences of this *user-orientation gap* are far reaching as the irrigation system becomes non-responsive to the changing needs of its users, and fails to effectively utilize its institutional resources for water allocation, fee collection, and system maintenance. While there are notable initiatives in inducing farmers' participation[9], most attempts continue to be limited in the degree of farmer management, and are more paternalistic than partnership-oriented. The millions of hectares of irrigation found in most states, requiring hands-on management right down to outlet and micro-levels, means that such systems are unmanageable without private sector participation. There is a manifest need now for the involvement of user groups, NGOs, and the private corporate sector in water management.

Financial and Economic Constraints

1.20 Insufficient Cost Recovery. Water charges are very low and are related neither to the productivity and scarcity value of water, nor to the cost of capturing and delivering it. They are equivalent to hardly 5% of the average incremental production of irrigated areas over rainfed lands, account for just 8% of the cropping expenses, and are a fraction of the recurrent costs of O&M. Since even the low water charges are not fully collected, arrears are accumulating in most states. Notably, this loss represents about 7% of the total Plan expenditure on all irrigation schemes[10]. Due to

9 For instance, as discussed elsewhere in this report, good piloting is underway in states such as Orissa and Tamil Nadu, West Bengal has had a successful program to transfer management of public wells to farmer groups, and Andhra Pradesh is currently launching a major state-wide initiative (Box A3.2).

10 In some states, like Karnataka, revenue receipts from irrigation covered only about 5% of current expenditure in 1993/94. Such situations have developed over time. In 1984-86, receipts represented only 41% of the annual consolidated states' budget for such expenses, down from 78% in 1974-76.

insufficient cost recovery, irrigation currently contributes one-third of the states' revenue deficits[11]. While such fiscal consequences are clearly undesirable, the most serious result is on the sustainability of the irrigation systems themselves. Without cost recovery covering at least O&M needs, expenditures on O&M must rely on subsidies rather than self-generated funds, and schemes cannot become self-sufficient.

1.21 Inadequate O&M Allocations. Insufficient O&M budgetary allocations have been the main factor behind the severe deterioration in the conditions of public irrigation schemes. Unable to generate enough revenue from within, the irrigation sector is heavily dependent on budgetary sources for O&M and other recurrent expenditures, making it susceptible to inter-sectoral budgetary competition, especially under the economic liberalization policy. O&M's relative share (as a percentage of total Plan expenditure) and its value in constant terms are on a continuous decline. As discussed in the Vaidyanathan Commission report, in many states, O&M expenditures presently hardly cover the needs for staff salaries, leaving negligible amounts for actual O&M works.

1.22 Poor Incentives. Subsidized water and its public provision do not provide incentives for water-use efficiency and conservation. To the contrary, both the level and method of water pricing create a disincentive structure inducing farmers to maximize water application per unit of area instead of maximizing output per unit of water (Rath and Mitra, 1989). Surface irrigation water is provided on the basis of water charges per hectare by crop grown which only very partially correlates with water usage. As water is not charged volumetrically, there is no financial incentive for conserving water. A similar situation applies for groundwater irrigation, for which flat-rate electricity charges rather than volumetric pricing is practiced.[12] Consequently, on-farm water wastage adds to the amount already lost in conveyance above the farm gate. Water wastage and inefficient use are not just a resource issue but a production issue as well. They cause production loss via both the discrepancy between the irrigation potential created and the actual irrigated area, and sub-optimal productivity even in areas actually getting irrigation.

[11] As a result, financial losses of major and medium projects in 13 major states amounted to Rs. 22 billion (equivalent to US$ 1.32 billion) in 1989-90 (GOI, 1992; see Table A5.8).

[12] Refer to the WRM reports on "Intersectoral Water Allocation, Planning and Management", and on "Groundwater Management" (World Bank, 1998) for more detailed discussion of surface and groundwater pricing issues.

D. Prospects For Future Growth Of Irrigated Agriculture

Growth Challenges

1.23 The major challenge India has set itself is to meet the Ninth Plan (GOI, 1996b) target of a 4.5% growth rate per annum for agriculture to successfully meet domestic demand and take advantage of export opportunities, as against its 3.0% historic growth rate. Such a radically enhanced agricultural performance would only be possible if there were a much higher productivity growth and a more diversified and higher-value farm production. The irrigation sector must be expected to play a major role in generating such dynamism. If past growth patterns are used to predict the future (paras. 1.05-1.11), irrigated agriculture would need to contribute most of the targeted incremental production. In order to achieve Government's targeted 4.5% growth rate, and if it were assumed that the rainfed sector continued to grow at only 1% per annum, *the irrigation sector would have to grow by at least 5% per annum.*[13]

1.24 What does this higher growth path mean in terms of the challenge to Indian agriculture, and specifically to irrigated agriculture? Table 1.1 illustrates production enhancement needs under several different growth assumptions. Clearly, even a 3% annual agricultural growth rate has major implications on required future productivity (a 65% increase by 2015, and a 157% increase by 2025). Realizing a 4.5% growth rate presents an even more dramatic challenge. It implies increases of 112% by 2015 and more than 300% by 2025.

1.25 What would be the best irrigated agriculture strategy for meeting such agricultural challenges, particularly under a progressively less favorable resource condition? Indian surface irrigation systems are in disrepair and suffer from chronic operational problems. Groundwater irrigation, while showing higher productivity than surface irrigation, is also performing well below potential. Major changes in irrigation and irrigated agricultural productivity will be needed on a variety of fronts to achieve such results. The analysis below will explore two main options, which are not mutually exclusive, that India has to accelerate the growth rate of irrigated agriculture: physical expansion of irrigation and drainage facilities; and performance improvement of the existing irrigation systems. The appropriate mix between these two options will be crucial for achieving future targets in agricultural production.

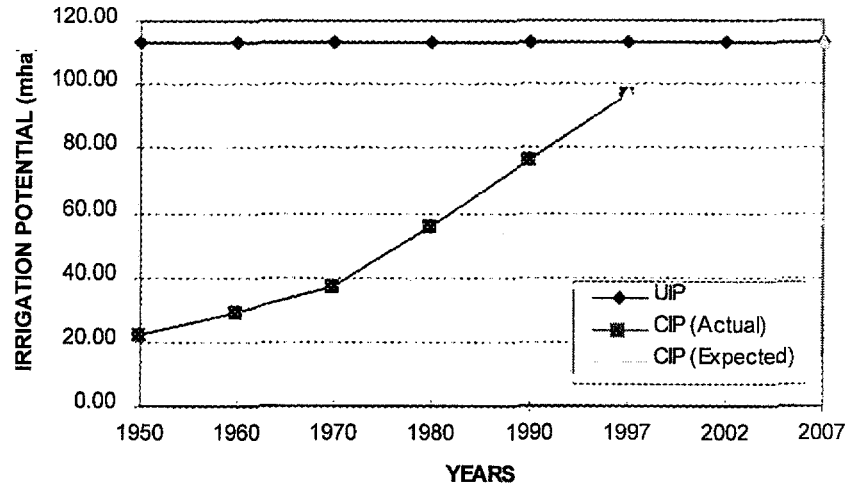
[13] It took India 30 years to last double its foodgrain output, under much more favorable technology conditions, still relatively abundant water resources, and much larger fiscal spending than at present. The Green Revolution's technological impact has been mostly incorporated, and no new major breakthroughs appear currently in the pipeline. The overall land resource base of agriculture is declining, due partly to land degradation (part of which is water-related) and partly to the continuous shift of farm lands to non-farm uses. As a result, the per capita net cropped area is expected to decline from 0.20 hectare (ha) in the late 1980's to 0.15 ha by year 2000 (Rajagopalan, 1991). Out of it, the area devoted to rainfed agriculture is actually declining.

Table 1.1: Projected Agriculture Production Growth Under Different Growth Rate Assumptions (In Percent of Base Year 1998)

Agricultural Growth Rate Assumptions (% per annum)	2015 (% increase on base year)	2030 (% increase on base year)
2.5	+52	+120
3.0	+65	+157
3.5	+79	+201
4.0	+95	+251
4.5	+112	+309

Growth Prospects from Physical Expansion

1.26 Resource Limits to Physical Expansion. The past agricultural strategy, centered on irrigation-induced area expansion, is fast approaching its physical limits. India has already developed almost 76% of the official estimate of the ultimate gross irrigation potential of 113.5 million ha [14]. The development of the remaining 24%, at the current rates of growth, could be



UIP = Ultimate Irrigation Potential; CIP = Created Irrigation Potential

Figure 1.1: Irrigation Expansion Vs. Ultimate Irrigation Potential

[14] Many researchers and irrigation engineers have questioned the current validity of this estimate made in 1981. Seasonal imbalance in the flow of rivers (especially in peninsular India), geographic incongruity between regions with undeveloped water potential and those with irrigable lands; increasing competition for land and water from non-irrigation sectors, and possible overassessment due to non-conjunctive assessment of surface and groundwater, are some of the factors leading to such probable overassessment of the real resource base available for irrigation development.

completed in the next ten to twenty years (Figure 1.1). And such expansion will be difficult as it will increasingly involve dam and canal construction in increasingly harder and environmentally more fragile locations. Investment costs could also become prohibitive due to design, resettlement, and environment-related issues.

1.27 The expansion constraint for major and medium irrigation schemes is already evident, as many river basins and states have either reached or are fast approaching their ultimate irrigation potential [15]. Some river basins, such as the Mahanadi and Narmada, still have significant development potential, and such situations also apply at the level of some states, for instance, in states such as Orissa, Gujarat, and Madhya Pradesh. In most other river basins and states, water resource constraints are developing, and will become rapidly more apparent over time. In water surplus situations, such as the above examples, expansion can continue; but should not be at the expense of maintenance and performance improvement of existing irrigation.

1.28 Further expansion of irrigation in the groundwater sector also faces limits. As discussed in the WRM Groundwater Management Report[16], groundwater limits have both a quantitative dimension in the form of aquifer depletion, and a qualitative one in the form of salinization and water quality deterioration. While, as with surface water resources, there remain areas in India where further abstraction is possible, groundwater resource constraints are an increasing problem.

1.29 The spatial incongruity between water availability and cultivable lands also reduces the irrigation value of the available water resources. While large scale inter-basin water transfers from surplus basins have often been mentioned as one of the solutions, the practicability of such transfers may be limited by inter-state water sharing issues, environmental concerns, and the huge fiscal costs involved.

1.30 Competition for Water with Non-irrigation Sectors. Not accounted for in the above are the increasingly pressing domestic water needs for rural and urban communities, and the rapidly expanding urban, industrial and power sectors. In view of the growing competition for water from the non-irrigation sectors, future water resources development will need to increasingly contain allocations to these non-irrigation uses[17]. There will also be more instances of the need for re-allocation of water

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15 A more detailed discussion of the water resource situation is contained in the WRM Paper on "Intersectoral Water Allocation, Planning and Management" (World Bank, 1998).

16 India: Water Resources Management Sector Review: Groundwater Management Report (World Bank 1998). This Report, inter alia, provides a detailed discussion of groundwater resource issues and future management needs.

17 Some examples are the supply of drinking water to the cities of Delhi, Hyderabad, Chennai (formerly Madras), and Jaipur; the conflict-prone supply of water to the Bhilai steel plant in the Mahanadi; the competing demands of irrigation, thermal and hydropower generation, and municipal and industrial requirements in the Sone sub-basin of the Ganga; and the competition between irrigation and drinking water supply to Ahmedabad and Gandhinagar in the Sabarmati basin (IWRS, 1997:21-42). The flow of the Yamuna and Upper Ganga reaches down to Allahabad during the non-monsoon season is already insufficient to meet the joint requirements for drinking water, irrigation, and industrial uses. In all such cases, irrigation has seen its water taken away for other purposes.

See the Inter-sectoral Water Allocation, Planning, and Management Report, as well as the Groundwater Management Sector Report prepared under the Water Resources Management Sector Review (GOI/World Bank, 1998a;b).

from irrigation to non-irrigation uses. With the at least four-fold growth in the gross demand for water that the non-irrigation sector is expected to exert between 1985 and 2025, the maximum share in total water use in India that irrigation could muster is expected to decline from the present 87% of consumptive use to 73%.

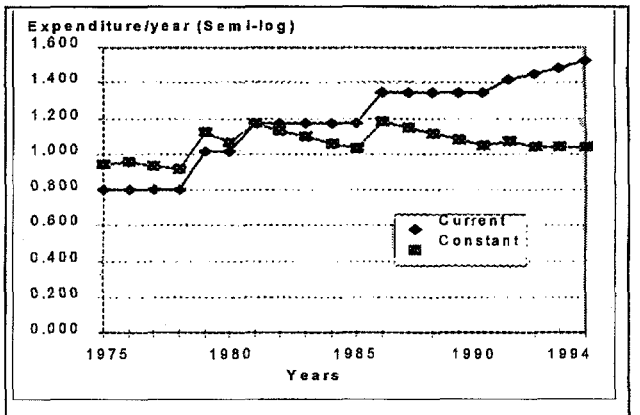


Figure 1.2
Irrigation Investment:
Current Vs. Constant (1980-81) Terms

1.31 Fiscal Constraints to Expansion. Compounding the above physical and inter-sectoral constraints, fiscal constraints are also limiting physical expansion of irrigation. As a result of the intense budgetary competition from other sectors, the share of irrigation investment in total Plan expenditure declined from 22% in the First Plan to 7% in the Eighth Plan, while the absolute volume of resources (in constant terms) has been declining since its peak in 1986 (Table A5.6). Figure 1.2 illustrates the stagnation in irrigation and drainage investment levels India-wide since the mid 1970s. Such trends are also evident from disaggregated state-level data.[18]

1.32 Far more serious than the increasing constraints with Plan funds for investment, is the decline in funding of maintenance works as discussed in Section C. above. Funding for operations and maintenance has been inadequate for years. Irrigation systems have deteriorated, and in a number of states, this could be resulting in an actual *decline* in the state irrigated area, even when large Plan revenues still go into new construction[19].

1.33 The stringent requirement for financial discipline introduced under the New Economic Policy will make additional financial flows into the irrigation sector increasingly difficult. Resolution of financial constraints will need to rely on targeted prioritization of the funds which are available, generation of additional funds from within the sector and attracting private sector financing.

Growth Prospects from Performance Improvement

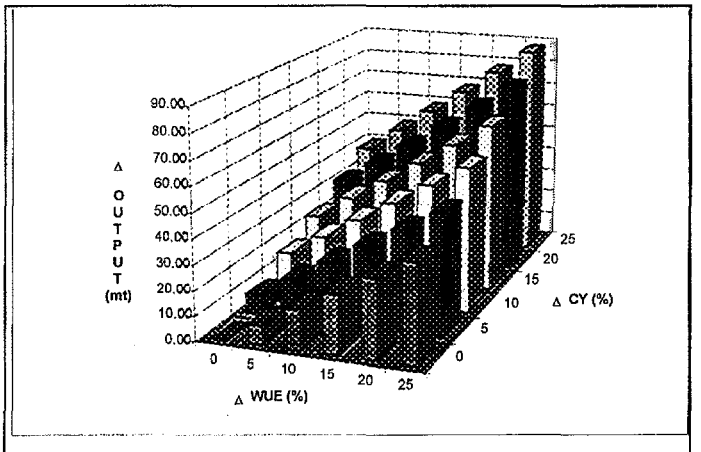
1.34 The increasing limitations on expansion for irrigation provide a strategic need to assess the prospects for improving the performance of existing irrigation. As discussed in Section C, the sector is

[18] From 1980/81 to 1993/94, capital expenditure in irrigation in real terms fell in Bihar by 6.7% per annum in Uttar Pradesh by 6.5%, in Haryana by 4.4%, and in Orissa by 3.4% (National Institute of Public Finance and Policy, NIPFP, 1997:23.

[19] In Andhra Pradesh, for instance, the Government has advised its extreme concern with this situation. Andhra Pradesh's gross irrigated area declined from 4.3 million ha in 1991/92 to 3.9 million ha in 1993/94 and, of the state's 4.8 million ha of net irrigated area created, today only 2.8 million ha are actually being irrigated. This situation, due primarily to years of neglect of maintenance, is in spite of major Plan expenditures in the state on irrigation expansion (Rs. 25 billion, or 24% of total Plan expenditure in the Eighth Plan) (GOAP, 1997). The highly laudable irrigation sector reform program that the state has recently launched to address these problems is discussed later in this report.

performing well below potential. Improvement in productivity of existing irrigation, already the base for over two thirds of agricultural production, could be a major source of future agricultural growth. This strategic need has been discussed in various government and other documents.[20] The opportunity available would be to realize the *hidden irrigation and agricultural potential* prevalent in existing irrigation projects: better water utilization and a larger area actually irrigated in the irrigation commands, and higher crop productivity per unit of land and water. This opportunity is relevant to both surface and groundwater irrigation. Productivity of surface irrigation is particularly low, but major opportunities are also available in the groundwater sector where the technologies of application and associated agronomic practices are still rudimentary for the majority of farmers.[21]

1.35 An illustration of the potential gains is given in Figure 1.3. The model illustrates the production impact of different assumptions regarding improved crop yields and/or water use efficiency.[22] For instance, a concurrent 25% improvement in both crop yields and water use efficiency (WUE from 35% to 43%) could yield an additional foodgrain output of 88 MT. This would represent some 44% of current foodgrain production in India, or 55% of the additional 159 MT of foodgrain estimated by GOI to be needed by 2025. The above is only illustrative, and planners may try alternative scenarios. For instance, higher yield growth (and/or higher value crops made possible by more timely and reliable irrigation services) may be easier than achieving irrigation efficiency significantly above 40%. The key point, however, is that *productivity enhancement could have significant impact.*



Note: ΔWUE = Water-use Efficiency Improvement, ΔCY = Crop Yield Improvement, and Δ Output = Incremental Crop Output.

Figure 1.3
Output Gains from Improvements in Yield/Water-use Efficiency

1.36 While the average productivity levels of most irrigated crops have been increasing over time, the gap between them and those obtained in demonstration farms in India still remains substantial. The comparison of Indian yields of wheat and paddy with those observed in some of the major countries similarly shows a significant yield gap. Although India has more than doubled the yield levels of its

20 For instance, the 9th Plan Approach Paper, 1997, the World Bank India Irrigation Sector Review, 1991, and Saleth, 1997. Saleth estimated that a 10% improvement in the efficiency of water use would be equivalent to adding some 14 million ha of additional gross irrigated area (1996:274).

21 Most farmers with pump sets are applying groundwater to irrigate their crops in much the same way as they do for their surface irrigation supplies. Drip and sprinkler irrigation, while expanding rapidly, is still only a minority of groundwater usage. Even for Indian farmers using drip and sprinkler irrigation, significant further advances are still possible through using the technologies practiced in countries such as California, Israel and Jordan.

22 The illustrative model shown in Figure 1.3 is based on the following approximating base assumptions: a gross irrigated area of 88 million ha; a water use efficiency level of 35%, and an average crop yield of 2 t/ha (foodgrains).

two most important staples over the past 30 years, these are still far lower than those observed in countries like China and the USA (Table A5.4). It is thus worth assessing whether, under the right interventions (below and Chapter II), India's irrigated crop yields, crop diversification options and effectively irrigated area on existing commands could increase. The desirable outcome, if high agricultural growth is to be achieved, would be for a combined impact well beyond the illustration provided above.

Experiences from Performance Improvement

1.37 Experience to date in India from irrigation sector performance improvement activities is still limited, and data on results is even scarcer. Only recently, and usually as pilots or under specific projects such as the World Bank assisted Water Resources Consolidation Projects (WRCPs), has an emphasis begun on performance improvement. Data from most of these projects has yet to build reliable time series observations. This section will nevertheless summarize some of the material available, also referring to selected experience from other countries:

- **System Improvements in Orissa**: Under the Orissa WRCP the impact of rehabilitation is being felt even after the first year of deferred maintenance works. Box A1.7 shows one command where discharge at head, middle and tail reaches has nearly returned to the designed discharges and where irrigated area increased by 6%.

- **WUA Scheme Modernization in Rajasthan**: A WUA in Rajasthan modernized its minor and received intensive agricultural extension under the Rajasthan Agricultural Development Project. Irrigated area expanded by 40% and the yields for soyabean, mustard, and wheat increased from 1.2, 0.9 and 0.8 t/ha per hectare to 1.4, 1.2 and 2.4 t/ha. More wheat was also grown than before due to less water logging (Box A1.6).

- **Increased Irrigated Area in Andhra Pradesh After WUA Formation**: In Andhra Pradesh, under the AP Irrigation III Project in the first season (1997-98) after WUA formation, reported irrigated area doubled on Sriramsagar scheme due to a combination of expansion of irrigated area and greater willingness of farmers to report their irrigated areas (Box A1.9).

- **System Modernization in Karnataka:** In Bhadra scheme in Karnataka, largely successful scheme modernization resulted in irrigated area expanding from 20,000 ha to 29,000 ha (95% of design) in the head end, and from 4,000 ha to 9,500 ha in the tail (82% of design) (Box A1.2).

- **Modernization and Rotational Water Supply in Gujarat:** In Gujarat's Dantiwada scheme, the system was modernized and converted to a rotational water supply system. Losses at the head end were significantly reduced and water better distributed in tail reaches, with reportedly beneficial impact on scheme productivity and equity (Box A1.1).

- **Impact of Flood Control, Drainage and Irrigation Rehabilitation in Haryana**: Under the Haryana WRCP, major rehabilitation of drainage and flood control works was undertaken before the 1996 season. The areas affected by flooding in 1996 and 1997 were 200,000 and 50,000 acres respectively, compared with 2.2 million acres in 1995, with largely similar rains. Rehabilitation of

irrigation works resulted in an additional 600,000 acres under irrigation in 1996-97, the state's largest ever annual increase (Box A1.5).

- **Improved Groundwater Irrigation After Government Hand-over to Communities in West Bengal**: Medium and high capacity tubewells were transferred to Panchayat management in West Bengal. Cost recovery substantially improved and the wells even generated savings to the community. Other reported impacts are higher irrigation intensities and crop yields and some diversification to higher value crops (Box A1.4).

- **Participatory Sodic Soil Reclamation in Uttar Pradesh**: Under the Uttar Pradesh Sodic Land Reclamation Project a grassroots and beneficiary involvement approach has been used to drain and agriculturally reclaim sodic lands. Cropping intensity has increased from 37% to about 200%. Yields of wheat and rice have substantially increased and crop diversification has started (Box A1.8).

- **Impact of Low Cost Drip Irrigation**: Significant water saving and crop yield advantages have been demonstrated using drip rather than flood irrigation in India. Water savings of between 40% to 80 % and yield increases of 25% to 40% have been recorded (Box A4.1).

- **Irrigation Management Transfer (IMT) in Mexico**: Mexico's IMT program resulted in a dramatic turnabout in the viability of the irrigation systems, improved O&M, and rehabilitation and modernization of the systems (Box A2.2).

- **Irrigation Management Transfer in Turkey**: Turkey's IMT program has resulted in greatly improved and reliable funds for O&M by WUAs, improved water distribution, major reduction in the number of irrigation related complaints, reduction in government spending and reported substantial increases in production (Box A2.3).

- **Farmer Managed Irrigation Systems in Nepal**: Transfer of smaller irrigation schemes to farmers in Nepal resulted in average increases in cropping intensity of over 30%, yields of 40% and farm incomes of 117%. Government funding requirements for O&M have substantially reduced (Box A2.6).

E. THE NEED FOR A NEW STRATEGY

1.38 Several conclusions may be drawn from the discussion above. First, irrigated agriculture has been and remains critical for India's agricultural growth and rural welfare. Second, despite the lead role of irrigation in past agricultural growth and India's "Green Revolution", the performance of irrigation has been severely constrained. The many issues confronting the sector have held back its real potential and the possibilities for a much larger contribution to agricultural growth. Third, the past basis of irrigation's growth contribution; rapid expansion of irrigated area, is becoming progressively less feasible. Continued physical expansion remains a short-term option in a number of states and basins, but prospects are diminishing as resource constraints, and the needs of other sectors emerge.

The relative neglect of productivity enhancement practically throughout India, has had major opportunity cost, as indicated in the case examples above.

1.39 A first need is, thus, to make what may be termed a **"Paradigm Shift in Emphasis".** Figure 1.4 illustrates the change required. From the past heavy emphasis on physical expansion, effort now needs to turn to a much greater emphasis on productivity enhancement. In states where expansion is already effectively exhausted the effort needs to be exclusively on productivity enhancement. In states where expansion prospects still remain, such expansion--based on sound multisectoral basin planning, good design and construction practices and fully effective environmental and resettlement and rehabilitation--can continue. But a balance in effort will be appropriate. There is no state in India where much greater emphasis on productivity enhancement is not needed. The case of Andhra Pradesh, now commencing a major reform program (Box A3.2) is illustrative. There, despite massive investment in new construction, severe neglect of existing irrigation caused low yields, and an actual decline in irrigated area in recent years. As a first priority, before allocation of funds to construction, the basics should have been assured: adequate maintenance of existing systems, enhancing productivity of these systems, and assuring financial viability to achieve this.

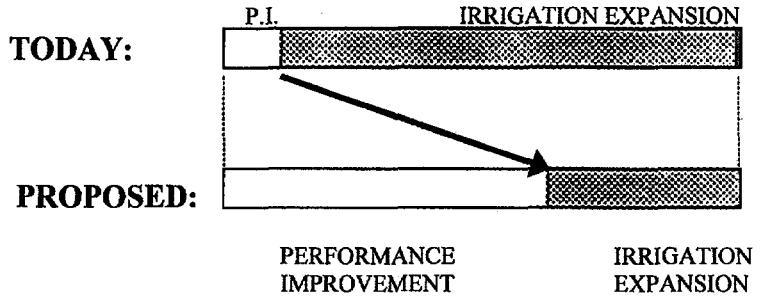


Figure 1.4
A Major Paradigm Shift

1.40 A second need is to approach the opportunities available from productivity enhancement in **radically new ways** than have been piloted so far. Table 1.1 above illustrates that marginal changes in irrigation practices and irrigated agriculture are unlikely to be successful. To achieve, for instance, 4% growth in irrigated agriculture, productivity will need to double by 2015 and to increase by 250% by 2030. A salutary instruction from any state leader would be to ask his staff, farmers and citizens to take a reflective tour of the country and imagine how farmers and irrigation and agriculture staff are going to achieve such or better results. In the 1960s and 1970s, India was blessed by its "Green Revolution"; the combination of rapid area expansion of irrigation and the use of high yielding varieties and fertilizer. The formula used under this major achievement is now largely exhausted. India must now look to **a "Second Revolution in Irrigated Agriculture"**, with a different set of interventions, to achieve its aspirations.

1.41 A third need, developed in the following chapter, is to tackle the above challenge through **a Comprehensive and Interlinked Approach**. International experience, and emerging experiences in India, are showing that success requires radical departures from traditional management, financing and incentives, and that these need to be applied in a holistic manner. An improved irrigation service must be accompanied by improved agricultural practices and exploitation of crop diversification options. A

close and client oriented relationship must be forged between irrigation and agriculture staff and farmers. From a largely exclusive government domain, water users (farmers) must be brought into decision making and management, and government must significantly revise its role and expenditure priorities. Subsidy based, inadequately funded and poor quality government activities must give way to high quality irrigation "services" paid for by the "client" (farmers), responsive, and answerable, to client needs, and enabling much higher productivity and incomes of the clients. The incentives environment must be adjusted to encourage such changes. The end objective would be high quality services provided commercially, managerially and financially autonomous irrigation systems, and transition to a primarily private rather than government managed sector.

II. THE FRAMEWORK FOR REFORM

2.01. As found in Chapter I, the largest opportunity for accelerating and sustaining agricultural development in India is to improve the performance of the irrigation potential already created. The remainder of this Report will thus focus on this opportunity. This Chapter will provide a schematic diagnostic of the current irrigation sector inadequacies in India (Section A), discuss the key changes needed (Section B) and identify the points of intervention to tackle these issues (Section C). This will establish the analytical framework for the detailed reforms recommended in Chapter III.

A. THE BASIC PROBLEM: THE VICIOUS CIRCLE

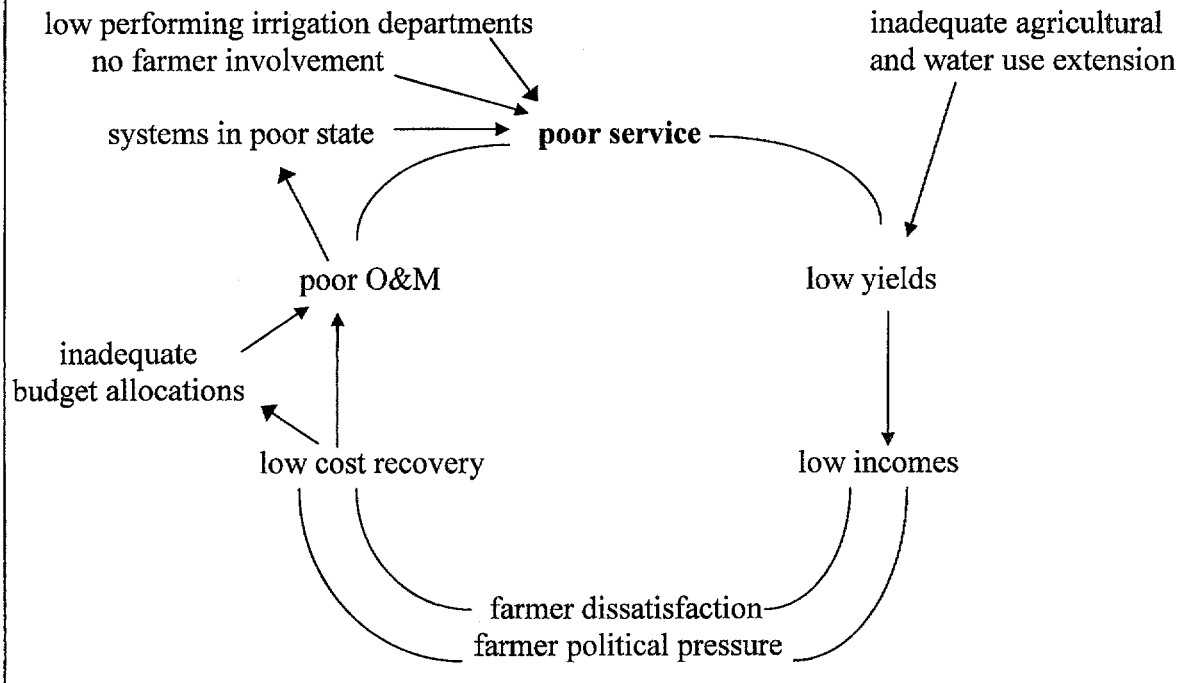
2.02 The physical, institutional and financial problems which affect the Indian irrigation sector are operationally inter-related- problems in one area affect others and, in turn, are affected by others. From the policy reform perspective, they can be articulated as a "**vicious circle**", where the different facets of the irrigation problem interact with each other and mutually reinforce themselves, keeping the irrigation sector at a low level of performance (Figure 2.1).

2.03 The frequently found *poor quality of the irrigation service* can serve as a starting point. Farmers typically have no participation in irrigation decision-making and, thus, no control over the quantity or timing of water they receive, and even whether they will receive it at all. Combined with *poor quality agricultural extension work*, it leads to low yields and then low incomes, which in turn lead to *farmer dissatisfaction* with the irrigation system, bureaucracy, and state government. Under this condition, water rate revisions are resisted and water payments are delayed, leading to low cost recovery and the ensuing *political pressure not to pay* for a service which is not appreciated as responsive to their needs. *Low cost recovery*, in turn, is linked to *underfunding of the operation and maintenance* of the conveyance systems which, coupled with the *poor quality and state* of most systems, and compounded by the inappropriate structure, policies and staff skills of many *state IDs*, closes the circle by perpetuating the *poor quality service*. Since these problems are inter-related and reinforce each other, resolving one or the other alone will not remedy the earlier deficiencies (Oblitas, 1992; Chitale, 1996). Therefore, it is necessary to tackle them simultaneously or in a well-thought-out (and politically feasible) sequence.

B. Changing the Vicious Circle

2.04 The key need is to *change the incentives structure* currently perpetuating the vicious circle. Central to this is to tackle the present exclusive government monopoly of irrigation and lack of client involvement. Changes are required both at the levels of the service provider (the present government monopoly) and the clients (farmers). Both presently have few incentives to change the status quo. For government, lack of accountability to the client means that incentives are internal to the department and based on satisfying bureaucratic and political constituencies. There is no need to be cost efficient in providing services, to be financially self-sufficient, to improve the technical quality of services, or to link up with other government services, the private sector and civil society. For the farmer, there are also no incentives to improve. Because farmers are not involved in the management of irrigation systems and are seldom consulted by government, they are detached from decision making and feel they have little influence on improving the service. Their only leverage is through political pressures resisting to pay for surface water irrigation and electricity charges for ground water pumping. This *incentives gap* for both service provider and user must be tackled.

FIGURE 2.1
THE VICIOUS CIRCLE



Adapted from K. Oblitas, Making Irrigation Pay, 1992

2.05 Marginal changes will not be able to surmount these problems. A highly capable and dedicated Irrigation Secretary or Engineer-in-Chief may be able to make a small impact on a temporary basis in the absence of major institutional and financial reforms. For instance, greater consultation with the farmers may be achieved by continuous encouragement and pressure on ID staff. Temporarily, when there is a period of high political will, a skilled Secretary or Minister of Irrigation may secure the full funds required for maintenance. However, for these and other initiatives, as there is no in-built incentive structure to persist with and build on such interventions, they will founder with staff changes or changes in the economic and political environment.

2.06 Instead, significant restructuring is required of the institutional and financial environment in order to create the incentives to initiate a continuous and vigorous process of change. A first need is to bring the farmers into the management of irrigation systems and to create client driven pressures on the service provider to improve performance. A second and parallel need is to change the role of the ID. This needs to become a client responsive agency, funded by the client, at least generating revenues to cover full O&M costs and fully accountable to the client. This would break the current reliance on perpetual and inadequate handouts from government and enable the farmer, by paying for the service, to be in the driver seat regarding the agency's policies, expenditure priorities and cost effectiveness. These changes need to be accompanied by actions to create accurate monitoring of technical and financial performance and fully transparent information for users, civil society and the private sector.

2.07 Full transformation would go further than this. For the irrigation schemes, these would become managerially and financially autonomous entities managed by the farmers. A typical structure likely to be suitable for India would be a two or three-tiered structure. Water User Associations (WUAs) would fully manage at tertiary levels (e.g., a minor, small distributory or a large water course, or the whole of a small minor irrigation scheme, or a communal tubewell). These would also form the democratic management base for whole scheme management of medium and major schemes. Distributory level WUAs and, in turn, scheme level WUAs would be formed. Initially, distributory and scheme level WUAs might restrict themselves to participation in scheme decision making but the objective should be that full management and responsibility proceeds up the irrigation scheme. As soon as possible, the entire scheme should become financially autonomous for its day-to-day operations. Progressively, the government role in management can be reduced, being eventually limited to management of major headworks as in Mexico (Box A2.2). Also, the irrigation schemes can adopt various management and financial structures. These could range from a WUA as a registered society, to a farmer owned corporation, to management or service contracts with the private sector. Government staff could be transferred to these entities including the opportunity for higher pay and the authority of the WUAs to continue or replace their services.

2.08 At the overall State level, the service provider would become a fully autonomous corporate body, entirely financed by user contributions and fully accountable to the users who would be represented on the Board of Directors. The agency could take various corporate forms from a public corporation, to joint farmer/government ownership, to full farmer ownership, and could also involve the private sector through service contracts for particular activities, or management contracts. As such structures are created, the current ID handling all activities would need to be unbundled. Typically, the unbundling would result in: (i) a Water Service Agency (WSA) for O&M as described above (or several in larger states); (ii) a smaller government department focused on policy, planning, design,

supervision of construction and monitoring; (iii) a probably separate institutional structure for multi-sectoral water planning, allocation and management; and (iv) an independent regulatory agency to monitor technical, environmental and financial performance, water pricing and costs, and to provide guidelines and safeguards against unfair practices.

C. CREATING A VIRTUOUS CIRCLE

2.09 The following core action areas are needed to move from the "vicious circle" to a "**virtuous circle**". Under the "virtuous circle" the key institutional and financial features would be created to provide an enabling and incentives-based environment for irrigation sector improvement, including the bases for further transformation over time (refer Figure 2.2):

- **Irrigation Management Transfer to Farmers:** The formation of water user associations (WUAs) with subsequent system turn-over to them is the cornerstone of the proposed reform strategy. The farmers can better manage minor and tertiary irrigation systems than a distant bureaucracy which neither has the staff numbers, detailed local knowledge or incentives to perform these tasks. Turning over the irrigation systems to WUAs enables the hands-on-management required, allows participation in decision-making in management of the main systems by the stakeholders and sets the stage for progressively higher levels of management by farmers, including eventual fully autonomous farmer managed irrigation commands.

- **Reforming the Irrigation Departments:** This needs to be accompanied by major reforms, upgrading and restructuring of the State ID covering the following five key areas: (i) an immediate need is to create a farmer driven environment. The ID should be made answerable and accountable to farmers to establish a client and service orientation; (ii) as quickly as possible, financial reforms (see below) should be implemented to make IDs fully funded for O&M by users; (iii) IDs need to be restructured and strengthened in one or two phases: an initial reorganization emphasizing creation of the new specialization areas required, decentralization along river basin lines and vigorous skill upgrading; accompanied or succeeded by more fundamental restructuring to create an autonomous user funded and directed commercial entity (para.2.08); (iv) active involvement of the private sector, civil society, academia and NGOs; and (v) improved linkages for both WUAs and the ID with concerned public sector agencies especially agriculture (see below).

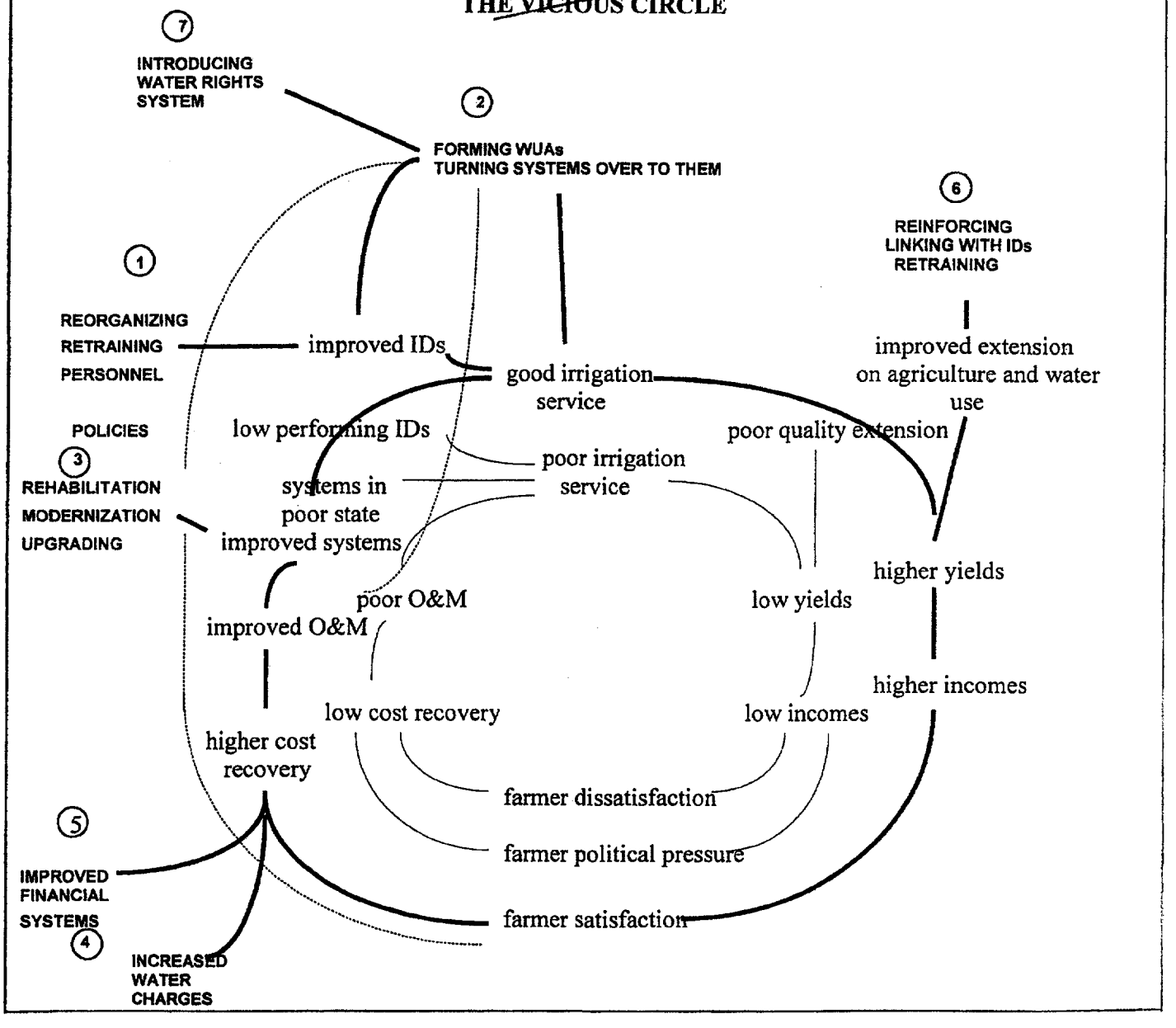
- **Achieving Financial Viability:** Sustainable service improvement and improved productivity and incomes of farmers can only be achieved if the institutions (WUAs and ID/WSA) are financially self-sufficient: (i) an essential first need is to raise water charges to levels sufficient to fully cover the costs of O&M; (ii) a direct link must be established between revenues collected and expenditures on O&M. The present collection, usually by the Revenues Department, going to the general exchequer needs to be replaced by direct collection by WUAs and sharing of revenues between WUAs and the ID/WSA according to the respective responsibilities and services provided; (iii) transition to volumetric charges should be made with billing at WUA levels; and (iv) further cost sharing should be introduced including a share of investment and capital replacement costs.

- **Upgrading the Irrigation Systems**: The institutional and financial reforms need to be accompanied by improving the performance of the irrigation systems. Key priorities are: (i) to immediately raise funding (by government until full cost recovery is achieved) for maintenance works to levels required to sustain the infrastructure; and (ii) to implement a major program to rehabilitate and modernize the irrigation systems. This will typically require a radical reprioritization of government expenditure emphasizing maintenance and system improvement as first rather than last state priorities. These programs would be done in a partnership approach between the WUAs and ID, maximizing the responsibility and implementation actions of the WUAs.

- **Improving Agricultural Services:** In parallel with the irrigation service improvements, farmers must also be helped to improve their agricultural productivity. There are notable gaps between the potential and actual agricultural productivity from irrigation, and as the irrigation service improves, potential will rise still higher. A targeted program should be mounted by the AD, in partnership with the WUAs and ID/WSA, to upgrade agricultural extension and provide state of the art agronomic and on-farm water management advice.

- **Monitoring, Transparency and Public Involvement:** The above actions need to be accompanied by improved monitoring of sector performance and a fully transparent and participatory approach, fully integrating the general public and in particular the main stakeholders.

Figure 2.2
VIRTUOUS
THE ~~VICIOUS~~ CIRCLE



III. THE REFORM AGENDA

3.01 The reform agenda would comprise three broad action areas at state levels: (i) institutional reforms both to involve farmers and to restructure IDs as client driven and commercially operated entities; (ii) restoration of the sector's financial viability and cost effectiveness including measures to enable private sector financing; and (iii) improving technical performance through ungrading irrigation systems and agricultural extension.

A. INSTITUTIONAL REFORMS AND REORIENTATION

3.02 Improving the performance of irrigation will depend most fundamentally on clarifying who does what most effectively: farmers organizations, government and the non-government sector; reforming institutional roles as necessary; and enhancing the incentives for and capacity of these institutions to perform. The main institutional issues demanding priority action in the reform agenda are: IMT to water users; restructuring and modernizing the service agencies; creating a farmer-government partnership for service delivery; and involving the private sector in irrigation delivery and technology dissemination.

Promoting Irrigation Management Transfer

3.03 At the heart of the reform agenda is IMT to farmers. As found in countries such as Mexico, Turkey, Chile, and Australia, etc., farmers can better manage and maintain systems than government, and have the direct incentive to do so. They have a direct stake in the quality of service, have far better understanding of local needs and can better resolve water management issues amongst themselves than can a remote government service.

3.04 India has a long and rich tradition of community participation in irrigation, particularly in the management of smaller irrigation schemes such as tank irrigation and in ground water irrigation. Many tanks, and even some larger irrigation schemes have been managed, owned and even constructed by farmers for centuries. This community management has unfortunately eroded over time due to progressively increased government involvement in irrigation this century. Based on unsatisfactory experience with government management, particularly at secondary and tertiary levels and for minor surface irrigation and groundwater irrigation, government and civil society have increasingly been emphasizing the role of farmers. As the first major attempt to promote farmers' participation, the centrally-sponsored Command Area Development Programme was implemented in various states commencing in 1974. The 1987 National Water Policy (NWP) (Ministry of Water Resources (MOWR)) and the 1991 India Irrigation Sector Review (World Bank) also underlined the importance of farmers' participation. The 73rd and 74th Constitutional Amendment Acts of 1992 (Panchayati Raj Acts) empowered establishment or revival of local government structures at district, block and village

levels. Many initiatives have been taken by both the central government and in various states to promote WUAs. [23]

3.05 Most of the earlier centrally and state sponsored attempts to establish WUAs have been only partially successful. First, clarity has often been lacking on what the WUAs are supposed to be doing and the respective roles of the WUAs and the ID. Quite often the WUA does not have a real job to do and members do not perceive any benefits from working together. WUAs have sometimes been imposed from the top and lack ownership and grassroots participation. Another problem is the piecemeal approach in establishing WUAs. WUAs have frequently been established in particular minors here and there, rather than taking an irrigation system as a whole. Also, WUAs have often been established in isolation from other actions required to ensure their success; an associated irrigation system improvement program involving the WUAs in the investment is required to enable benefits from WUA formation. Again, where system improvement is done, it needs to be done for the irrigation command as a whole (an improved minor will hardly be better off if the main system cannot deliver water). Where government help has been provided to WUAs, a frequent mistake is to employ a subsidy based approach. In these circumstances, farmers may agree to form WUAs simply to get the subsidy. Instead, a demand-led approach is required where WUAs share part of the costs of system improvement and firmly commit to take full charge of O&M of their systems. Finally, there has usually been inadequate support to IMT. Successful IMT requires major and long term commitment from the political establishment, the government agencies involved, the rural community and NGOs. This needs to include a major training campaign for the service agency state, NGOs and, above all, the WUAs. Such problems substantially explain why, despite past policy statements and the efforts of many, successful WUAs are still the exception rather than the norm in India. By 1991/92, India's irrigated area purportedly under WUAs was less than 0.5%.[24] Further, it is expected that the great majority of the reported WUAs were more on paper than real viable and sustainable entities.

3.06 Recent developments are far more promising. In particular, using different approaches, successful initiatives are commencing in such states as Andhra Pradesh, Orissa, West Bengal, Rajasthan and Tamil Nadu. India should also look to examples of success from other sectors in India: for instance, the National Dairy Development Board sponsored dairy cooperatives, particularly in Gujarat; and successful Rural Water Supply and Sanitation with village water users societies in Uttar

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23 For instance, there are positive initiatives in Orissa, Andhra Pradesh, Tamil Nadu, West Bengal, Bihar, Maharashtra and other states. In the case of two WRCP states (Orissa and Tamil Nadu), IMT is effected in surface irrigation systems as an integral part of the "System Improvement and Farmer Turn-over" program (SIFT). In Orissa, where IMT occurs along with an agricultural intensification program, the resultant yield and income prospects are likely to expand, consolidate, and sustain user-centered water institutions. In West Bengal, the operation and maintenance of state/public tubewells is being transferred to local *panchayats*, involving WUAs supported by NGOs. The most notable case is Andhra Pradesh, where IMT has acquired a legal status with the enactment of the Andhra Pradesh Farmers Management of Irrigation System Act of 1997 and where WUAs have been established across the state (refer Boxes A3.2 and A3.3). The initiatives in West Bengal and Andhra Pradesh have been financially assisted under, respectively, the West Bengal Minor Irrigation Project and the AP Irrigation III and AP Economic Restructuring Projects. Central government has also been an important proactive player. Under MOWR, with assistance from World Bank's South Asia's Rural Development Unit (SASRD) and the Economic Development Institute (EDI), a series of workshops on participatory irrigation management (PIM) have been mounted in the last two years.

24 Source: CWC, 1995.

Pradesh and Karnataka.[25] Successful international experiences with IMT include Mexico, Turkey and Chile, with, next door to India, promising developments in Nepal (see Boxes A2.2, A2.3, A2.4, and A2.6).[26]

3.07 Based on the developing Indian experience, and experience internationally, the following features are likely elements for success with Irrigation Management Transfer in India:

- **A Democratic Grassroots Base:** WUAs need to be established through a grassroots and democratic process. The likely best approach is to start with elections at the lowest levels in the irrigation system. For instance, the lowest tier in the WUA structure can be a minor. Within this, constituent areas should be delineated to ensure representation in the WUA committee of tail, head and middle reach farmers. Elections should be by secret ballot and preferably facilitated by an NGO or local government representative. Subsequently, the base level WUAs would be represented on a higher level organization representing, say, a distributory or branch canal or, in the case of a medium scheme, likely the whole irrigation command. The WUA representatives on this organization would also democratically elect their senior office bearers (President, Secretary, Treasurer, etc.). For major systems, a third and final tier would be to federate into a scheme organization for whole scheme management. The elected Presidents of the distributory organizations would be automatic members of the scheme organization. Consideration should also be given to creation of a state level WUA comprising all scheme level Presidents and electing their senior officers. This committee should play a significant participatory role in state irrigation policies, monitoring, conflict resolution and decision making.[27]

- **A Demand and Client-led Approach:** WUA formation and associated investments need to be "demand-led" to be successful. This is needed to create "ownership" of the system and its subsequent sustainability. WUA's must contribute up-front a part of the investment costs and should immediately shoulder O&M responsibilities and costs at their levels in the irrigation system.[28] The investment program must be planned with and led by the WUAs. A first step in this process should be a joint participatory "walk through" of the irrigation system by the farmers and ID and AD staff.[29] While the government staff have the crucial role of providing professional

25 NDDB was provided financial assistance under the World Bank/EEC supported Second National Dairy Project. The UP and Karnataka RWSS programs are being supported, respectively, under UP Rural Water Supply Project (Ln-40560) and Karnataka Water Supply and Environmental Sanitation Project (Cr-24830).

26 Mexico and Chile are the likely most relevant international examples for India. Other examples containing elements of possible utility in India include USA, Australia, Turkey, China and Argentina.

27 This structure, for instance, is currently being established in Andhra Pradesh (Box A3.2).

28 For instance, in Andhra Pradesh, WUAs will contribute 15% of investment costs, either in the form of cash or labor, and are immediately taking charge of O&M.

29 Based on recent experience in India in Orissa and Andhra Pradesh, the joint "walk through" has been found to be a particularly indispensable part of the process both in the formation of WUAs and initiation of cultural change at the level of the IDs. In the case of Orissa, the learning, ownership creation and cultural change process has been documented on video by Orissa DOWR.

inputs and guidance, the farmers should be considered the client and the primary decision makers regarding water management and system improvement.

- **Financial Viability**: An essential need is for WUAs to be financially self-sufficient, at least for O&M, right from the outset. At establishment, each WUA's objective should be to collect water charges itself at a level sufficient to cover the cash costs of O&M at its level in the system and the funds required to pass on to the higher tiers in the WUA structure and the fair costs of O&M activities on main system works undertaken by the ID/WSA.[30] A further objective should be to cover capital costs. Although full costs of capital expenditures may not be feasible, a proposed minimum objective should be a contribution to "renewals fund" accounts held by the WUAs and the ID/WSA to build capital for future reinvestment.

- **A Clear Legal Framework:** Piloting of WUAs can usually be done within existing state legislation. For instance, the Societies Act can usually be used as a legal basis for establishment of WUAs. However, to take matters further and to enable WUAs to take increasing responsibility, new legislation is required. Excellent examples of such legislation are the Mexico legislation and Andhra Pradesh's "Farmers' Management of Irrigation Systems Act", 1997 (see Box A3.3).

- **A Hydrology and Whole Command Based Approach:** : WUAs should be created based on hydrological units: minors, distributories, branch canals and whole irrigation systems. This is the necessary management and investment unit for irrigation. It is also important when forming WUAs and undertaking investments that the whole command (or whole hydrological units within the command) is tackled rather than piecemeal WUA formation and investment. Generally, WUAs would be distinct from other grassroots social organizations, such as, the Panchayats because hydrological boundaries seldom coincide with administrative boundaries. In West Bengal, however, management of community owned tubewells has been successfully handled under Panchayats with sub-management of each well by the farmers concerned (see Box A1.4).

- **Investment and Technical Support:** WUA formation is not an end in itself but a key part of the process of improving the productivity of irrigation systems and ensuring their sustainability. Accompanying or succeeding WUA formation should be provision of opportunities for improving the system and all technical and motivational help required. While farmers must put in up-front commitment, effort and investment, it is important that this is rewarded by tangible and preferably early benefits. In Orissa and Tamil Nadu, WUA formation is part of a combined package of upgrading the systems together with farmer organization under their "Systems Improvement and Farmer Turn-over (SIFT) programs. In Orissa and Andhra Pradesh, and planned in Rajasthan and Tamil Nadu, the SIFT program is accompanied by an agricultural intensification program (Systems and Agricultural Improvement and Farmer Turn-over). An equally important requirement is provision of technical, managerial and motivational support to WUAs. Experience to date in Orissa, Rajasthan and Tamil Nadu is that this is critical for success and still needs further strengthening. Particularly in the initial stages, a massive effort is needed. ID/WSA staff need

30 The term "ID/WSA" refers to the Irrigation Department in transition to a WSA (Water Services Agency; the commercially managed agency for O&M services discussed in para 3.09) or to the WSA where this has already been formed.

major training in their new roles, the community needs to be familiarized with WUA concepts, WUA office bearers need training, etc. In all of the above states, grassroots NGOs have also been used as facilitators to assist with training and community organization, and have been found to be very useful. The desirable extent of government commitment and support to WUA formation is most recently and best exemplified by Andhra Pradesh state. The major mobilization undertaken by Andhra Pradesh is described in Box 3.2.

- **"Big Bang" Versus Gradualism Approaches**: Approaches to WUA formation in India and in most countries have tended to follow a gradual process. In India's case, this has meant a very slow progression in most states. The more recent experience is that a "big bang" approach may be better. Mexico, Turkey, and most recently, Andhra Pradesh (see Boxes A2.2, A2.3 and A3.2) have implemented major change involving rapid formation of WUAs across the nation/state, all with promising results. By contrast, while states such as, Maharashtra have been espousing WUAs for nearly two decades, aggregate coverage and impact is still not significant. Major and rapid change, based on the examples of success above, is a likely better strategy but requires several features: several years of successful piloting; very detailed preparation of the program including training; total commitment by both the political/administrative authorities and the farmers; and a massive mobilization of effort by the government agency.[31]

- **Ensuring Participation of Women and Minorities:** While the election process discussed above can help establish a good representation, geographically and socio-economically, more is likely to be needed to ensure full and equal participation in WUAs of women and minorities (scheduled castes and tribes). At present not much experience is available, and this should be an active area of research, social assessments and piloting. Two forthcoming studies may help provide inputs for future strategies. In Orissa, an all women's WUA is being piloted in Aunli command by Orissa (Department of Water Resources (DOWR) and a local NGO.[32] In Andhra Pradesh, where a number of women have been elected as presidents and office bearers of WUAs but where the situation is still not common, a study of women's participation in WUAs is planned by AP-Irrigation and Command Area, Development Department (I&CADD).

- **Establishing Water Rights:** In parallel with or succeeding WUA creation, the legal framework for water decisions and water rights can also be adjusted. For instance, in some states (e.g., Maharashtra), farmers must get permission to grow particular crops. Each WUA in an irrigation system should be provided a legal water right and have full freedom of the use of this water, crops grown and sale or lease of water. Within each WUA, members should have water rights proportionate to their farm area and be able to sell, buy, lease or rent their water. This system, already practiced in countries such as Chile, Western USA, and Australia can serve to improve

31 Orissa, Tamil Nadu and Rajasthan states are examples of a, to date, intermediate approach. Effort in all three states has been significant but the strategies are still based on a progressive build-up from pilot activities. In at least the cases of Orissa, Rajasthan and several other states in India, the experience has now built up to a level that would enable preparation and subsequent implementation of a "big bang" (Andhra Pradesh/Mexico type) approach.

32 This experience is being currently evaluated and will be discussed in a forthcoming Bank Technical Paper (K. Oblitas and B.Dhar, forthcoming).

equity of water delivery, based on equal rights, between farmers, and can also facilitate efficient transfer of water from low to higher value uses through voluntary mechanisms.[33]

- **Possible Wider Functions for WUAs**: Although the primary function of a WUA should be water management, maintenance of the systems, participation in investment, and participation in water policy decisions; on a case by case basis, WUAs can take on other activities. The new institutions could, for instance, be the primary contact point for agricultural extension, marketing of inputs and products, and possibly for provision of credit.[34] They could also participate with ID/WSA engineers in monitoring contractor performance and construction quality. They are the natural vehicles for participatory discussion and decision making on water pricing.[35] They also provide ideal stakeholder groupings for participation in river basin organizations, inter-sectoral discussions of water allocation and environmental issues and in state water policy formulation[36].

Restructuring the State Irrigation Institutions

3.08 The drive to involve farmers in irrigation management must be accompanied by major reforms in the public sector. In part, this process will be driven by the client pressures from the WUAs which, with greater empowerment and as financiers of O&M, will be insisting on better and more cost efficient services from the irrigation agency. As discussed in Chapters I and II, irrigation in India is monopolized by the public sector--state IDs--which are severely constrained in their effectiveness. The IDs are generally centralized, bureaucratic, isolated (particularly from the farmers, but also from civil society, the private sector and other government departments), entirely financially dependent on state government hand-outs, and basically non-accountable especially to their primary clients, the farmers. Their emphasis tends to be on system construction[37] rather than on water delivery, and their O&M functions are generally chronically under-funded. For ID staff, incentives are oriented towards bureaucratic advancement rather than to serving their clients. Under these circumstances, and in common with many other countries with historically based governmental approaches to irrigation, the performance of IDs is understandably impaired. Despite the presence of many dedicated staff, initiatives and the financial possibilities to carry them out are stifled within this incentives framework.

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33 Water rights and water markets are discussed in more detail in the Water Resources Management Sector Review Papers on: (i) "Intersectoral Water Allocation, Planning and Management"; and (ii) "Groundwater Regulation and Management" (World Bank, 1998). Also discussed in these papers are the need to build in features to safeguard vulnerable groups and to protect the environment.

34 In Andhra Pradesh and Orissa, the WUAs will be the primary contact for the Agriculture Departments in implementation of the Agricultural Intensification Programs implemented under the AP - Economic Restructuring Project (Irrigation Component) and the Orissa WRCP.

35 In Andhra Pradesh, representatives from the state "Apex Committee" (the state level federation of WUAs) are represented on the state level "Water Charges Review Committee".

36 Refer to the the Water Resources Management Sector Review Paper on: "Intersectoral Water Allocation, Planning and Management" (World Bank, 1998).

37 In Tamil Nadu, for instance, the ID was under the Public Works Department, and its staff often rotated between irrigation and other public works.

3.09 The government's role will change quite radically as irrigation management is transferred to WUAs. In other countries such as the USA, Chile, Australia, and Mexico, where WUAs have taken significant responsibilities and where the private sector has developed as a provider and investor in irrigation and water provision, the government agencies have tended to become smaller, with fewer activities, but highly specialized in their roles. Also, the present full gamut of activities undertaken by Indian IDs has tended to be progressively "*unbundled*" into several functional entities. The *IDs role* should be restricted to necessary government functions such as policy formulation, water planning, design, investment funding, legislative and regulatory functions, and some monitoring, but even these activities should involve a participatory approach with civil society and WUAs. The actual irrigation service (O&M) tends to be handled by a separate *water service agency (WSA),* or several WSAs organized by river basin or major irrigation system in the case of large states or countries. The service agency would be particularly closely involved with the clients (WUAs), financed by them, and answerable and accountable to them.

3.10 Two other institutions also typically evolve. One need is to have an institutional apparatus for *inter-sectoral water planning, allocation and management.* Appropriate institutions for this, comprising a multi-sectoral state Water Resources Board and its State Water Planning Organization, are discussed in the WRM's Report on Inter-sectoral Water Allocation, Planning and Management. Also often desirable is to create a separate state *regulatory apparatus,* possibly comprised of two entities. One would handle regulation of resource management, in particular of groundwater and surface water abstractions and possibly pollution control. The other would focus on pricing and safeguarding monopolistic practices by water suppliers and users. An immediate need is to establish a water pricing committee which should be independent of political decisions. Over time, as WUAs develop and the private sector increasingly enters into water sector investment and management, this body needs to take on full regulatory powers.

3.11 The specific modalities of restructuring would differ from state to state and would need to be situation-specific depending on the degree of institutional restructuring and improvement already achieved by the state. The following paragraphs provide guidance on the key objectives and implementation actions to be aimed for:

Establishing Autonomous Water Service Agencies

3.12 A fundamental need, to be undertaken sooner rather than later, is to establish autonomous commercially operated WSAs serving and answerable to the farmers. All activities related to O&M and support to the WUAs should be put under one or several WSAs.[38] As quickly as possible, water charges should be directly collected by the WUAs and the WSA and these revenues should be retained by the WUAs and WSA in amounts corresponding to their respective levels of responsibilities and

[38] Typically, a WSA would handle provision of irrigation and drainage, flood control and bulk water supply services to WUAs and other bulk users (municipalities, industries, power plants, etc.). Its services, charged for commercially, would go down to the level of hand-over to the bulk users (e.g., WUAs), plus professional advice (charged for) to these entitites.

costs. In other words, the present situation where there is no link between water charges and the funding of expenditure must be replaced by this direct linkage. Also, as discussed in Section B below, water charges must quickly be brought up to levels at least covering, in the first instance, the recurrent cost needs of the WUAs and the WSA, and the WSA must have the mandate and authority to set water charges at levels ensuring financial viability of the WUAs and WSAs. The creation of WSAs (which could be autonomous companies or utility-type entities) would provide administrative and financial autonomy; full accountability to users; facilitate contacts with NGOs and private firms; introduce a less politicized environment to set and collect water charges; and enable the option of mobilizing private sector funds. Pakistan has recently commenced a program to create such public utilities as described in Box A2.7.

Improving the Service Agencies

3.13 The irrigation service agency(ies), whether the ID in transition to a WSA or a WSA, will also need decentralization, restructuring and a sustained drive to improve agency capabilities and staff skills. The Australia transition at Box A2.1 is one such example. The following are the main features which will usually be required in India's states:

- **Decentralization:** The agency (ID or WSA) should be decentralized in management authority, transferring decision making and responsibilities to lower levels in the staffing structure and maximizing responsibilities at local levels where the contact with farmers and actual field conditions is strongest. This should include operational decisions, relevant personnel management and financial authority at the local levels. The decentralization should be implemented along basin lines under Chief Engineer level "Basin Managers" who will be responsible for all activities within their basins.[39]

- **Reorganization and Specialization:** Reorganization of the ID/WSA also needs to create the features enabling more effective management, specialization of functions and creation of new functions. Traditionally, IDs have been organized on the basis of "circles" of staff each expected to handle all irrigation responsibilities in their areas. At the center, there are very few specialist units to provide support to the field-based engineers. Further, a number of necessary specialist functions are absent. Each state should restructure its ID/WSA to create the specialist units required. Needs will vary by state depending on the existing institutional structure. Typical functional needs at the center would be: (i) water planning, hydrological measurement and regulatory activities; (ii) design, construction and O&M/WUA support; and (iii) various management and human resource development (HRD) capabilities.[40] For many IDs a number of

39 This has been implemented under the WRCPs in Orissa, Tamil Nadu and Haryana. In Haryana the two main hydrological systems -- the Bhakra and the Yamuna have been taken. In Orissa and Tamil Nadu, each state has divided their state area into four or five Basin Manager Regions each corresponding to a group of contiguous small basins or a large basin. In the case of large major projects, specific project level CEs have also been appointed. A Basin Manager is fully responsible for all activities in his region and is also expected to forge initiatives towards multi-sectoral river basin planning and management and creation of river basin organizations (refer also to the WRM Report on "Intersectoral Water Allocation, Planning and Management" World Bank, 1998). While these initiatives are still recent (initiated in the 1993-95 period depending on the state), the experience is progressively proving positive. Management is now at more local levels and is progressively taking on the broader functions of whole basin management.

40 In the full institutional restructuring described in paras.3.08 & 3.09, a number of functions would be unbundled from the ID. For instance, as discussed, water planning and regulatory functions would likely be separate entitites. The WSA(s) would comprise O&M/WUA support activities,

these functions will essentially be new, especially in management, HRD, water planning and regulatory areas. Specialist basin planning and regulatory functions are still a rarity at state levels. For the subject of this Report--irrigation service management--particular remark must be made of the virtual absence of corporate management capabilities in IDs. Functional units need to be created in such areas as: programming and budgeting (P&B); management information systems (MIS); financial management and accounting; monitoring; procurement; HRD including training; and public outreach. Examples of two such reorganizations --Orissa and Tamil Nadu--are at Box A3.7.

- **Upgrading staff skills and performance:** Staff skills also need to be significantly upgraded. Most IDs need major improvement in the HRD area which is recognized by modern corporations as a professional specialization in itself. Because of limited training opportunities, many ID engineers have not had the opportunity to develop skills to the state-of-the-art required for the challenges of today. Further, most of the training is in engineering areas, and other needs such as community participation, computerization, corporate management, agriculture and environmental skills have tended to be neglected. Further, ID staffing is almost entirely (likely well over 95%) staffed at professional levels only by engineers, most of whom are civil engineers. There is a need to broaden the professional specializations within the new institutions. The skill mix should include economists, social scientists, financial specialists, computer analysts, agriculturalists, environmentalists and a broader mix of engineering specializations (water resources engineers, agricultural engineers, hydrologists, basin modellers). All states should consider HRD, improving skill mix and vigorous staff training as centrally important to improving water resources management and irrigation sector performance. The current activities of state training institutes such as the Water and Land Management Institutes (WALMIs) and other state or university training centers need significant support and improvement.

- **Improving Staff Incentives:** Incentives for the staff in state water agencies also need to be improved. At present, incentives in the form of housing allowances and other opportunities encourage staff to take field positions, especially in construction. Where an engineer is posted to a function other than this, he tends to seek return to field and construction-based activities as quickly as possible. Additionally, because of rigidities in sanctioned positions by work unit, whenever a staff is up for promotion he tends to be moved. There are few rewards for good performance and in general staff are promoted based on longevity. Hence, staff have limited incentives to do a good job and negative incentives to stay in the same position especially as regards specialized postings. Each state should examine these issues and derive a practical set of measures to improve incentives. These could include merit based promotions, faster promotions for staff staying in the same function especially in key specialist areas, greater flexibility in the number of sanctioned posts by unit, greater housing allowances and other financial incentives for less popular postings, prizes and access to study tours for high performing staff, etc.

the Basin Managers and the various management functions. Activities remaining with the unbundled ID would include policy, some planning and funding activities, design, construction supervision (major structures) and, some corporate management activities including monitoring.

Creating a Farmer Government Partnership

3.14 An important cultural change must be central in all initiatives. From the former internally oriented and isolated functioning of traditional IDs, the new emphasis should be on serving the client and outreaching to other government departments and civil society in a partnership between the public sector agencies, WUAs and civil society:

- **The WUA/ID/AD Partnership**--This is the most critically needed partnership. Both the ID/WSA and the AD need to strongly focus their activities on providing demand-driven services needed by the WUAs. The two agencies also need to coordinate their activities and work closely together.[41] Linkages between the ID/WSA and other government departments are also important.[42]

- **The Government/WUA/Civil Society Partnership:** Inter-linked with the above, a strong partnership should be established with civil society. The universities and other institutions form a major source of expertise that can be provided to both the public agencies and the WUAs. In most states, there is a thriving and growing NGO sector. A number of practically oriented and field based NGOs have demonstrated aptitudes in community organization and implementing grassroots activities.[43] More generally, the public as a whole should be brought into dialogue on irrigation sector issues and an active public outreach program should be a standard part of any ID/WSA's activities.

Involving the Private Sector

3.15 Private sector participation (PSP) also offers significant opportunities. To date, this is limited in India's irrigation sector and is primarily restricted to contracting by IDs of construction activities, and, to a lesser extent, of contracting for identified maintenance works. As found internationally (and commencing in India) in the urban water supply and sewerage sector, far more opportunities for PSP are actually available. PSP can be a source of innovative ideas, enables reduced government staff needs (or additional activities without increasing government staff numbers) and can provide technical and financial assistance with investments. Further, in a number of areas, especially, in corporate management, the private sector has expertise that government agencies often lack, and private firms tend to operate with greater efficiency and

41 Each state should consider appropriate ways to achieve the WUA/ID/AD partnership. A whole series of measures is likely to be needed from management coordination to joint meetings and work in the field. Two field level examples are: (i) the essential need to have joint "walk throughs" of irrigation commands by WUAs and ID/WSA and AD staff; and (ii) regular scheme level operational planning meetings between the WUA and WSA and AD staff to discuss irrigation operational plans and key maintenance and rehabilitation needs. In Orissa, consideration is also being given to assisting successful WUAs to construct small "Apex Committee Centers". These would be simple buildings approximately in the center of an irrigation command (or for large commands, at branch canal or distributory levels), comprising a meeting room for the WUA and also for training purposes, and several offices: for the WUA committee; the local ID engineer; an AD Subject Matter Specialist (extension agent specialized in irrigated agriculture); and a room for marketing by the WUA of agricultural inputs.

42 To mention but a few: the Departments of Finance, Revenues, Land Administration, Environment and Forests, Groundwater, Pollution Control Board, municipalities, State Electricity Board, etc.

43 For instance, NGOs are being used to assist in forming WUAs in Orissa and Tamil Nadu WRCPs; in Andhra Pradesh's Third Irrigation Project and the Economic Restructuring Project; and in Rajasthan's Agricultural Development Project. The assistance of NGOs has also been enlisted by state IDs in a number of other states.

accountability. It must be emphasized that, just as financial viability is critical for all WUAs and WSAs, private sector options require commercial viability and, hence, the full revenues (cost recovery, including on capital) to enable this. The following are some of the opportunities that India can develop:

- **Unbundling and Contracting Out:** More activities can be contracted out: (i) in addition to the new WUA full responsibility for maintenance at their levels; more contracting out can be done by the WSAs of maintenance at main system levels; and (ii) a number of discrete activities are highly suited for out-sourcing. These might include various studies, establishment and operation of communication systems, computerization and computer networks, MIS, P&B systems, asset management tools, monitoring and evaluation, computerized billing and collection systems for water charges. Private firms or consultants can also implement or support other activities such as basin modeling and support to WUAs.

- ***Promoting Innovations:*** Many private firms or private sector associations have interest in supporting innovations. The Indian Water Works Association, entirely sponsored by the private sector, supports innovation primarily in the Urban Water Supply and Sanitation Sector, but similar initiatives by private firms could be encouraged for irrigation. A successful existing example is the Bharat Chamber of Commerce in West Bengal which is helping farmers to develop intensive technologies for high yield diversified irrigated agriculture (Box A3.10). For drip and sprinkler irrigation, largely from groundwater sources, various private firms and an NGO (international development enterprises) are promoting low cost innovative technologies (Box A4.1).

- **Research Piloting and Training:** Central government could encourage involvement of the private sector and academia both within India and internationally through provision of supplemental grant funds to meritorious proposals, as currently under consideration under the proposed Water Resources Research, Innovation and Training Project (WRRITP).[44]

- **Management Contracts for Irrigation Schemes:** Scheme operation and maintenance could be tendered out to qualified private firms. This may result in a transparent and less expensive operation in which the lowest cost qualified bidder gets the contract and must submit periodic monitoring reports and accounts of expenses to the scheme level WUA and the WSA/ID. A successful example of a private canal operator from Chile is in Box A4.4. Possibilities in India might include locally based agri-businesses that already have an interest in assuring quality and regular supplies for their processing plants; for instance, some sugar factories, canaries and freezing plants, major Indian or multinational businesses, or large cooperatives if well established and commercially viable.

- **Assistance in WSA or ID Management:** As sometimes done in the case of international UWSS and power utilities, the private sector can be brought in under a "management contract" to either manage the agency or specific aspects of the agency's operations. A number of major Indian firms

44 The proposed WRRITP would establish a Water Resources Research, Innovation and Training Fund for such activities sponsored and managed by a national committee comprised of government, NGO and private sector participants.

have considerable skills in corporate management. A state government could invite a qualified firm to take over or assist the management of its WSA(s) and ID.

B. ACHIEVING FINANCIAL VIABILITY AND SUSTAINABILITY

3.16 The institutional reforms discussed above must be integrally accompanied by reforms in irrigation sector financing. The sector is in financial crisis: inadequate revenue generation; chronically underfunded O&M; revenues not directly channeled to expenditure; absence of commercial viability and accountability; inappropriate prioritization of government expenditures; expenditures neither driven by nor transparent to client demands; inadequate availability of public funds; and as yet undeveloped access to private sector investment and capital markets.

3.17 Allocations for O&M are typically half or less of real O&M expenditure needs. Allocations for system rehabilitation are also minimal. Water user contributions represent less than half of actual O&M expenses--and in some states, only 5%--requiring state treasuries to divert scarce funds from other sectors. All states borrow significantly for budget support purposes, but state ceilings for total and annual indebtedness set by the Reserve Bank of India (RBI) and the Planning Commission leave little room to maneuver. The almost invariable result is the shortchanging of funds for O&M. Funding is frequently so low that it barely covers staff costs, leaving negligible amounts for actual maintenance works. Also, IDs are overstaffed, especially for "work charge" establishment (positions below junior engineer). Even with the very limited funds available, expenditures on O&M are inefficient due to rudimentary financial management and performance monitoring systems, as well as inadequately planned system operation and maintenance. More generally, the entire priority ranking for expenditures in the sector needs overhaul. The present "de facto" last rankings for O&M expenditures, system rehabilitation, and institutional capacity building, need to be first priority.

3.18 Inadequate financial inflows (cost recovery) and lack of direct linkages between both revenue and expenditure and between client and service agency are at the root of all these problems. Expenditure decision-making processes are top-down, without adequate consultation with the stakeholders. As a result, many projects do not address the real needs of the intended "beneficiaries". Alternative financial sources have been tried by some states through tapping capital markets and credit sources. For capital markets, the usual route has been to create government-backed "corporations"; but, as cost recovery has not been tackled, such entities are unviable, unsustainable, and are essentially merely short-term tools for government access to high interest capital. Further, the total amounts mobilized so far have been small in aggregate terms. Access to credit (e.g., loans from the National Bank for Agriculture and Rural Development (NABARD)) are also augmenting a state's unrecoverable debt unless cost recovery is achieved. The major financial issues demanding priority action are: (i) achieving financial self-sufficiency of the sector at large and of its main entities (IDs, WSAs, WUAs); (ii) reprioritizing government expenditure in the sector; and (iii) establishing the conditions for accessing credit, private sector and capital markets.

Cost Recovery and Financial Self-Sufficiency

3.19 The NWP[45] states that O&M expenses are to be fully funded by the water users through adequate water charges.[46] Contrary to this policy, however, all states set charges which are much too low, and have tended to keep them unchanged over many years, resulting in a cumulative decline in real terms.[47] In 1993/94 such revenues accounted for less than 1% of total state receipts, and were equivalent to only 10% of the states' revenue expenditures in irrigation.[48] This has become a major burden on the states' finances. In view of these problems, GOI constituted the Committee on Pricing of Irrigation Water (the "Vaidyanathan Committee", GOI, 1992). The Committee reiterated the main thrust of the NWP and set out a program for increasing revenues from users. Its main recommendations were: to increase water charges to fully recover O&M costs, plus interest and depreciation of capital costs; improve assessment and collection; and promote WUAs. The Committee also recommended that these be accompanied by improvements in the irrigation service and O&M efficiency.[49] The recommendations of the Vaidyanathan Committee, as further refined by GOI and the Bank based on recent implementation experience and this review, need to be urgently put into practice. This requires: (i) drastically increasing and rationalizing the current water rates; (ii) reducing inefficiencies in the costs at which operations and maintenance are performed; and (iii) developing additional sources of revenue to finance irrigation expenditure.

- **Substantially Increase Water Charges to Cover O&M.** The critically needed and urgent priority is to increase water charges to cover O&M thus enabling the financial autonomy of WUAs, WSAs, and the ID. There is no avoiding this difficult step. In most states, this will require a several-fold increase in water charges, and would be best surmounted in a single large increase, as recently done in Andhra Pradesh, which tripled its water charges in 1997 (Box A3.2). If a one-time jump is not feasible, water charge increases should be implemented through annual increases in a time-bound program explicitly announced from the outset, and suggested not to exceed three years before achievement of at least full O&M cost recovery. Once water rates have been raised to cover

45 The National Water Policy states that "Water rates should be..... adequate to cover the annual maintenance and operation charges and a part of the fixed costs". (GOI, 1987, para 11).

46 This was the situation in pre-Independence days as well, when irrigation was treated as a "commercial" sector, and was self-sustaining in financial terms. Water rates were devised based on an internal rate of return commensurate with the interest rate then prevailing in the London money market. The IRR and, therefore, water rates were periodically revised upwards. The assessment of these water rates, covering all costs plus a return on capital, were strictly enforced.

47 In February 1997, Punjab went so far as to rescind all charges for water and power for irrigation.

48 An evaluation of public expenditure in water carried out by the National Institute for Public Finance and Policy (NIPFP, 1997, background paper for the India WRM Sector Review). Revenue expenditure is defined as expenditures in O&M, wages and salaries, and interest liabilities and payments .

49 Expenses in administration increased from 26% of total O&M costs in major and medium projects in 1980/81, to 43% in 1988/89--and have continued to rise. The Karnataka public expenditure review shows that the increase in current expenditures has been mainly accounted for by interest payments and wages and salaries, rather than actual works (World Bank. 1998. Karnataka: Economic Reforms for Sustained Growth). Broadly similar observations could be made in most other Indian states (India Irrigation Sector Review, 1991, World Bank).

O&M, they should be annually reviewed and adjusted for inflation; one technique is the use of an automatic, commonly available price index.

- **Direct Collection of Water Charges by WUAs, WSAs, and ID.** As quickly as possible, the direct linkage between revenues collection and expenditure should be established. Those responsible for managing the irrigation systems should collect and retain water fees, as well as be responsible for O&M expenditure. In most states water charges are collected by the Revenues Department and go into the state's general exchequer, rather than earmarked for irrigation. WUAs, in association with the ID/WSA, should collect water charges and use these revenues to directly finance their operations. The share of water charges allocated to each tier in the WUA/WSA hierarchy would depend on the level of responsibilities they are accountable for, and is scheme dependent. In a fully evolved water fees system, on a major irrigation scheme, the WUAs at the tertiary level would retain a share for their O&M, the distributory organization a share for its responsibilities, the command level organization a similarly appropriate share, and finally, the bulk provider would receive its share corresponding to its water service provision costs. This approach is practiced in Mexico (Box A2.2) and is being introduced in Andhra Pradesh.[50]

- **Improve Collection Rates.** In many states there is a large gap between estimated and actual collections contributing significantly to the revenues shortfall. Each state should examine their situation and devise measures to remedy this. It is expected that making the farmers and the WSAs directly responsible for billing and collection (refer above) will dramatically increase collection rates.[51]

- **Additional Revenue Sources.** Most IDs also provide bulk water supplies to municipalities, industries, power plants, as well as other services such as drainage, flood control, fisheries, etc. Such services are often provided free or at subsidized rates. Each state should undertake a review of potential additional sources of revenue. If a subsidy is to be provided, it should be targeted to the entity concerned, and the ID/WSA should charge commercially. It is not reasonable that agricultural users should subsidize other water users.[52]

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50 Andhra Pradesh is introducing this in a phased manner. In the first phase, the Revenue Department will continue to collect water charges, but now with the assistance of the WUAs. Accounts will be maintained by the WUAs as well as the Revenue Department as a basis for allocation of funds to the WUAs for O&M of their systems. Also, the Revenue Department will transfer the amounts collected to a special head of account of the ID to be exclusively used for O&M. Until water revenues fully cover O&M needs, this account will be further supplemented by the state Finance Department. In the second phase, the WUAs will collect water charges directly from their members, and pass on agreed amounts to the Distributory Committee, the Project Committee (Scheme Level Committee), ID, and probably, the state level "Apex Committee" (the anticipated state level federation of farmer water user organizations).

51 The preliminary indications from Andhra Pradesh are very encouraging. As discussed in Box A1.9 the process of forming WUAs on Sriramsagar project demonstrated a substantial increase in reported irrigated area, expected to be the combination of improved reporting and water management practices by WUAs.

52 Orissa and Andhra Pradesh are each assessing such prospects.

- **Introduce Volumetric Pricing.** The current area-based water charging system needs to be replaced by systems based on the volumes of water actually delivered. In most states, water charges are determined on a land area basis, with different rates set for different crops. This system is expensive to administer; frequently has poor collection rates; does not reflect the scarcity value of water as a limited resource; and does not provide an incentive for farmers to conserve water or invest in water-saving application techniques. An administratively and technically feasible option for India is to charge volumetrically for bulk supplies at the outlet level, through selling water in bulk to a WUA.[53]

- **Improve Cost Effectiveness of O&M.** Water charge reforms also need to be accompanied by improved efficiency of O&M. Present efficiency is likely to be low due to the high costs of staffing in O&M expenditures and the presence of surplus staff. Additionally, India can learn from countries such as Australia where O&M is a highly monitored and professional activity, involving farmers in cost oversight. Better internal organization, decentralization, elimination of duplications, out-sourcing of works currently being carried out on force account, reductions in work charge staff, and introduction of programming and budgeting and computerized asset management techniques, can contribute significantly to reducing the costs of O&M. In Australia, such changes resulted in cost savings in excess of 30%.

- **Client-Driven Service Improvements.** Increased water rates should be accompanied by client-driven improvements in the irrigation service. Where the farmer appreciates that the service is improving or will improve, an increase in fees is more readily accepted. Service improvements are discussed in Section C.

- **Investment Cost Sharing.** Cost sharing is important for a demand-led program and to create a sense of "ownership" for long term sustainability. Users, when they are contributors, become a direct part of the decision making and prioritization of expenditures, and will insist on cost-effective construction. They will also be encouraged to directly take over construction at lower system levels, if they assess that construction costs can thereby be reduced. Even for larger structures, user involvement in monitoring contractors, where users have a stake in minimizing costs and ensuring construction quality, will be beneficial. An additional benefit of cost sharing is that scarce public funds can be made to go further. In rehabilitation and modernization of irrigation systems, and ideally for new construction, WUAs should contribute an affordable, but meaningful, share of investment costs.[54]

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53 This will need to be accompanied by improved water control in main systems and measuring devices at the head of each outlet. States undertaking minimum rehabilitation or systems improvement programs (e.g., Orissa, Tamil Nadu, Haryana and Andhra Pradesh) should have the capability to introduce volumetric charging.

54 In Mexico, WUAs are required to contribute 50% of investment costs, with the other 50% contributed as a grant by Government. In Andhra Pradesh under its new Irrigation Sector Policy, WUAs will contribute 15% to investments at the tertiary level of the system, with such contributions possible as either cash or labor, or a combination of both.

- **Financial Capacity Building.** Although the short-term goal of fully covering O&M needs is already a major challenge, cost recovery should ideally cover depreciation and interest on capital. "Renewal funds", a variant on the capital cost recovery concept, may be more practical in India. The objective for the WUAs and ID/WSAs should be to progressively build their financial capacity through contributions in excess of O&M requirements to renewal funds held by the respective parties, as practiced in Australia. These funds would be earmarked for future replacement investment, emergency capital reserves, and further improvement of their systems.

- **Transparent Billing and Cost Monitoring.** A transparent billing and monitoring system should be introduced both as a management tool and a public information program. This information will empower and enable WUAs and the general public to both participate in and influence decision making regarding O&M management. Transparency in cost reporting will stimulate public pressure on IDs and WSAs to decrease costs associated with overstaffing and operating inefficiencies. An example of computerized billing is presented in Box A4.2.[55]

- **Establish an Independent Price Regulating Agency.** Water charge setting needs to be removed from the political arena. One option to achieve this is to set up an independent state Water Tariff Board with the mandate to adjust rates independent of the political process. Water pricing decisions would be made by the WSA(s) and the WUAs with oversight and, as needed, mandatory instructions provided by the Water Tariff Board. Such organizations have been established in other countries such as the UK and Chile, some of which go as far as vesting upon them regulatory and even enforcement authority. This is also not a new idea in India.[56] In the power sector, bodies of this nature are being set up in states such as Orissa, Andhra Pradesh and Haryana. In irrigation, Orissa and Andhra Pradesh have started to move in this direction by establishing state water pricing committees. The terms of reference for Andhra Pradesh's "Water Charges Review Committee" (WCRC) are presented in Box A3.5. The WCRC, and its counterparts in other states, is charged with making annual reviews of O&M and water pricing and resultant recommendations to government.[57] None of these committees, however, are currently able to set water prices independently as needed. This would be an appropriate next step.

- **Assess and Pilot Water Markets.** Water charges should take into account the costs of capture, conveyance and distribution (O&M plus capital costs), but the scarcity value of water as a resource can be further reflected through water markets. In countries where a water rights system and formal water markets exist, like Chile, the scarcity value of water is reflected in the market value of

55 Box A4.2 describes the computerized billing system introduced by the Hyderabad Metropolitan Water Supply and Sewerage Board. In irrigation, billing could be at the level of WUAs and should have a full breakdown on the bill of the cost structrue for O&M.

56 For example, Andhra Pradesh has constituted a WCRC, with most of the above-described responsibilities (Box A3.5), and Orissa has its own WCRC, but neither has as yet the full statutory responsibility to actually set the charges and fees - let alone, to monitor and enforce them. A similar idea is being pondered for the power sector, with a proposal to establish a nation-wide Power Tariffs Board.

57 Andhra Pradesh's WCRC includes a small executive secretariat and consultancy provisions for undertaking analysis. In Orissa, a computerized cost attribution model has been developed for analysis of charges and costs by sectoral users.

a water use right (Box A4.7). This also enables transactions in water, and a market based system for allocation to higher value uses. Opportunities for developing water rights and water markets should be assessed and piloted.[58]

Expenditure Prioritization

3.20 Despite the massive public expenditure on irrigation in the past, there is concern that actual expansion of surface irrigated area has slowed down in the last twenty years.[59] The states need to undertake a major reprioritization of their public investment in the irrigation sector. The necessary actions are well known and have been abundantly dealt with in the 8th and 9th Plan documents (GOI) as well as the India Irrigation Sector Review (World Bank 1991). However, expenditure reprioritization has only commenced successfully in Orissa, Andhra Pradesh, and Tamil Nadu. The typical state situation is one where maintenance works are severely underfunded, negligible expenditures go into institutional capacity building, and rehabilitation and modernization of existing schemes is largely not done. Instead money is put into construction, including starting new schemes when there are already too many construction sites. This tendency is fueled by political lobbyists against which the IDs, without effective evaluation and ranking procedures, have little influence. Further exacerbating this problem is the perverse incentives in inter-state competition for water, where Tribunal award decisions are perceived as favoring states that have commenced construction of consumptive water use infrastructure.[60] Paradoxically, despite the emphasis of expenditure on new construction, irrigated area is not expanding commensurately. In some states, actually irrigated area may risk or actually be declining. For instance, Andhra Pradesh, in its candid diagnostic of irrigation sector issues, observed that from 1991/91 to 1993/94, gross irrigated area dropped from 4.3 million ha. to 3.9 million ha.[61] The primary reasons for such situations are typically that funding is dispersed across multiple construction sites so that very few actually get completed, and, for existing schemes, reductions in the actually irrigated area due to deteriorating infrastructure.

3.21 In effect, a complete reversal of the past order of priorities in irrigation sector expenditures is required. The new priorities (refer Orissa and Andhra Pradesh examples at Boxes A3.8 and A3.9) should be as follows:

58 Water markets are discussed in more detail in the WRM Report on "Intersectoral Water Allocation, Planning and Management (World Bank, 1998). The discussion also provides pointers on features required for success, including features for avoiding potential pitfalls in the environmental and social fields.

59. For instance, as discusseed in the India Irrigation Sector Review net irrigated area under canal irrigation rose from 8.3 million ha. in 1950/51 to 12.8 million ha. in 1970/71 and in the following fifteen years, increased less dramatically to 15.9 million ha. (1984/85). (World Bank, 1991. Volume II, Table 1.1).

60. Such inter-state issues, and recommended actions, are discussed in depth in the "India WRM Report on Inter- Sectoral Water Allocation, Planning and Management" (World Bank, 1998).

61. Source: "Reforming the Irrigation Sector for sustainble Management and Development- Policy Statement." (Government of Andhra Pradesh, 1998).

- First and foremost, the expenditure requirements for *maintenance works* must be assured to the full required levels to enable the sustainability and satisfactory operation of the irrigation systems (until the ID/WSA becomes financially viable, the required funds would be a priority government expenditure);

- Smaller requirements, but also given top priority, are required for investment in *institutional capacity building* (training, computerization, communications equipment, study tours, consultancies, etc.);

- Nearly similar emphasis should be given to *rehabilitation and modernization* of existing schemes. Generally, a statewide program is needed to make up for many years of cumulatively deferred maintenance. The program, however, needs to be well prepared and implemented, done in association with the simultaneous development of WUAs, and including improvements in agricultural support services (Section C);

- *Construction activities must be sharply focused,* based on rigorous cost-benefit analysis and realistic estimation of public resources and social development objectives. Instead of spreading investment over a large array of projects, with investment levels on each insufficient to bring them to completion, investment should be concentrated on a few viable investments with near-term completion as an objective;

  - Selection of *viable scheme completions* as a first priority within available public funds;

  - *New constructions* should be limited to carefully assessed essential requirements based on thorough examination from technical, water availability and economic, environmental and social criteria. These constructions should only be undertaken where the higher priorities, described above, are already being met.

3.22 Achieving the above reprioritization will require establishment by the states of more rigorous procedures and mechanisms for planning, evaluating and monitoring expenditures.

- Introduction of *cost sharing and requirements for community participation* as a basis for investment. For new construction, contributions by farmers might be small but should include demonstrated community participation as a requirement. Cost sharing for rehabilitation and modernization can be significantly larger. This provides a built-in self-selection process, and better chances of sustainability based on community commitment;

- *an annual expenditure review* of the irrigation sector within the priority ranking above. Zero-based budgeting and computerized programming and budgeting techniques would be useful for this purpose;

- introduction of *discounted cost-benefit procedures,* in place of undiscounted benefit-cost ratios, to evaluate investment proposals; and

- improved *technical evaluation* for investments, including hydrological assessments, environmental assessment, and preparation of the investment within the framework of a multi-sectoral basin plan.

Accessing Credit, Private Sector and Capital Markets

3.23 As discussed above, improved expenditure prioritization can increase the effectiveness of existing public sector resources. Nevertheless, the stringent fiscal discipline required under India's new economic liberalization and economic management policies, together with rapidly increasing demands for public sector funds across sectors, has placed limits on the funds available for irrigation. The share of irrigation over total Plan investments has steadily dropped from 23% in the first Plan to 11% in the Sixth Plan, and to between 8% to 6% per annum in the period 1990/91-1994/95. The demands from other sectors are unlikely to enable irrigation to significantly increase its current budget allocations. External support from multilateral and bilateral sources is a small part of total expenditures in irrigation, thus providing only marginal incremental funding in aggregate terms. These realities have induced Indian states and central government to consider other financing options, though at this stage experience is mixed and still largely experimental. The experience to date is reviewed below under the three primary options: (i) institutional financing; (ii) private sector investment; and (iii) funding from capital and debt markets.

3.24 Institutional Financing. NABARD is the apex financing agency which guides, coordinates and supervises rural lending operations of commercial, cooperative and regional rural banks, and supplements their resources by providing refinancing facilities. In particular, NABARD is a major source of funding for groundwater and minor irrigation. Investment in groundwater and minor surface irrigation amounted to Rs. 11 billion (US$304 million) in 1994/95, NABARD's largest portfolio, accounting for 29% of its total financing. As WUAs develop, this type of microlending is likely to assume greater importance. NABARD will also remain centrally important for small loans to individuals, particularly for groundwater development, and investment in more sophisticated on-farm water management techniques such as improved field channels, land leveling and drip irrigation.

3.25 Another window for routing bank funds for irrigation development is NABARD's Rural Infrastructure Development Fund (RIDF), which receives the shortfalls of commercial banks in complying with the required 18% threshold of lending for agriculture. During 1994/95, the shortfall was Rs. 20 billion (US$550 million) (RIDF I), for which banks are paid interest at 11.5% per annum. A second RIDF was set up with shortfalls in 1995/96, estimated at Rs. 25 billion (US$690 million). About 98% of RIDF I funds were on-lent to state governments for completion or rehabilitation of irrigation projects, the remainder being for soil conservation, watershed management and flood protection. This facility has been used by a number of state governments, and has been of significant assistance. Prospects for increasing overall credit financing for irrigation development are, however, limited. At the state level RIDF will be available only as long as scheduled commercial banks do not comply with the 18% threshold. At the individual level (including the WUAs as these become creditworthy), lending can continue growing until it reaches the 18% figure, but such growth entails an equivalent reduction in RIDF funds. Furthermore, retail lending to the agricultural sector is expensive for both borrowers, due to high interest rates, and for the banks, due to high administrative costs. This is likely to make the mandatory 18% requirement function more as a ceiling than a threshold.

3.26 Private Investment in Irrigation Development. Direct investment in irrigation by the private sector (other than by individual farmers for groundwater development--which has been very large), is virtually nonexistent. The key for success in attracting private direct investments is the level of water charges the state is prepared to set and collect or allow to be collected. This explains the minimal success to-date in attracting the private sector. Until state governments raise water charges to commercially viable levels, and/or allow private investors to do so, this situation will continue. The most adventurous state in this regard has been Maharashtra, but its attempts to interest the private sector have been beset by the financial viability issue.[62] India would do well to look at examples of private sector investment in other countries, particularly in Latin America. Two other essential needs are, firstly, for full transparency and clear identification of risks. Secondly, constraints to physical investments need to be tackled: land acquisition, resettlement and rehabilitation; environmental mitigation if needed; and securing all necessary clearances from the relevant departments.

3.27 Funding from Capital and Debt Markets. These markets represent important prospects for the irrigation sector.[63] The following conditions need to be met, however, for such financing to become a major source of funding. Firstly, only companies, corporations, and utility-type entities can issue papers to be traded in these markets (state-issued papers are subject to the overall ceiling on state borrowing). Only four states have created such companies or entities, and only three of these are active (Gujarat, Maharashtra and Karnataka).[64] States interested in tapping the capital or debt markets would have to create such entities. Secondly, the bonds must be professionally designed and issued, with terms, interest, and payment modes attractive to the specific market segment addressed. Risks must be unbundled and clear transparency must be introduced. Lastly, the issuing companies must

62. The Government of Maharashtra recently explored the possibility of having private firms directly invest in medium and minor irrigation works under build-operate-own, build-operate-transfer or build-operate-lease schemes. The ID invited bids for the construction of one or more of 52 schemes, covering some 2.0 million hectare at a total cost of Rs. 9.4 billion (940 crores, or US$270 million). At the time of analysis for this report (1997) no applications had been received, although the ID was negotiating the possible award of two of the schemes with firms that showed interest. Awardees would be allowed to collect water charges from all water users, plus retain revenue from tourism, forestry and fishery activities. The ID was also identifying additional sources of income which could be made available to the awardees so that these could obtain sufficient income to make their initial investment in dams, headworks and distribution networks competitively profitable.

63. The capital markets consist of primary and secondary segments and term capital market; the debt markets trade bonds of public sector undertakings and corporate debentures. They mobilize thousands of millions of rupees each year.

64. The Maharashtra Corporation and the Karnataka Company have placed bond issues recently. The experience of Maharastra's MKVDC in selling the first three issues has been very successful from a short-term perspective. The first two issues were substantially oversubscribed, allowing the Corporation to place a third issue privately, for a combined total of about Rs. 10 billion (1,000 crores, or US$ 280 million). An innovative government guarantee has satisfied investors that the bonds will get serviced (refer Box A3.11 for details). In Karnataka, the Krishna Bhagya Jala Nigam (KBJN), was registered as a corporate body under the Indian Companies Act, and has also issued bonds, but securing adequate subscription proved more difficult than in Maharashtra. In operational terms, its mandate covers only selected commands in the basin. Since it operates in parallel to GOK's Irrigation Department, KBJN's authority to set water charges has a ceiling determined by the charges set by the ID in neighboring schemes. Such restricted charge-setting authority would prevent KBJN from achieving financial viability and, in due course, would affect its ability to remain solvent. Bonds have also been issued by Gujarat's Sardar Sarovar Nigam corporation.

function efficiently and should have the capacity to generate enough cash flow to service the bonds. In the case of irrigation, this is obviously problematic due to the low levels of water charges.

3.28 The initial success of the corporations in Maharashtra and Karnataka in placing their bond issues is due to a factor that may unravel the whole effort, namely, the unsustainably high interest rate (17.5%) at which they were placed. The respective state governments may find the ensuing financial burden unaffordable. At present, until Maharashtra substantially increases its water charges, the MKVDC (Maharashtra Krishna Valley Development Corporation) bond issues, while secure for the investor because of a government backed guarantee, are merely an expedient way of incurring more government debt, and at a very high interest rate. It has not solved the fundamental financial problems of the sector, and will not until MKVDC becomes financially viable. In the case of Andhra Pradesh, while investment prospects may now be much more attractive given the recent three-fold increase in water charges, the state corporation had earlier financial difficulties. Previous interest payments accounted for 80% of current expenditures in irrigation in the state, and the state corporation became paralyzed as a result of unaffordable interest payments.[65]

3.29 In short, the viability of all the above options depends fundamentally on radically revising water charges so that such initiatives are financially self sustainable. If this were done, supplemented by liberalizing the private sector and capital markets to set their own terms for finance (with appropriate regulatory safeguards), the opportunities would open considerably. In particular, capital and debt markets and private investment, are potential major sources of irrigation investment in India. Lessons should be drawn from India's infrastructure sectors, where this type of financing is more common, though still largely to be developed, and from successful international experience in the irrigation and urban water supply sectors. The WRM report on the urban water supply and sanitation sector provides further discussion of financing options, many of which are applicable to the irrigation sector.[66] Recommendations for further investigation are:

- development of microfinance. New opportunities are opening up for more diversified investment in irrigation, particularly for groundwater irrigation and in the technology of field applications for surface irrigation. Through improved on-farm water management, these could significantly enhance the productivity of both ground and surface water irrigation. Such opportunities include: investments in drip and sprinkler irrigation; use of solar and wind energy for lift irrigation; continued development of tubewells where groundwater resources permit; land leveling; drainage; and various agricultural technologies and equipment. A review of these opportunities and how to promote them could be undertaken by NABARD, MOA, MOWR, and selected participants from the private sector, NGOs and academia; and

65. The Andhra Pradesh State Irrigation Development Corporation (APSIDC)was registered in 1974 to function on corporate lines and access private/institutional finance, but cost recovery never even approached actual expenses. APSIDC accumulated heavy losses and could not service its bank loans.

66. India, Water Resources Management Sector Review, Report on Urban Water Supply and Sanitation. World Bank, 1998.

- development of private sector investment and of capital and debt market financing. The issues and opportunities need to be better understood. As done for the urban infrastructure sector.[67], a committee could be established to review Indian and international experience and should include applicable examples from the urban and power sectors. A study tour to see international best practice should be part of this process.

C. TECHNICAL ACTIONS TO IMPROVE IRRIGATION PERFORMANCE

3.30 The inadequate quality of designs, construction, and management of system operations and maintenance, and inefficient water delivery systems have contributed to water losses, inadequate, unreliable and inequitable distribution of water to farmers, reduced irrigated areas and agricultural productivity below potential.

Improving Water Operations Management

3.31 There is a need to improve the operations management of irrigation systems, particularly in the large schemes, to increase agricultural productivity. In particular, measures are needed to improve operational efficiency and develop better control and measuring structures to ensure timely delivery and correct amounts of water to farmers. A critical element is the preparation of detailed scheme POMs. These should be developed with active involvement of the state AD, farmers and other water users, and after realistic consideration of water needs and supplies. The scheme diagnostic involved in preparing a POM would also serve as a basis for the design of scheme rehabilitation and modernization programs.

Upgrading Maintenance and Rehabilitating and Modernizing Systems

3.32 Maintenance: The almost negligible funds that have all too frequently been available, have resulted in low professional attention to maintenance by IDs. Accompanying the new full funding levels for maintenance must come a "re-professionalization" of this activity, including taking on more recent O&M management techniques as practiced in countries such as the USA and Australia[68]. Maintenance must become a fully planned and monitored activity conducted annually. Each year an annual maintenance plan should be produced and costed for every scheme, detailed by every reach and

67. The "Rakesh Mohan Committee for Commercialization of Infrastructure" (1997) provides an example of such a review for the infrastructure and urban sectors. Of particular interest is the specialized financial intermediary proposed by the Committee, which has been incorporated as the Infrastructure Development Finance Corporation. This corporation was visualized to act as "a guarantor for investments made by credible financial intermediaries as well as large project entities themselves." (India, Water Resources Management Sector Review, Report on Urban Water Supply and Sanitation. World Bank, 1998. pp. 69.). The irrigation committee should include significant, inter sectoral, financial expertise from both the private and public sectors.

68 In particular, the maintenance management practices developed in Australia, with similar physical conditions as in India, merit study. They include computerized asset registers and various monitoring of performance and costs.

structure, and a maintenance report produced of last year's activities as part of this process. The maintenance plan should be devised jointly between the ID/WSA and the WUAs, and should be monitored jointly, including monitoring of costs and quality of works.

3.33 Rehabilitation: Many irrigation and drainage schemes will require rehabilitation before maintenance activities can be stabilized to normal maintenance. Typical problems are heavy silt build-ups in both canals and drains, weed infestation and broken structures and outlets. The costs of rehabilitation will depend on the scheme and local conditions, and whether modernization (improving the system beyond the original design) is also undertaken.[69] Several states are undertaking wide-scale rehabilitation programs (e.g., Haryana, Tamil Nadu, Orissa, Andhra Pradesh). In the case of Andhra Pradesh, a state-wide "minimum rehabilitation" program is getting underway and is expected to cost about Rs 2000/ha (US$55). Works are confined to the minimum works required to re-establish essential working order, and consist primarily of desilting and weeding, repair of identified key structures and all outlets, and limited improvements such as simple measuring devices. With the exception of the major structures, the bulk of the work is being done by the WUAs themselves.[70] In Orissa and Tamil Nadu, more intensive improvements are underway under SIFT programs, costing (Orissa) about Rs 9000/ha (US$250/ha). These include more intensive water management improvements such as more regulators and long-crested weirs. The Haryana program includes major improvement in drainage and flood control infrastructure (Box A1.5).

3.34 Modernization: Still further improvement is possible and should be piloted in India, including observation of technology introduced in other countries. Existing state-of-the -art in India includes the Majalgaon scheme in Maharashtra, where a computerized dynamic regulation system has been established (Box A4.6). This has capability for a high degree of responsiveness to farmer needs and localized rainfall, but needs to be combined with build-up of effective WUAs to realize its potential benefits. Andhra Pradesh also intends to pilot dynamic regulation. While these actions may represent higher cost interventions than can, for now, be replicated broadly, such and other technologies need testing in India. A more universal need is for improved within-command communications systems, especially for the larger schemes, and for communication systems between field engineers and headquarter offices as planned for establishment in Orissa and Andhra Pradesh.[71]

69 Works to be undertaken are scheme-specific and depend on the diagnostic of needs, and the extent of rehabilitation and modernization targeted. Typical works comprise: desilting, weeding, repair of erosion of embankments or linings, special repairs of structures, drops, cross and escape regulators, cross-drainage, etc., special repairs of mechanical hydraulic equipment (motors, hoists, gates, etc.), long-crested weirs, raising of embankments, installation of measuring devices, sills to raise water levels, re-sizing of outlets to enable specific discharges at designated points, etc.

70 In the first minimum rehabilitation campaign, which commenced in May, 1998, Rs 1,290 million (US$35 million) was spent on works in the May-June 1998 period. Interest of WUAs was such that many of the works originally anticipated to be done by contractors under I&CADD were instead done by the WUAs, with more timely and satisfactory results.

71 A NICNET (satellite communications) system is planned by Andhra Pradesh for state-wide communication. Within major schemes, a dedicated monitoring system (DMS) with VHF communications will be established.

Improving Agricultural Technology

3.35 On-Farm Water and Agricultural Technology: System improvements should also be accompanied by upgrading of on-farm water management and agricultural technology. Especially where irrigation has been unreliable, Indian irrigated farming techniques are still largely governed by subsistence and risk-averse practices, with resultant low yields. Knowledge of crop water requirements can be improved, water delivery to crops is basic (typically through crude field channels, and often field-to field in eastern India), whereas improved field channels and drains, and increased use of pipe delivery systems and drip irrigation can substantially improve the productivity of water use. Improved varieties, biofertilizers, micronutrients, integrated nutrient, weed and pest management, and other technologies can substantially improve agricultural productivity, especially where water delivery is assured, justifying more intensive practices. Field visits clearly demonstrate farmer interest in accessing improved agricultural knowledge and technology, but existing extension services typically have difficulty reaching farmers. Part of the problem is that AD staff are not adequately trained in irrigation agronomy. Access to farmers is also difficult. The need is to provide existing AD staff with the incremental access to research, knowledge, and equipment for training and demonstrations, and to establish a mechanism where they are in close contact with the farmers and their ID colleagues, and where the clients are primary motivators to AD staff. A natural new medium for contact between the AD and irrigated farmers will be provided through functioning WUAs. Contact with private businesses, cooperatives, and banks will also be made easier.

3.36 Each state should examine the possibilities for enhancing agricultural technology and more intensive use of water. The following are examples of planned or current piloting efforts. Under the Orissa WRCP, successful scheme-level WUAs will be given the option and investment assistance to construct an "Apex Committee Center" in their scheme comprising a meeting room[72], and offices for the WUA committee, DOWR engineer and an AD subject matter specialist. The AD is being provided with funds to upgrade staff training, improve linkages with research centers, conduct demonstrations, and purchase training equipment. In Andhra Pradesh, the AD is also being provided with assistance to upgrade training and extension capacity for irrigated agriculture, including contracted assistance from universities and research centers. Additionally, one progressive farmer will be selected by each WUA to receive intensive training, conduct on-farm demonstrations of more intensive irrigated agriculture, and act as the WUAs "agricultural motivator". NGOs or agribusinesses can also be encouraged. The Chamber of Commerce in West Bengal is sponsoring NGO activities to help farmers diversify agriculture to higher return production. Agribusinesses (canneries, food processors and packagers) can also be an important source of crop intensification and diversification, and as in other countries, can be expected to help forge new opportunities.[73]

3.37 Refocusing and expanding crop diversification efforts: The main objective of crop diversification should be to increase the value of production per unit of water. Crop diversification

72 The meeting room will double for both WUA meetings and as a training center, with training in areas jointly identified by the WUA, ID and AD.

73 Financially assisted respectively under the Orissa WRCP and Andhra Pradesh Economic Restructuring Project (World Bank), and the Bharat Chamber of Commerce, West Bengal.

efforts can be further intensified, moving from wheat, paddy and traditional pulses to high-value fruits, vegetables, berries, spices, medicinal plants, aromatics, and flowers, and products for processing, for both the domestic market and export. Flower production in Maharastra, first for the Mumbai market and now for exports, is one of many Indian examples. Chile, a tiny country with 15 million people, exports US$1.2 billion in such commodities a year. India could likely export much more than it does at present. Attracting private sector interests, and facilitating initiatives by local farmers and entrepreneurs would likely be the principal source of such innovation, and would have greater opportunity where irrigation delivery is reliable.

3.38 Government efforts at diversification - worldwide - have faced two obstacles: the lack of existing markets for many of the commodities, and the incapacity of human beings generally to predict the future and choose the winners. These have led to many failures through the world. It is critical to grant farmers the right to move water from command to non-command areas, and to give them freedom to crop. While the vast majority of farmers will continue their business as usual, a few more entrepreneurial and better located ones will try to grow bananas, citrus trees, flowers, or other crops on neighboring uplands. Their enhanced income will soon attract the interest of neighbors in similar locations. Similarly, moving away from field-to-field and other basic water conveyance to more precise volumetric water deliveries--and rights--would allow farmers to plan their water and cropping pattern, and pay for the level of water service they individually need.

Improving Design and Construction Quality

3.39 Design: Design procedures and standards also need attention. A strategic issue is the design objective for irrigation. Current design still tends to be influenced by India's historic concern with "protective" irrigation; i.e., assurance against famines. Designed irrigation intensity is deliberately low, averaging about 130% and comprising typically about 90% in the main kharif (monsoon) season and 30% to 40% in the rabi season. There is then, because of social pressures to maximize area coverage, a tendency to overstate water availability through the analysis procedures used. Dependability is based on averages rather than statistical analysis of demand, which would better show the peak demands in dry years. Irrigation efficiency is systematically over-estimated at 55% to 60%, compared with actuals in India's predominantly unlined systems of 35% to 45%. There is thus, a large shortfall in performance relative to assumed potential to irrigate. In reassessing POMs and rehabilitation/modernization programs for existing systems, and establishing design for new investment, realistic assumptions should be used and discussed with farmers and local politicians.

3.40 Construction Quality: This also needs to be an attention area, as much for construction in maintenance, rehabilitation and modernization as for construction to build new schemes.[74] In particular, where construction activities are widely dispersed (the inevitable case for all activities related to maintenance and rehabilitation), monitoring and management of construction quality has proven difficult in most states. Encouragingly, several states are introducing improved construction quality procedures based on established USA Bureau of Reclamation practices. The procedures being developed should be further encouraged to full application in the states concerned, and other states

[74] Construction quality in India is highly variable, ranging from excellent--e.g., machine lining in some schemes in Gujarat, construction of the Solani Aqueduct in Uttar Pradesh--to very poor, even possibly within the same state.

should also take steps to introduce them.[75] For maintenance, rehabilitation and modernization, several further steps should be introduced. First, WUAs should be brought into construction supervision and monitoring. While the engineering cadre will need to advise on the more technical aspects, common contractor deficiencies such as skimping of cement or inadequate curing of concrete are readily apparent to community observers, with a direct stake in the quality of the work. Second, WUA cost sharing will add to the financial stake involved and the interest of the WUA. Third, much of the work can be done by the WUAs themselves, either directly on the lower systems with their own or part of their own funds, or as the contracted party for simpler main system work.[76]

[75] Advisory visits by construction experts S. Guy (USBR) and R.K. Malhotra (ex GOI/World Bank) have been made to Orissa, Haryana, Tamil Nadu and Andhra Pradesh at the request of those states. The advice provided comprised technical points, the establishment of construction quality control and assurance procedures, staff training and institutional capacity building. A system of "OK cards", and lab-testing procedures, training and quality auditing, as well as adjustment in contractor supervision and other practices are central to the improvement program.

[76] The emerging experience in Andhra Pradesh during its first season of rehabilitation (1998), where WUAs took on even more of the construction than had been envisaged, is encouraging, and should be assessed for lessons and possible improvement and replication.

IV. STRATEGY AND ACTION PLAN

A. ADJUSTING TO THE NEW CHALLENGES

Shifting Emphasis to Performance Improvement

4.01 The new strategy will entail shifting from the past near exclusive reliance on irrigation expansion, to emphasis on performance improvement. While in some states and river basins prospects for further expansion of irrigated area remain, even in these states new construction should be balanced by much greater effort to preserve and enhance the productivity of existing irrigation. In most states productivity enhancement will be the primary source of future growth of irrigated agriculture. Irrigated agriculture is likely to remain the main source of agricultural growth in India, yet the technology of the Green Revolution of the 1960s and 1970s has now largely been adopted. Future growth will need to be based on a "second revolution".

Introducing a "Second Revolution in Irrigated Agriculture"

4.02 The Green Revolution was based on the radically new environment created by transition from rainfed to irrigated conditions combined with use of high yield varieties and fertilizer. This enabled a jump in the production frontier, despite the fact that both surface and groundwater irrigation, while much more productive than rainfed conditions, were still far short of their production potential. The "Second Revolution in Irrigated Agriculture" must now tackle the productivity gap *within* India's irrigated agriculture. Just as the first revolution was based on radically different conditions, the second revolution will similarly require radical change. This time, easy technological transformations (new water, seed and fertilizer) are not evident. Radical change must come instead from how the irrigated agriculture sector is managed. Fortunately, ample scope exists, but the changes now required relate to the organization of the sector and the establishment of incentives to influence the key actors involved.

Establishing an Incentives Framework

4.03 Establishing an incentives framework for change will in particular depend on giving the client (farmers) empowerment and responsibilities. Institutional change is the key need. As the primary stakeholders, farmers will need to drive the incentives for reform. The service entities need to be either managed by the clients (WUAs) or accountable to the clients through WUA involvement in their management and because the agencies are financed by and accountable to the farmers. In turn, by paying for the services, farmers will be responsible for the level of service that they receive, and performance incentives will be provided to government and private service providers, as they will need to satisfy their customers. Establishing this incentives environment is essential if the irrigation sector is to significantly improve in a sustainable manner. The current absence of this framework is the primary reason why, although the problems of the irrigation sector are well known, resolution has proven so difficult. The farmers are not involved and the government agencies have no intrinsic

incentives to perform. Despite many dedicated staff, change is difficult where incentives are entirely internal rather than to the clients.

B. Reform Agenda And Action Plan

The Reform Agenda: Creating the "Virtuous Circle"

4.04 Transforming the "vicious circle" of low performing irrigated agriculture to a "virtuous circle" of productive and sustainable use of water for high productivity agriculture will require a comprehensive and interlinked approach. The key features required are:

- **Irrigation Management Transfer to farmers:** Formation of WUAs, turnover of lower system responsibilities to WUAs and involvement of WUAs in higher system and sector management.

- **Reforming the Government Agencies:** Unbundling and restructuring of government irrigation and drainage agencies including creation of commercially managed service agencies funded by WUAs, decentralization of management along river basin and irrigation scheme lines and provision of opportunities for private sector involvement.

- **Achieving Financial Viability:** Transforming from inadequate water charges and dependency on government for O&M to de-linking from government financing and financial self-sufficiency for both WUAs and irrigation service agencies, with WUAs and service agencies directly collecting and retaining water fees.

- **Upgrading Irrigation Systems:** Full funding of O&M needs by users and assistance by government under cost sharing arrangements to rehabilitate and modernize irrigation systems.

- **Improving Agricultural Services:** Refocusing AD services to support agricultural intensification needs of WUA farmers through partnership with WUAs and IDs/WSAs.

- **Monitoring, Transparency and Public Involvement:** Exploiting all opportunities to involve WUAs and civil society in sectoral monitoring and decision-making.

Action Plan

4.05 The Action Plan for the Reform Agenda is presented in the Matrix (pages 55 to 60) which summarizes the detailed implementation features from Chapter III. The matrix also indicates responsibility and suggested time-frame.

4.06 A State Specific Approach: Given the diversity of physical, institutional and social conditions in India, it would not be appropriate to consider the action plan as a standard "blueprint" for all states. The reform agendas need to be state specific and individually tailored to the conditions and needs of each state. Most states would find that the action areas discussed in Chapter III and the matrix would broadly apply. The need for tailoring is likely to apply more to specific modalities, desirable pace and sequencing of the reforms. For instance, a state with minimal experience with WUAs should pilot a WUA approach before embarking on a large scale program.

4.07 The Need for Boldness : It is recommended that the states' planned reform agendas should be both *comprehensive and bold*. For ultimate success all elements of the virtuous circle need to be tackled synergistically as the actions are complementary to each other and reinforce each other. In actual implementation a step wise approach may be needed, but a vision of the full intended agenda needs to be established from the outset.

4.08 It is noteworthy that countries that have vigorously implemented reform agendas--e.g., Mexico, Turkey, and as now commencing in Andhra Pradesh--are demonstrating more success than gradualist approaches. Thus, WUAs have been promoted for years in a number of states, but have remained as marginal players in irrigation management. The need for full funding of maintenance and cost recovery has been recognized as a key need for decades, but no state has yet taken the complete actions for ensuring that this is achieved. While several WRCP states and Andhra Pradesh have significantly stepped up government maintenance allocations, cost recovery is still not at required levels and revenues do not yet go to the implementing agencies, thus not fulfilling the financial self-reliance required under the virtuous circle. Several states are experimenting with private sector financing through bond markets. However, until irrigation is financially viable such efforts will add to state debt burdens. In the institutional arena, most states are making efforts to upgrade the effectiveness of their IDs, and significant improvement from previous capabilities can be noted in such states as Orissa and Tamil Nadu. But the effort is relying on present government commitment and is not yet driven by client-pressures from farmers. Until the service agencies are paid for by the client and necessarily responsive to client needs, institutional effectiveness will remain dependent on continued government commitment and will tend to falter under new staffing, economic or political circumstances. The failure of the government apparatus in Mexico and Turkey, which, under financial pressures, could not finance maintenance, led to collapse of the irrigation systems, and realization that the key needs were providing responsibility to stakeholders, self reliance and financial self sufficiency.

4.09 Adaptive Implementation: While the reform agenda should be far reaching in its overall policy intentions and should be very specific in terms of detailed implementation actions in at least the short and medium term, there is also need for flexibility and continuous adaptation during the reform process. The degree of change required will mean that lessons will be continually emerging as change

is implemented. Recent reform programs in Mexico and Turkey have been characterized by the need for adaptation. Similarly, in Andhra Pradesh, only a year into its reform program, adjustments are being made as experience is gained. For instance, the degree of WUA interest has necessitated an acceleration of the intended pace of the deferred maintenance program, and WUAs have assumed a larger role in civil works than had originally been planned. In general, it is expected that as reforms are implemented, they will in turn give rise to further opportunities, often beyond the original expectations.

Roles of State and Central Governments and Civil Society

4.10 State Governments. The primary responsibility for change will be at state government levels. Irrigation management is a "state subject" under India's Constitution and all implementation is handled at the state level. The state governments would each need to initiate the reform process as, presently, government is the only decision-making actor in the sector. State governments should, however, seek to engage the non-government sector in planning and implementing the reform agenda: civil society, academics, NGOs, the private sector and, in particular, the farmers.

4.11 Central Government. Central government has a key role as a provider of policy advice and in facilitating and financing state reform agendas. A core role should be *awareness building and technical assistance*. The center (MOWR and its member agencies, Ministry of Agriculture (MOA), Planning Commission, Ministry of Finance (MOF) and other involved ministries and agencies) should build an active outreach program to state governments and civil society to encourage change. This can include: organizing workshops and study tours on best practice; issuing bulletins and news letters documenting issues, innovations and achievements both from within India and internationally; and encouraging the academic community, research centers, NGOs and the private sector to get involved. Secondly, *financing* can be used to facilitate change. Particular receptivity should be given to financing state reform programs. At time of Plan reviews of proposed state investments, MOWR and the Planning Commission should review a state's progress with its reform agenda. Centrally sponsored schemes should also be considered to help finance state reform agendas or to facilitate innovation and linkage between government and non-government sectors. One such option is the proposed WRRITP. This would provide grant contributions to proposals from states, research agencies, NGOs and private parties (including encouraged links between national and international parties) for relevant training, piloting, research and other activities promoting change.[77]

4.12 Civil Society and the Private Sector. India has a thriving resource of academic institutions (universities and research centers), NGOs, consulting firms and private individuals from which to draw on. Some of these are already actively involved in the irrigation sector but more can be done to integrate their skills and energies. Universities and research center programs can more directly support irrigation improvements and innovation, and the proportion of NGOs involved in irrigation can be

[77] The WRRITP has been proposed for World Bank financing, and is currently in preparation stage. As currently envisaged, it would involve creation of a National Water Resources Research, Innovation and Training Council, to oversee and implement grant funding provisions to assessed useful proposals fostering change and capacity building.

increased.[78] Private business can also be more involved: investment partnerships between WUAs and local agribusinesses; contracts with private firms for scheme management or selected activities; and the development and promotion of new technologies. Integrating these major resource potentials will need active encouragement by the central and state governments in a partnership approach. As farmer organizations develop, WUAs will become the major players in the irrigation sector, in partnership with government, civil society and the private sector.

C. GETTING STARTED

State Level Start-up Actions

4.13 The first action would be for a state to prepare an *Irrigation Sector Policy (ISP)*. The ISP would comprise a candid diagnostic of the state's irrigation and drainage sector and irrigated agriculture, a vision of the sector's future needs, a reform agenda to get there, and a detailed implementation plan, the latter emphasizing the short and medium-term agenda.

4.14 To prepare this, the state could establish a small task team consisting of academics, NGO, farmer and private sector interests; and, from government, irrigation, agriculture and finance practitioners. It would be important that the team is multi-disciplinary, with skills as much in economics, finance and social organization as in technical aspects. In order to practically prepare the ISP, a small core team may be desirable reporting to a larger group.

4.15 Preparation of the ISP would need both a reflective and conceptual approach as well as a strong basis in the realities of the state situation. In particular, the needs and views of the irrigation users should be strongly integrated through field visits and village, district and state level discussions and workshops. In parallel, it would be helpful for the task team to visit reform experiences elsewhere, both in India and internationally, and also to observe relevant experience from other sectors. Thus, in India's irrigated agriculture sector the developing experience in Andhra Pradesh, the WRCP states, West Bengal (for farmer managed community groundwater irrigation) and selected successful scheme level interventions in a number of other states could be examined. Internationally, Mexico and Turkey provide good examples of recently initiated major reform programs, while countries such as Australia, the U.S.A. and Chile provide examples of further evolution. Nearer to India, Nepal's experience with WUAs, and the just commencing program in Pakistan to create irrigation and drainage public utilities (equivalent to WSAs) could also be of interest. Experience from other sectors in India is also relevant. Power sector reforms in states such as Orissa contain many of the features ultimately desirable in irrigation. Some of the more modern urban water utilities (e.g., Hyderabad, Chennai, Ahmedabad) have implemented corporate and financial management improvements of relevance in establishing WSAs. The management practices of successful major businesses. would also have relevance. In

[78] NGO involvement is, however, rapidly building in some states. NGOs have, for instance, been actively and successfully integrated in Orissa, Tamil Nadu and Andhra Pradesh for facilitating formation of WUAs and in implementing resettlement and rehabilitation programs. Amongst other states where NGOs have played positive roles are: Maharashtra, Rajasthan and West Bengal.

community organization, there are many successful examples from other sectors, for instance, the dairy cooperatives (e.g., Gujarat), rural water supply and sanitation (e.g., Uttar Pradesh and Karnataka) and sodic lands reclamation (e.g., Uttar Pradesh).

4.16 Public consultation and outreach needs to be an integral part of ISP preparation. Stakeholder involvement during the diagnostic, conceptual and planning stages is a self-evident need. In the later stages of preparation, public outreach would need to be a major activity involving strong political commitment from the top and a concerted effort by the irrigation, agriculture and revenues departments together with civil society leaders such as rural based NGOs. Ownership and commitment are essential for successful implementation of the reform program. An excellent current example of such state commitment and major mobilization of the farming community is being implemented in Andhra Pradesh's irrigation sector reform program. Mexico and Turkey also offer good examples of public outreach.

Central Level Start-up Actions

4.17 The National Workshops on the Water Resources Management (WRM) Sector work program, of which this Report is a component part, have launched an intensified dialogue on the water sector. This process should continue with further build-up of promotion and outreach activities from central government to state governments and civil society. Financial facilitation to state government reform programs should also be considered. To facilitate cross-ministerial interaction, it is recommended that a GOI irrigation sector steering group be established including both government and non-government representatives. From government, key ministries would include: MOWR and its agencies, Planning Commission, MOA and MOF as well as some state government representatives. Academics, NGO and the private sector would also be strongly represented.

ACTION PLAN FOR THE REFORM AGENDA

N°	Recommendation	Responsible	Time Frame
A.	**INSTITUTIONAL REFORMS AND REORIENTATION** Main action areas are: (i) promoting irrigation management transfer to WUAs; (ii) restructuring state irrigation institutions; and (iii) involving the private sector in irrigation service delivery and technology dissemination.		
A.1	**Promote Irrigation Management Transfer (IMT)** OBJECTIVE: An irrigation system responsive to users' needs, operated at lower costs, allowing users to make most O&M decisions, and creating self-reliant, financially autonomous irrigation schemes primarily managed by WUAs.		
A.1.1	**Launch Major Drive to Promote WUAs and IMT:** • Review State, India and International Experience • Discuss with Civil Society, Farmers and in Political Fora • Devise Comprehensive Program and Prepare all components in Detail (Pilot as needed) • Major Outreach Program, staff training and farmer workshops • Organize and hold WUA elections • Implement Major WUA support program including WUA organizational support, Systems Rehabilitation and Improvement, and Agricultural Support	State task team, state government/ID ID and NGOs " ID, AD and NGOs "	short term " " short term as soon as ready "
A.1.2	**Implementation Features for Successful WUA Formation & IMT:** (i) Democratic Grassroots Base; (ii) Demand and Client Led Approach; (iii) Financial Viability; (iv) Supporting Legislation; (v) Whole Scheme Approach; (vi) Accompanying Investment and Technical support; (vii) Major Government Mobilization and Political Commitment; (viii) Participation of Women and Minorities; (ix) Water Rights for Farmers and WUAs	ID/WSA & WUAs, and State Govt.	short term

N°	Recommendation	Responsible	Time Frame
A.2	**Restructure State Irrigation Institutions** OBJECTIVE: Demand-driven and decentralized; up-to-date on managerial technologies; accountable and self-financing; managerial transparency with farmers and other stakeholders.		
A.2.1	**Restructure and Unbundle Governments Role:** • **Unbundle Irrigation Department:** To: (i) Water Service Agency(s) (WSAs) for O&M funded by WUAs; (ii) State Water Resources Board for intersectoral water allocation, planning and management; (iii) regulatory body for water resource management; (iv) Regulatory body for water pricing; and (v) smaller ID for remaining government functions (e.g., design, construction supervision, investment funding)	State Govt./ID	medium term
A.2.2	**Establish Water Service Agency (WSA):** Commercially operated O&M agency, funded directly by users (WUAs), and answerable to WUAs. (one - or several by major basin/command - per state)	State Govt./ID	medium term
A.2.3	**Improve the ID/WSA(s):** (i) Decentralize management on basin lines; (ii) Reorganize to create specialist units including corporate management capabilities; (iii) Upgrade staff skills (training), expand skills mix including non-engineering disciplines; and (iv) Improve staff incentives for specialization, continuity and good performance.	ID/WSA	short term
A.2.4	**Create a Farmer-Government Partnership:** Cultural change in ID/WSA & AD : clients service, demand driven approach, and WUA/, ID/AD Partnership; and Government, WUA/Civil Society Partnership actively involving NGOs, universities and outreach to public	ID & AD	short term
A.3	**Involve the Private Sector** Objective: Bring additional actors into the irrigation sector with stronger commercial orientation, innovative ideas, corporate management and other skills and financial resources.		
A.3.1	**Unbundling and Contracting Out** of activities where private sector has comparative advantage	State govt. and ID/WSA .	medium term

N°	Recommendation	Responsible	Time Frame
A.3.2	**Involve & encourage private sector** in promoting innovations	ID/WSA and private sector	short-term
A.3.3	**Management Contracts for Scheme Operations** (e.g., agribusinesses)	WSA/WUA	medium term
A.3.4	**Management Contracts with ID/WSA for specific activities.**	ID/WSA	medium term
B.	**ACHIEVING FINANCIAL VIABILITY AND SUSTAINABILITY** Objective: Achieve cost recovery, financial viability, adequate O&M funding, appropriate government expenditure priorities, and access to credit, private sector investment and capital markets		
B.1	**Achieving Full Cost Recovery and Financial Self Sufficiency:** Objective: ID/WSAs and WUAs to be self-financing for O&M, contribute to investments and build financial capacity. Also improve efficiency of O&M, introduce independent (non-political) price regulation, and pilot water markets		
B.1.1	**Raise Water Charges to Cover O&M Costs, Collection by WUAs and WSAs and Volumetric Pricing:** (i) Substantial increase in water charges to cover O&M; (ii) Improve collection rates; (iii) Charge non-agricultural uses; (iv) Collection by WUAs and WSAs and retained by them; and (v) Transition to volumetric bulk sales to WUAs/ other users.	ID/WSA and WUAs	immediate to short-term for (i) to (iii); and 2 to 3 yrs. for (iv) & (v)
B.1.2	**Build Financial Capacity**: Create "Renewal Funds" for WUAs/WSA	WSA and WUAs	medium term
B.1.3	**Investment Cost Sharing**: WUAs to contribute a share of investment costs in rehabilitation and modernization.	WUAs with WSAs	immediate introduction
B.1.4	**Improve Efficiency of O&M:** through Improved Management, Client-Driven Oversight and Transparent Billing and Cost Monitoring.	ID/WSA and WUAs	Continuous
B.1.5	**Introduce Independent Price Regulation**: pricing as commercial decisions between WSAs and WUAs with regulatory safeguards: (i) establish independent state Water Tariff Board (WTB); (ii) alternatively, first establish a state Water Charges Review Committee (WCRC) for annual reviews and decisions as an intermediate step.	State govt.	short-term (for WCRC) or medium term (for WTB)
B.1.6	**Assess and Pilot Water Markets:** assess international experience with	GOI and interested states	medium term

N°	Recommendation	Responsible	Time Frame
A.3.2	**Involve & encourage private sector** in promoting innovations	ID/WSA and private sector	short-term
	formal water rights and water markets and undertake piloting.		
B.2	**Prioritize Expenditures** Objectives: Increase effectiveness of available government expenditures by prioritizing funding to improving irrigation sector performance and capacity building, focusing remaining funds on a limited number of works sites to successively complete viable investments. Establish self-selection and expenditure and investment review procedures to implement these objectives.		
B.2.1	**Re-order Government Expenditure Priorities** to emphasize: (i) full funding of maintenance works (applicable in transition phase until cost recovery fully covers O&M); (ii) full funding of institutional capacity building (training, computerization, communications equipment, consultants, study tours); (iii) rehabilitation and modernization in association with WUAs; (iv) sharply focused remaining funds on a limited number of sites at any one time for near-term completion.	State govt. and ID	immediate and continuous
B.2.2	**Introduce "Drivers" for Achieving Expenditure Prioritization**: (i) self-selection through cost sharing/participation; (ii) annual irrigation expenditure reviews by states; (iii) use of discounted cost-benefit procedures; and (iv) improved technical evaluations of investments.	ID and State Govt.(with advice from MOWR, Planning and Finance Commissions)	short-term and continuous
B.3	**Access to Credit, Private Sector and Capital Markets** Objective: Build financial viability and procedures for access to credit, private sector investment and capital markets (fundamentally depends on full cost recovery including on depreciation and interest.		
B.3.1	**Review Microfinance Opportunities:** review opportunities and modalities for viably expanding credit. Especially target groundwater irrigation and intensify on-farm water management.	NABARD with private sector, MOA and MOWR	short to medium term
B.3.2	**Promote Private Sector Investment and Capital and Debt Market Financing:** Form working committee to examine issues and options	GOI and private sector	medium term

N°	Recommendation	Responsible	Time Frame
C	**TECHNICAL ACTIONS TO IMPROVE IRRIGATION PERFORMANCE** OBJECTIVE: Improve performance of irrigation systems and increase agricultural productivity		
C.1	**Improve Water Operations Management** Undertake participatory scheme diagnostics and prepare POMS for improved operational efficiency, equitable water distribution, better water control and timely delivery of water.	ID & WUA in assocn. with AD	1st Field Action
C.2	**Upgrade Maintenance and Rehabilitate and Modernize Systems**		
C.2.1	**Full Annual Maintenance:** • Full funding of annual maintenance to required levels (by Finance Dept. (FD) until full cost recovery achieved. Then by WUAs and ID/WSA • Jointly (WUAs and ID) prepare annual Maintenance Plans for each command • Joint monitoring of maintenance by WUAs and ID (works & costs) • "Professionalize" planning and implementation of maintenance (staff training, equipment & modern maintenance planning, management and monitoring techniques);	FD, WUA & ID/WSA	Immediate 1 year and continuous
C.2.2	**Rehabilitate Surface Irrigation Schemes** • Undertake irrigation and drainage scheme rehabilitation by WUAs and ID/WSA (jointly identified and implemented program) • appropriate cost sharing arrangements to ensure client "ownership" and demand-led investment	WUAs & ID/WSA WUAs	Short term start demand led
C.2.3	**Modernize Schemes** • Undertake further scheme level improvements for higher levels of agricultural productivity (Jointly identified and implemented with cost)	WUAs and ID/WSA	medium-term
C.3	**Improve On-farm Surface and Groundwater Delivery** • Improve water courses, field channels and field drains (by WUAs with TA from ID/WSA) • Introduce drip and sprinkler irrigation (by individual farmers with private sector and NABARD) • Upgrade energy efficiency of tubewells and pumpsets (research, demonstrations, private sector) • Improve WUA/farmer knowledge of on-farm water management and crop needs	WUAs Farmers and private sctr. AD/ID/WSA & WALMIs	short to medium term

N°	Recommendation	Responsible	Time Frame
C.4	**Improve Agricultural Technology** • Upgrade farmer knowledge of agricultural technology through ag-extension and training support • Train WUA representatives as "agricultural motivators" • Promote agricultural diversification	 AD / WUAs AD/WALMI AD/agribusi.	 short term short term continuous
C.5	**Improve Design and Construction Quality** Objective: Optimize designs for intended irrigation service and ensure quality construction, both activities to involve WUAs		
C.5.1	• **Design for Appropriate Irrigation Intensity and Service** • appropriate assessment of desired irrigation intensity during scheme designs, POMs and plans for scheme rehabilitation and modernization	 ID/WSA with farmers	 Design or POM stage
C.5.2	• **Assure Construction Quality and Cost Consciousness** • Introduce Quality Control/Quality Assurance (QC/QA) procedures • Bring WUAs into construction supervision and monitoring • WUA contributions to rehabilitation and modernization construction costs (cost sharing) • WUA implementation of simpler works	 ID/WSA WUA & ID " "	 short term short term " "

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Box A1.1
Technical Improvements at Dantiwada Reservoir, Gujarat: Rotational Water Supply as a Tool for Increased Scheme Performance and Equity

The Dantiwada Scheme in Gujarat, is characterized by a shift in the management and operation of the system to address the needs of the farmers and the requirements of agriculture. The most fundamental of these shifts involved the introduction of a Rotational Water Supply (RWS) delivery concept. RWS was designed to address the multiple needs for demand and equity of distribution of available water to farmers within a command area.

The Dantiwada Dam was begun in 1958, and completed in 1965. Irrigation from the reservoir began immediately under shejpali irrigation management. Shejpali allows farmers a rotation turn of almost unlimited duration, which was found to be inappropriate in water scarce Gujarat. The scheme was switched to a RWS management system in the early 1980s. There are various types of RWS, but the basic idea is that the farmers are allocated time slots on a rotating, fixed weekly schedule (In the case of Dantiwada, the farmers receive allocations based upon their request, made prior to the irrigation season). If water is in the canal during a farmer's time slot, then he gets the water. In Gujarat, with historically low flow rates, the crops would require longer durations of irrigation to counter the low input flows and the significant seepage losses to unlined field canals. Seepage losses were especially critical to tail-end water users. In the late 1980s, the GOG began an irrigation improvement project in the Dantiwada command. This project aimed to find a way to improve irrigation service, and provide the farmers with the quantity and timing of irrigation water they desired.

A new, more equitable distribution mechanism for irrigation water within the scheme was needed. The RWS management system was introduced to the project in 1994/95, along with significant technical system improvements. The RWS has since been recognized as a good solution for Gujarat, and is popular with the farmers in the scheme. The Dantiwada RWS uses a similar rotating, fixed schedule as the warabundi system, but accounts for inherent losses in the system, and actual crop demand. The main characteristics of the RWS system are: water requirements for the major crops are considered in the rotation schedule; seasonal deliveries to individual farmers are allocated based upon predetermined schedules to meet crop water requirements (determined in consultations with the farmers regarding crop type and number of waterings needed before each season); seepage losses in the channels are accounted for so that each farmer receives an equal volume of water per unit of land; the rotation schedule is 10 days on 10 days off; and farmers are free to irrigate the crops of their choice.

The limitations of the RWS, is that it requires that the system be designed such that it reliably maintains a constant flow rate at the delivery ends of the system. The technical aspects of the Dantiwada conveyance system, therefore, are critical. Canals are lined down to the 8 chak level, with a greater density of lining than most projects in India. This decreases seepage losses, with the unintended benefit of reducing the number of illegal outlets created in times of drought. The conveyance system is designed to deliver the proportional amount of water, per unit land area, to the outlet at each distributory. The control mechanisms to achieve this are a complicated array of gates and weirs within the distribution network from the dam. They maintain the water level in the canals such that the delivery point, depending on area, receives the correct volume of water. This system was designed with the assumption that the supply from the dam would always be available.

Skilled gate operators throughout the network are responsible for maintaining the water level and flow rates in the canals constant. They record the water levels at cross regulators every four hours. If it is within plus or minus - 0.5 in. from a known level (based upon what area's turn it is in the rotation), no action is taken. If the level is more than 0.5 in. off, the operator communicates both

upstream and downstream for the gates to be adjusted to bring the system back into operating specifications.

Large scale changes in the water distribution methodology from shejpali to RWS were possible due to education and training done by the Water and Land Management Institute. The intensive training and education program, for the scheme workers and the farmers on the RWS distribution mechanism, facilitated the success of Dantiwada. Intensive training of the operators in the distribution system was also required, due to the relatively active role, in this RWS, that canal management plays in proper delivery.

Dantiwada is a successful modernization project. From a traditional system that provided poor and inequitable service to farmers; the RWS system coupled with the development of an effective control and regulatory system within the distribution system now provides service according to the farmers needs.

Features of the Dantiwada scheme that were not emphasized, include cost recovery; and farmer involvement in the scheme functioning. Water fees collected for the project are charged on a season and crop type basis. They represent about half of the annual O&M budget of the Irrigation Department. WUAs did not have much of a formal role in the reform process of the scheme. There is only one WUA. The GOG has provided an economic incentive for farmers that form a WUA and change to volumetric deliveries, by decreasing the water charge to half. It is unclear why more WUAs have not been formed, and this kind of subsidy-based incentive may not be appropriate.

While the WUAs have not been as successful as hoped, it is important to realize that the Dantiwada Reservoir Project was focused on the technical aspects of system performance and delivery, and not the formation and capacity development of WUAs. Dantiwada should now look to develop the capacities of it's user groups, become a financially autonomous scheme, with full cost recovery and farmer involvement. Relying on constant government help, both technically and financially, is not viable in the long term.

Source: Adapted by Keegan Eisenstadt, World Bank., based on S. Styles and H. Plusquelleq (1997) (India--WRM Sector Review, World Bank, 1998).

Box A1.2
Bhadra Scheme, Karnataka: Impact of NWMP and Lessons Learned

The Bhadra irrigation project was constructed during the period from 1948 through 1966. The scheme draws water from the Krishna River, and has been allocated 1,747 Mm^3 by the Krishna River Tribunal. The diversions at Bhadra in the 10 year period 1975 through 1984 ranged from 1,524 Mm^3 to 2,078 Mm^3, with the diversions exceeding 1,881 Mm^3 in 9 of the 10 years. It is pertinent to observe that the allocation by the Krishna Tribunal is a constant amount independent of the actual flows in the river, as Andhra Pradesh had opted to absorb all the variations above and below the amount determined as available for allocation. Thus, in 9 of 10 pre-National Water Management Project (NWMP) years the Tribunal allocation had been exceeded at Bhadra.

Pre-NWMP Conditions. The Government of Karnataka (GOK) recognized the problems with inefficient water use and delivery within the scheme, and its ramifications on the state's allocation according to the Tribunal. These factors combined with: the rapid deterioration in system condition due to the breakdown of the Water Resources Department's management; the inequitable distribution of irrigation supply; and the aggressive manifestation of farmer dissatisfaction led the GOK to begin an irrigation improvement program for the scheme. As part of this program, the GOK decided it would be necessary to develop an appropriate water distribution system and design rehabilitation programs of the physical system to make the new policy workable. It was also necessary to bring down water use at Bhadra to the allocated amount.

The NWMP Program. The GOK, with the World Bank assisted NWMP, commenced work on the Bhadra scheme in 1987. The main objective was to increase productivity and farm incomes through a more reliable, predictable, and equitable irrigation service. The project used a two part strategy. One aimed at developing the **institutional capacity** to plan, implement, and monitor improved O&M practices; and the second consisted of **low cost infrastructural improvements** designed to support an improved operational plan. The most important element of the strategy and scheme formulation was thought to be the preparation of an **operational plan**.

Impacts of the NWMP. Evaluation of the scheme in 1994 by the International Irrigation Management Institute noted significant increases in irrigated area during the rabi season. In the head end (Upper part of Malebennur Branch Canal) irrigated area had increased from about 20,000 ha. (about 65% of design) to over 29,000 ha. (95% of design). In the lower part of the same canal, irrigated area more than doubled from around 4,000 ha. to around 9,500 ha. (82%). Other parts of the command reported having between 30% to 40% increases in irrigated area between pre-NWMP and post-NWMP intervention.

Cropping Pattern. Analysis of data on cropping pattern changes shows that, in general, the area cropped is higher in both seasons after the NWMP in all distributaries. Particularly, area cropped under paddy is significantly higher in all distributaries. The largest percentage change in area under paddy, found in Distributary 10 of the Malebennur Branch canal, shows an 87% increase in kharif and 70% in rabi. Area planted in sugarcane increased as well. No noticeable change was found for the planting of garden crops.

Value of Crops. Gross value of output per hectare (GVOH) post-NWMP was higher in all distributaries than pre-NWMP. Significant variation between distributaries were noted with respect to GVOH, however, and the changes may reflect, in addition to the effect of NWMP, other factors such as sugar mill expansion, changes in relative prices of food crops, use of other inputs such as fertilizers, etc.

A comparison of three distributaries in terms of Gross Value of Output per m^3 of water diverted to the distributary showed values ranging from Rs. 3.8/m^3 to Rs. 4.5/m^3. No adjustments were made in the above calculations for differences in rainfall in the different distributaries.

Distributional Situation. During the kharif season, the distributaries were operated simultaneously at the specified kharif discharges. However, may distributaries, especially in the head reaches, were operated at higher than specified discharges to satisfy demand from water intensive cropping, and supplies to lower reaches diverged more from planned operation.

Results of analysis from two typical distributaries from head and tail reaches indicate that no definite operational plan was put into practice in either of the distributaries. In fact, examinations of the operation after the physical works were completed, indicated that the water distribution practices adopted were significantly different, in many respects, from the water distribution prescribed for in the operational plan.

Lessons Learned. There were many reasons for the divergence from the operational plan. Most importantly were the changes in the cropping pattern experienced after system rehabilitation and maintenance, the 100% irrigation intensity in rabi season and the inability to effectively integrate kharif rainfall into the operations. The issues noted above brought to the fore a critically important issue in irrigation sector reform, the need for adaptive management.

The Bhadra NWMP was initiated with great emphasis on the physical works to be accomplished on the conveyance system and the irrigation infrastructure. Early in the NWMP process, this was the focus. Inefficient delivery and water use were resolvable through physical works. The farmer participation components of the Bhadra project were not carried out. The inability to maintain distribution at levels predetermined in an operational plan was determined more by insufficient institutional capacity and farmer involvement than the condition of the infrastructure. The major lesson from the Bhadra scheme NWMP, was that the infrastructure is a critical part of successful irrigation improvement. However, as noted by the system performance after the O&M interventions, the need to include: institutional capacity development; farmers participation (through WUAs or other means); O&M management; cost recovery; monitoring; planning; management information systems; financial autonomy; and agricultural extension in future irrigation improvement was clear.

Finally, it is to be noted that Bhandra was one of the more successful scheme improvements under the NWMP. Elsewhere, weaknesses such as the above, and inappropriate design and implementation often had more apparent impact, and, hence, disappointing results.

Source: International Irrigation Management Institute, 1995. Evaluation of Schemes under NWMP: Bhadra Scheme and Sathanur Scheme. (India - WRM Sector Review, World Bank, 1998).

Box A1.3
Remote Sensing Applications for the Indian Irrigation Sector

Remote sensing is a unique tool with diverse applications for the irrigation sector. It can help with the identification of poorly performing sections within a command, with determining the actual distribution of water, changes in cropping patterns (from wet, irrigated dry, and garden/perennial crops), crop condition, and be used to predict productivity of crops within the command area on a per hectare basis. Given the frequency of satellite passes over India, and the variety of spectral sensors possessed by different satellites, the availability of analytical images is typically within weeks of each pass.

The National Remote Sensing Agency has been conducting near real-time satellite based evaluation of both the Bhadra and Malampuzha command areas in the state of Karnataka. The analysis was undertaken during the evaluation of irrigation reform programs associated with the NWMP, funded with World Bank assistance. Remote sensing was found to be a useful tool for both diagnostic and predictive purposes. Diagnostics of the commands included the time series collection and analysis (both frequent images within each rabi season[1] and for many years comparing rabi seasons through time[2]) of primary data on: irrigated area; cropping pattern; and the productivity of paddy, the major crop in both commands. The analysis enabled a quantifiable evaluation of the improvement in agricultural system performance from pre-NWMP to post-NWMP years. The identification of distributaries with chronically poor performance has stimulated further investigation into the causes and possible remedial measures.

The development of a satellite based paddy yield model makes remote sensing a predictive tool for agricultural outputs within the command, prior to harvest. The paddy yield model for the Malampuzha command:

$$\text{Paddy Yield} = (\text{NDVI} * 56.744 - 4721.06)\ \text{Kg/Ha}^{1}$$

(standard error of estimate is 185.88 Kg/Ha)

describes the relationship between the Normalized Difference Vegetative Index (NDVI) corresponding to the heading stage of the paddy crop, and plot yields obtained through crop cutting experiments conducted in the command area. This model improves upon conventional crop yield estimation methodology that are based upon crop area only, because it is able to take into account crop condition as well. NDVI captures the spectral reflectance of solar rays, which are affected by crop conditions (water stress, nutrient deficiencies, waterlogging, etc.). In 1994, crop condition information could be provided within four days of each satellite overpass, which was every 22 days.[3] The yield model already developed for paddy could be extended to other crops, if they can be individually discriminated in satellite images (depending upon local context and image resolution), and provided the satellite data corresponding to the critical growth stage of that crop is available.

Satellite derived performance indicators, in the case of the Bhadra irrigation system, relate to increases in the irrigated area and improvement in crop productivity after the NWMP. Spatial

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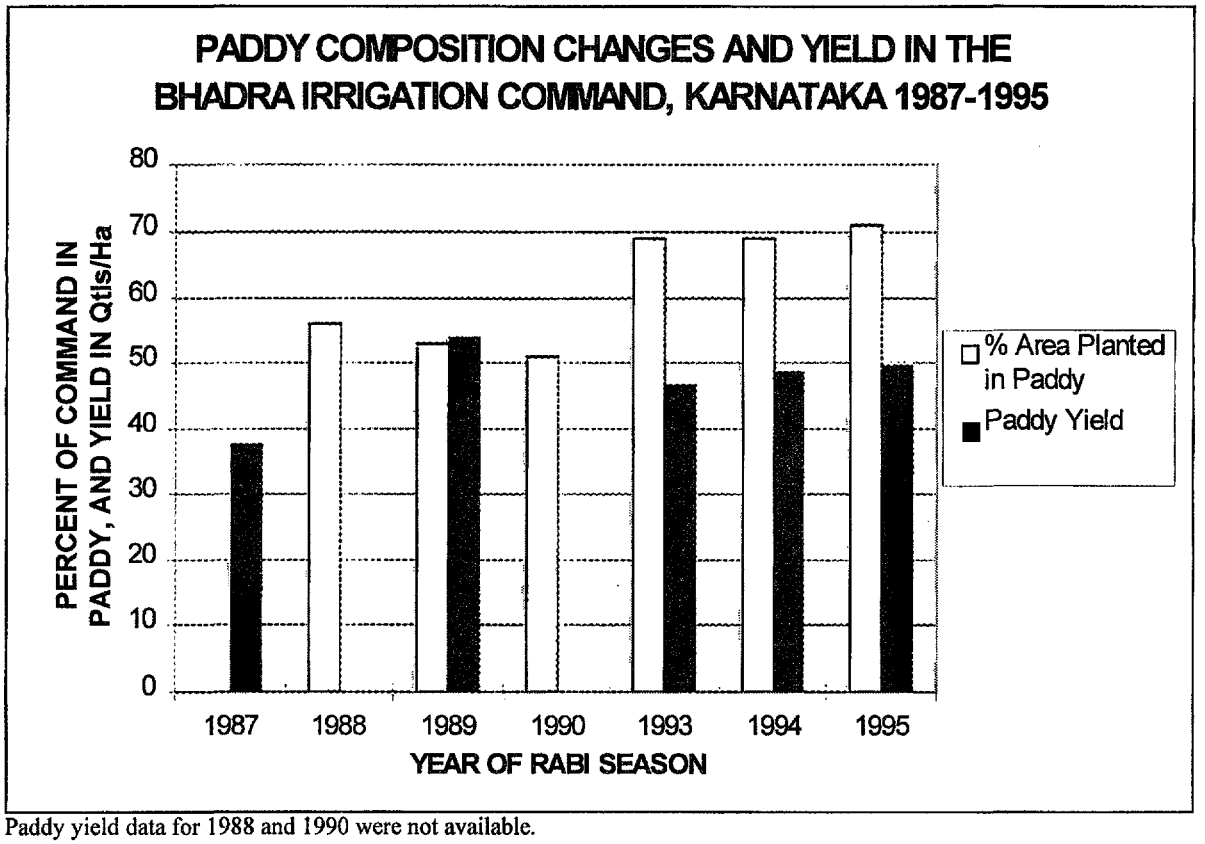
[1] Satellite evaluation of Malampuzha command area during the 1993-1994 rabi season. Water Resources Group Report, National Remote Sensing Agency. July 1994. Department of Space, Government of India. Hyderabad, India.

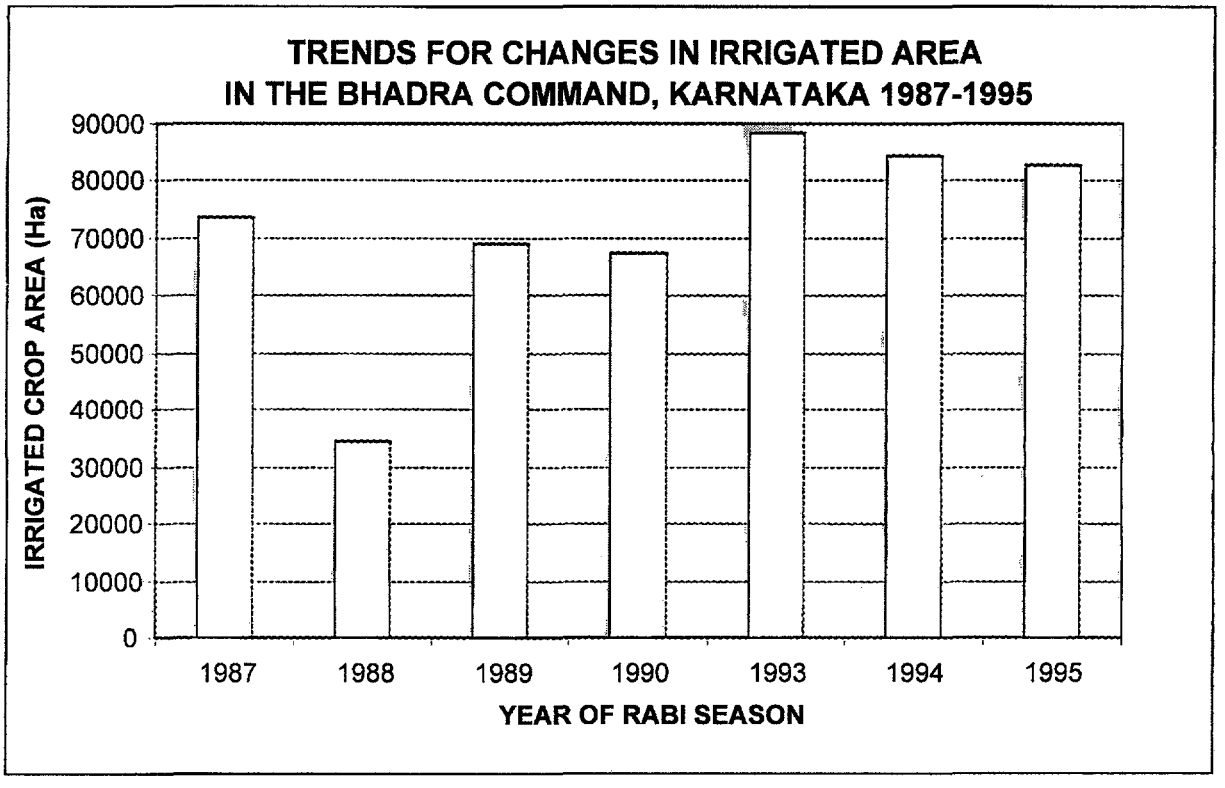
[2] Evaluation of system performance in Bhadra project command area through satellite remote sensing techniques during 1992-1993 rabi season (a supplemental report was prepared for the 1993-1994 rabi season). WRG Report, NRSA. June 1993 (1994). Department of Space, Government of India. Hyderabad, India.

[3] Satellite remote sensing applications for monitoring and evaluation of canal command areas: State of technology. WRG, NRSA. June 1994. Department of Space, Government of India. Hyderabad, India.

variability at the distributory level helped to identify problem areas with below par performance as well as inequities between distributaries and between head reach and tail reach areas within each distributary. The temporal analysis of historic and current satellite data highlights the extent of system improvements through the years, and with NWMP activities, which became operational for the 1993 rabi season. The changing cropping pattern in the command, towards greater paddy cultivation, are indicative of improvement in the reliability and predictability of canal supplies. The data demonstrate the system reliability post NWMP, with relatively constant values observed for irrigated command area, percent of the command in paddy, and paddy yields.



Paddy yield data for 1988 and 1990 were not available.



Source: Keegan Eisenstadt - World Bank, adapted from the sources footnoted.
(India - WRM Sector Review, World Bank, 1998).

Box A1.4
Successful Handover to Community Management: Groundwater Irrigation in West Bengal

The great majority of tubewells in India are privately developed, shallow wells, owned by individual farmers. For higher capacity or deep wells, government has frequently stepped in with "public tubewells", with investment, maintenance and operation by government. in the 1970s and 1980s major public tubewell programs were mounted in a number of north Indian states. These have largely been a disappointment. The case of Uttar Pradesh, with high operating subsidies, inefficient water distribution, smaller command areas than anticipated, low yields, and low rates of cost recovery was documented in 1991 (World Bank).

A similar initially public sector oriented program was mounted in West Bengal in the late 1980s under the World Bank assisted West Bengal Minor Irrigation Project. Performance of the wells was initially below expectations and the costs (and availability) of public tubewell operators (government employees) also presented difficulties. As a result of the Uttar Pradesh study and the 1990 research for the India Irrigation Sector Review (World Bank, 1991), a change in approach was initiated--to hand tubewells over to Panchayats (village level bodies) to manage them themselves. The West Bengal Minor Irrigation Department successfully steered this program, with very encouraging results as documented below.

The program with the World Bank was designed to develop the groundwater resource with small, light duty and heavy duty tubewells to service command areas of various sizes, ranging from 6-40 ha. Under the new approach, the project irrigation facilities are handed over to the local panchayats and are run by beneficiary committees, and the handover process is continuing. The high quality of irrigation service derived from most installations, including a reliable power supply and equitable water allocations have highly motivated the farmers. The beneficiary committees are in control of the management, operations, and maintenance of the tubewells after construction.

The experience in West Bengal with tubewell irrigation management transfer projects to the local panchayats is illustrative of the potential efficiency gains and capabilities of farmers to manage small scale irrigation schemes.

By February 1998, 4,186 low capacity tubewells and 6 high and 6 medium capacity tubewells had been transferred to the Panchayats for management and O&M. The program has been successful in: (i) achieving higher irrigation intensities and yields; (ii) turning over of O&M to panchayats; and (iii) establishing economically viable tubewell irrigation systems. Along with the generally higher yields, there has been a tendency towards the cultivation of higher value crops, particularly Boro paddy and potato. The tubewells are reported to be operating satisfactorily. Performance data from example tubewells shows the levels of cost recovery, and savings demonstrated by the beneficiary committees. Unfortunately, systematic data on yields is not yet available, but productivity impact can partly be inferred from the crops now grown and the high cost recovery. Despite the high operating costs associated with lift irrigation, the panchayat committees were able to fully recover costs, and generate savings.

Location of tubewell	Baburveri, Singur Block in Hooghly District	Janai, Chanditala-II Block in Hooghly District	Baldyapur-Paschim Simulla, Ranaghat II Block, Nadla District	Paschim Simulla, Ranaghat II Block, Nadla District
Tubewell type	cluster of 6 low capacity tubewells	high capacity tubewell	cluster of 6 low capacity tubewells	cluster of 6 low capacity tubewells
Date of handing over	2/24/93	12/19/93	12/29/90	12/29/90
Year of data presented	93-94	1997	91-92	91-92
Average discharge	$25m^3$/hr/well	$210m^3$/hr	$30m^3$/hr	$30m^3$/hr
Command area	26 ha	40.29 ha	36 ha	36 ha
Irrigated area	22.17 ha	36.21 ha	27.78 ha	25.18 ha
Hours of operation	6237 hrs (all wells)	2100 hrs (expected)	16,163 hrs (all wells)	11,289 hrs (all wells)
Major crops grown	Aman Paddy, Jute, Potato	Boro Paddy	Aman, Aus and Boro Paddy, Jute, Vegetables	Aman, Aus and Boro Paddy, Jute, Vegetables
Rate of water charge	Rs.2,250/ ha/yr	Rs.1985/ ha/yr	Between Rs.3-Rs.5 / hour	Between Rs.3-Rs.5 / hour
Water charge realizable	Rs.49,896	Rs.64,000	not available	not available
Water charge realized	Rs.43,756 as of April	Rs.45,000	Rs.58,914	Rs.43,145
Costs (financial):				
Operations	Rs.14,400	Rs.12,000	Rs.23,362	Rs.16,689
Electricity	Rs. 9,360	Rs.20,000	Rs.15,256	Rs.12,420
Maintenance	Rs. 7,570	Rs. 2,100	Rs. 3,770	Rs. 6,397
Miscellaneous	Rs. 31		Rs. 1,412	Rs. 1,174
Total Cost	Rs.31,361	Rs.34,100	Rs.42,500	Rs.36,681
Savings	Rs.18,535	Rs.10,900	Rs.16,414	Rs. 6,133

From the above figures, the irrigation management transfer (IMT) to the panchayats is a cost effective mechanism. In particular, it was found that smaller tubewells with command areas of about 6 ha, benefiting some 15 to 20 farmers, are highly suited to localized O&M through panchayats.

Source: Water Investigation and Development Department, Government of West Bengal, and N.K. Bhandyopadhay, World Bank.
(India - WRM Sector Review, World Bank, 1998).

Box A1.5

Impact of Drainage, Flood Control and Irrigation Rehabilitation in Harayana

The irrigation sector in the state of Haryana had been stagnant for decades. This stagnation resulted from the paucity of O&M and rehabilitation funds for both its drainage and conveyance systems. Years of deferred maintenance resulted in major hydraulic inefficiencies in the canal system, compounded by severe adverse impacts due to monsoon flooding. Rehabilitation and modernization works are now being carried out, under the Haryana Water Resources Consolidation Project.

Impact from Rehabilitation of Drainage and Flood Control. Subsequent to the severe floods of 1995, Haryana undertook an emergency program before the 1996 monsoon season, with WRCP financial assistance to rehabilitate and augment the state's drainage and flood control system.

This resulted in a dramatic reduction in flooded area in the subsequent two seasons. Against 2.2 million acres affected by floods during 1995, the area affected by flooding in 1996 was only 200,000 acres (less than 10% of the previous year), and less than 50,000 acres in 1997. This reduction saved the kharif crops which would otherwise have been affected, made previously flooded lands available for rabi sowing, and significantly reduced government costs previously associated with dewatering.

While the flood events after 1995 were slightly smaller in scale, it is determined that the decrease in flood affected lands resulted primarily from the desilting of drains and the construction of a number of versatile control structures for unwanted flood flows. The now effective drainage and flood control system not only has greatly alleviated the severity of the flooding, but has also been helpful in reducing waterlogging. By removing the floodwaters, the drains have been important to lowering the groundwater tables through decreased recharge. Therefore, the agricultural sector benefits include both the addition of previously flooded land area and the progressive reclamation of waterlogged areas as well.

Impact from Rehabilitation of Irrigation. With respect to the irrigation network rehabilitated to date, WRCP funds are primarily being used to improve and restore the canals, and rehabilitate ineffective structures. This primarily involves the removal of silt from the clogged conveyance system, repair to a variety of structures and repair of damaged canal linings (also of benefit to waterlogged areas).

The efficiency improvements were significant. With the same amount of water supplied as in previous years, an additional 600,000 acres were brought under irrigation during the 96-97 kharif and rabi seasons combined. Importantly, improvements in the delivery system also brought water to tail-end farmers on a more regular basis, thereby improving the equitability of distribution. Forthcoming agricultural intensification is expected to improve on-farm management, water use efficiency, and improve conservation which should further improve the tail-enders' situation, and will also impart agricultural extension to the benefit of all farmers.

Better water management, by way of the improved performance of versatile drainage works combined with improved hydraulic efficiency in canals, was responsible for achieving the state's first ever increase in irrigation of the magnitude of 600,000 acres. These additional irrigated areas resulted in a substantial increase of 1996 food grain production, probably worth about Rs.3.15 billion (US$79 million), one year after the initial works. This figure compares to the total investment for the WRCP thus far of Rs.1.29 billion (US$32 million) [Rs.757 million (US$19 million) on canal rehabilitation and modernization and Rs.537 million (US$13 million) for flood control during the 1994-March 1998 period].

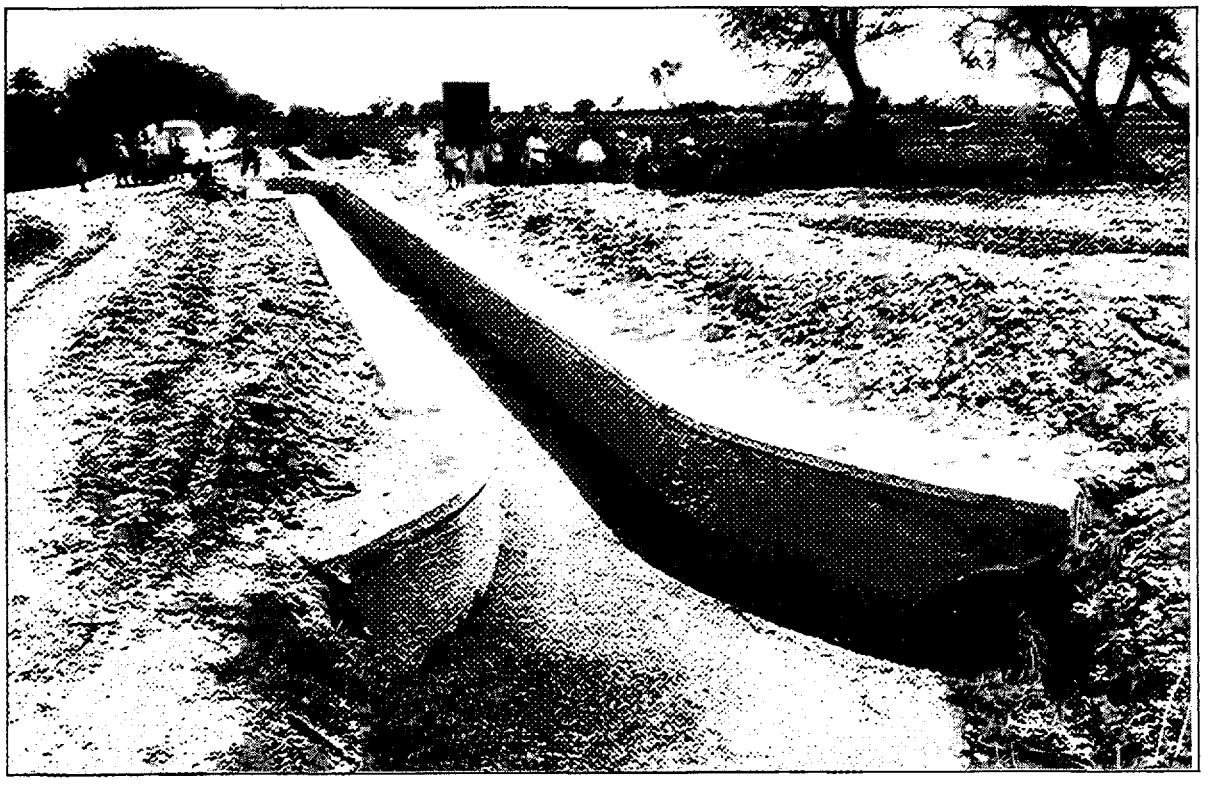
Source: Based on Haryana Irrigation Department, 1998. S.K. Dua, Engineer-in-Chief and R.K. Ailawadhi Chief-Engineer Co-ordination. (India - WRM Sector Review, World Bank, 1998).

Box A1.6
A WUA Experience in Rajasthan: Successful Scheme Rehabilitation and Regulation

The Prior Situation. Prior to the formation of a farmer's Water Users Association (WUA), the Kwarti Minor Scheme was in a state of disrepair and experiencing ongoing dilapidation. As a result, the scheme was unable to provide water to meet demand and would run dry during irrigation periods. The irrigated area was shrinking, and tail-end farmers rarely received enough water, irrespective of the timing of delivery. It was the farmers themselves, organized in a WUA, that were able to bring about positive changes in the scheme and improve their agricultural productivity as a result.

At the time of formation of the WUA, a list of problems in the scheme included: extensive silting, scouring and overall deterioration of the system; changing cropping patterns; uncontrolled outlets; inadequate and inequitable distribution practices; the lack of a sense of ownership among beneficiaries; the lack of an information system; and the lack of water management training among the farmers themselves. These problems led the farmers to organize theselves in an attempt to bring about necessary changes.

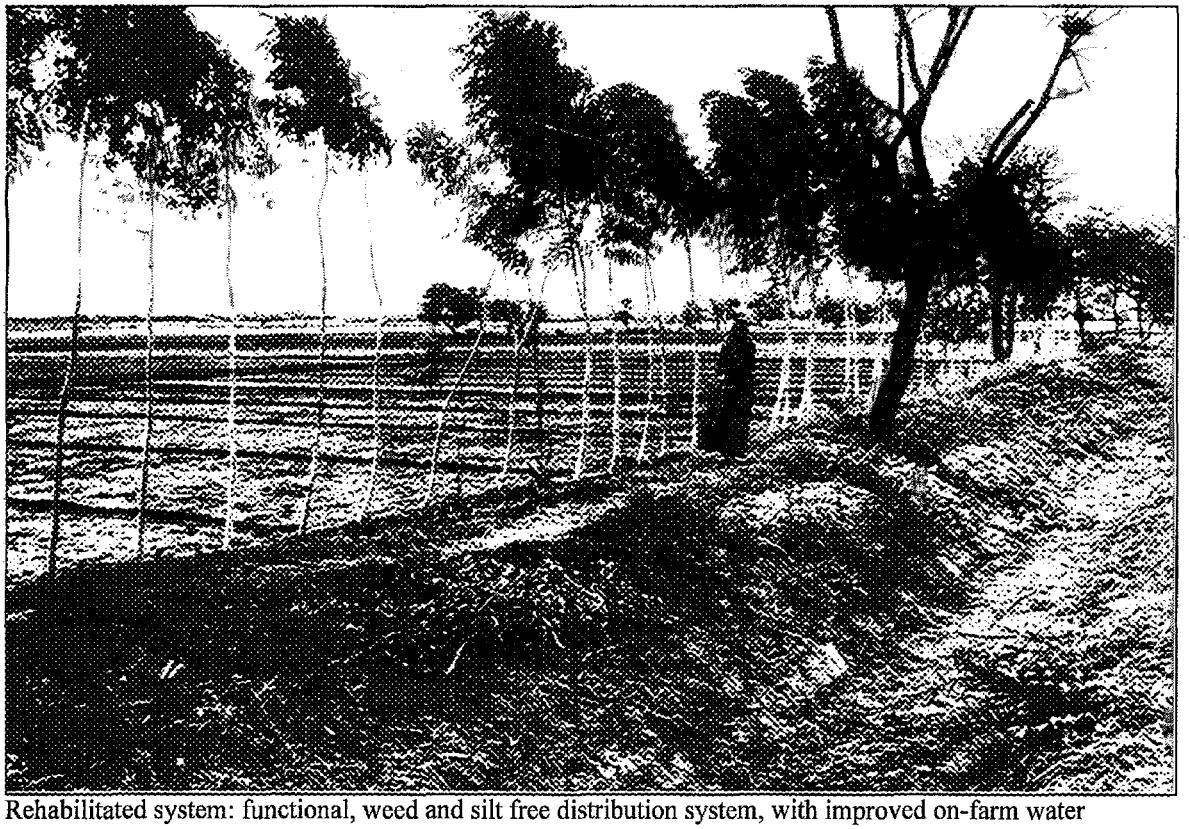
The Improvement Program. Through a proposal to improve the canal system, make optimum use of the water, implement water management practices, improve communication and conveyance facilities, and receive training in best practices, the WUA and others in the area were included under the Participatory Irrigation Management program, under the World Bank assisted Agriculture Development Project in Rajasthan, with matching labor provided by the WUA.



Improvement and remodeling of structures, regulator gates, canals and installation of cut throat measuring flumes for monitoring at head and tail of the minor.

Impact. The repairs have had significant impact on the functioning of the scheme. The WUA, by eradicating unregulated outlets (and coopting the former self-regulating farmers that had made them)

has enabled a significant amount of water to be conserved, making irrigation available to tail-enders where it wasn't previously. The reliable supply of irrigation water, and its coordinated management, has impacted cropping patterns. The 1994-1995 tail-end rabi crops consisted of 377 ha, primarily in Mustard, while the 96-97 Rabi crop consisted of 529 ha, primarily under wheat, which was not previously grown as a result of waterlogging. The additional area brought under irrigation after the first two years of WUA activity was 152 ha. Crop productivity for soybean, mustard, and wheat has gone from: 12, 9 and 8 Quintals/ha respectively prior to WUA formation, to 14,12 and 24 Quintals/ha after the WUA management and improvements. These results are coupled to an ongoing training program in irrigation and agricultural extension that has improved on-farm water management and reduced fertilizer application. Rajasthan's Kwarti Minor Scheme is a positive example of the potential impact that stakeholders can make when given a sense of ownership.



Rehabilitated system: functional, weed and silt free distribution system, with improved on-farm water management, and bank-stabilizing plantations on the canal.

Source: Report on Kuwarti Minor WUA. Shivshakti Ka Kheda, Dist. Bundi, CAD, Chambal, Kota.
Adapted by Keegan Eisenstadt - World Bank.
(India - WRM Sector Review, World Bank, 1998).

Box A1.7
Initial Gains from Systems Improvements in Orissa

Background. Under the World Bank assisted Orissa Water Resources Consolidation project (OWRCP) (Cr.2592), Orissa's reorganized Department of Water Resources (DOWR) is implementing various measures to: rehabilitate and modernize existing irrigation systems, involve farmers in management and O&M; reprioritize expenditures to emphasize institutional capacity building, O&M, rehabilitation of existing systems and focused expenditure on a few high priority and viable scheme completions; improve agricultural extension and research for irrigated agriculture; and establish multisectoral water planning and environmental management institutional capacity as well as basin plans and a state water plan.

Under one project component--the "Systems Improvement and Farmer Turnover: (SIFT) program, schemes are being rehabilitated and modernized and WUAs established. While field work is still at an early stage, the initial impacts are beginning to come through, with first season data on water distribution now available on a number of schemes. Data from one such scheme--Hirakud command, Tulandi Minor, is presented graphically below.

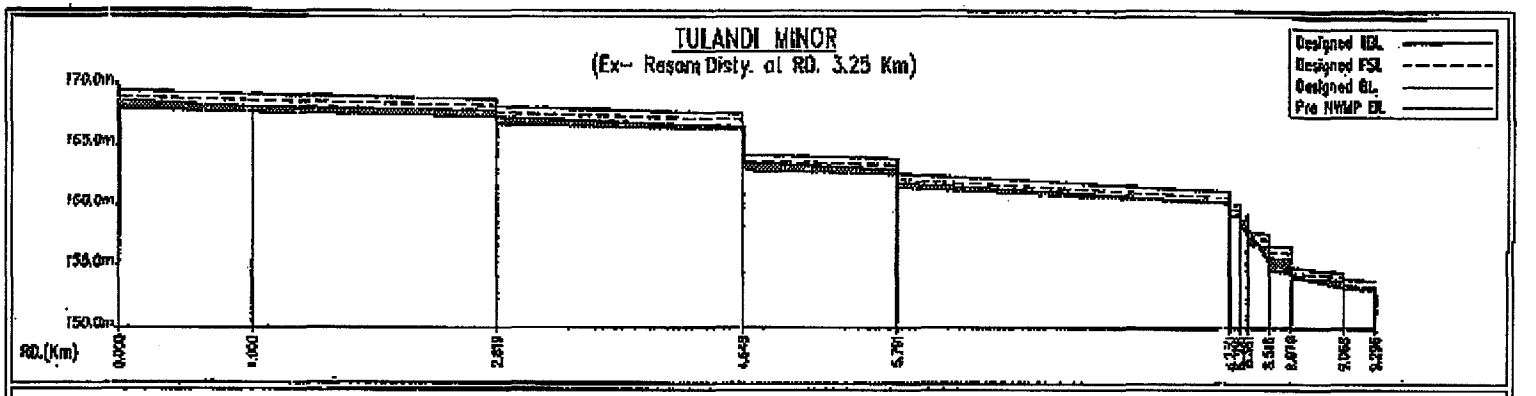
First Season Impacts. The attached diagram shows discharge and other data along one of the minors (Tulandi) in Hirakud system after the first year of deferred maintenance works. It will be noted that discharge is significantly better than in the previous year and has nearly been brought back to designed discharge. At head, middle and tail reaches, discharge improved by between 100% to 30% over the previous year. Irrigated area also increased by about 5.6%.

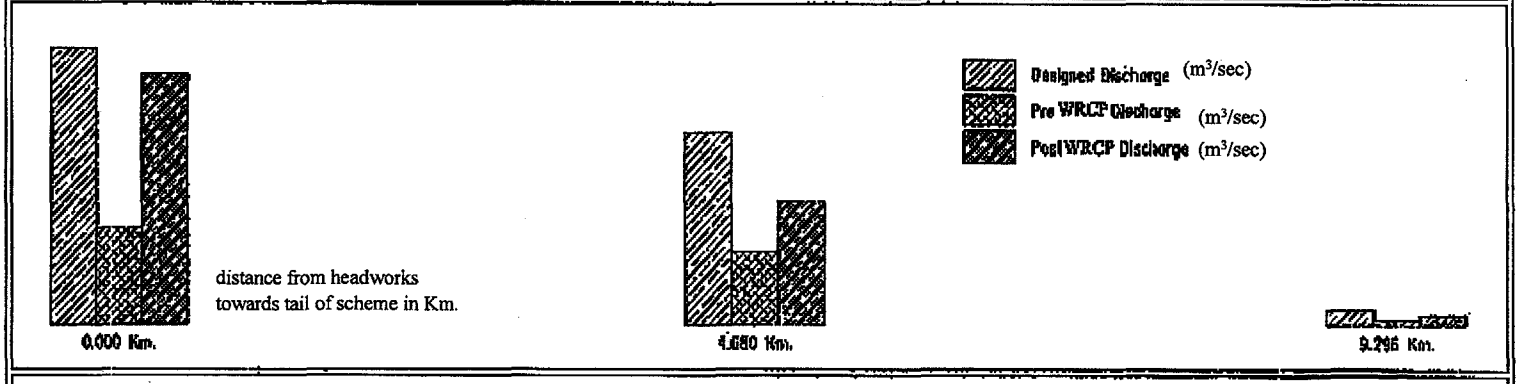
Importance of Follow-On and Ongoing Evaluation. Orissa is continuing data collection and analysis on its various schemes and is developing a good computerized data base and MIS. Monitoring and Evaluation needs to further develop yield and socio-economic impact data. All states need to build up Monitoring and Evaluation capabilities and data as a means of constant assessment of impact, implementation adjustments and self-evaluation and improvement.

Source: Based on Orissa Department of Water Resources, Dr. B.P. Das, Engineer-in-Chief. (India - WRM Sector Review, World Bank, 1998).

ORISSA WRCP

Preliminary Impact of System Improvement (June 1995)

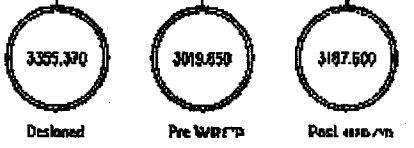




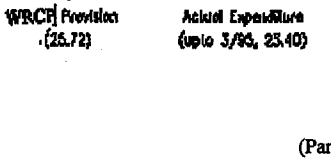
Works

	WRCP Provision	Actual Work Done
Resectioning	9.295 Km.	2.136 Km.
New Structure	36 Nos.	12 Nos.
Renovation of old structure	10 Nos.	2 Nos.

Ayacut (Ha)



Financial (Lakh Rs.)



Orissa WRCP
Project Evaluation

Hirakud System
(Parmanpur, Rasan & Bargarh Distributary)

Box A1.8
Participatory Sodic Soil Reclamation in Uttar Pradesh

Started in 1993, the IDA-supported Uttar Pradesh Sodic Lands Reclamation Project (Cr. 25100, US$111.2 million) is developing effective models for sodic soils reclamation and improved agricultural production in Uttar Pradesh, based on a grass roots approach. The project supports drainage and associated agricultural technologies for land reclamation, and strengthening of local institutions for effective management, and covers ten of the 35 most-affected state districts. The project's approach has proven so successful that the Government of Uttar Pradesh and several donors are taking steps to carry out all future sodic lands reclamation in the state following the same model.

Alkaline conditions adversely affect plant growth, human and animal health and the environment; soil particles are dispersed, and water and air cannot penetrate. About 1.2 million hectares in Uttar Pradesh (7% of the net cultivable area) are not used because of high concentrations of exchangeable sodium. Several previous schemes implemented to deal with this problem all had shortcomings.

A Grass-Roots and Adaptive Learning Approach. New technical solutions and modalities have been developed during the project's implementation reflecting its flexibility. Some examples include establishment of self-help groups, inter-cropping in horticultural activities, establishment of water user group accounts for maintenance of link drains, allotment of government land to landless families for reclamation, and continuous independent monitoring of implementation and impact.

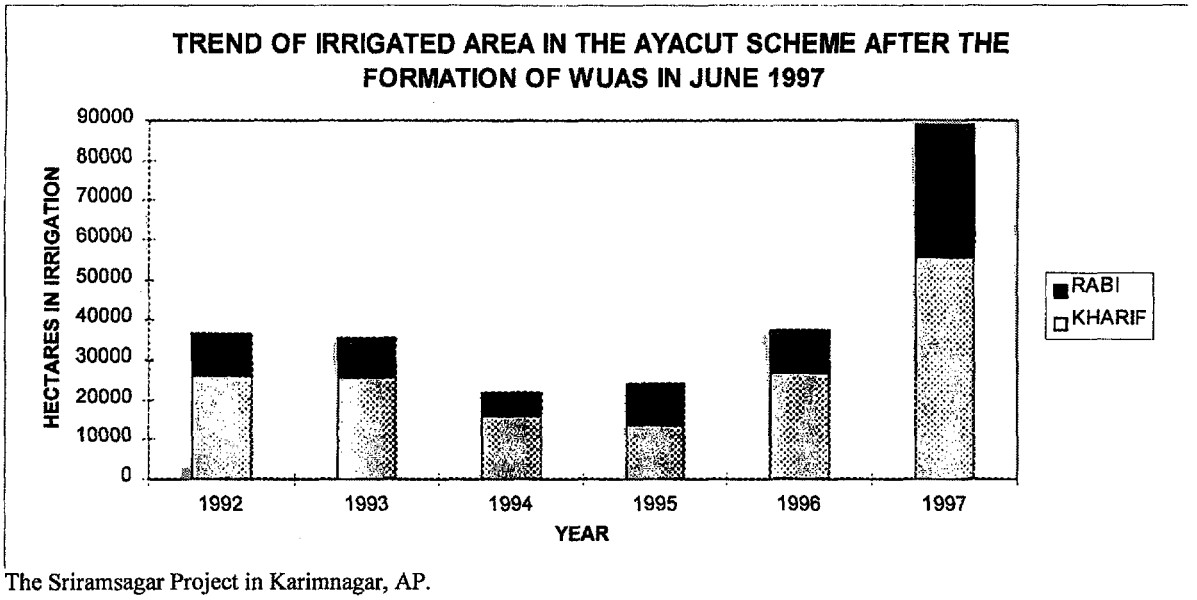
Beneficiary Involvement. Beneficiaries are involved in decision-making in all stages. With NGO assistance, 10 to 15 beneficiaries are organized into basic units of 4 to5 hectares. These units assist in the verification of site characteristics and cadastral data on areas selected for reclamation through remote sensing techniques. They carry out all site reclamation activities, and maintain the pumpsets and field drains. The project has fostered the formation of Women's Self-Help Groups to improve the socio-economic well-being of village families; their success has been so dramatic that Men's Self-Help Groups are also beginning to form.

Project Impact. By March 1997, a total of 34,000 hectares had been reclaimed. A total of 200,000 mostly poor families will benefit by project closing. About 17,000 hectares have been cultivated for the first time. Cropping intensity has increased from 37% to about 200% on average. Yields of wheat and rice are double the appraisal projections, and crop diversification has started. In some areas, land values have quadrupled and wage rates doubled, reflecting increased economic activity.

The project is succeeding because of its emphasis on participatory management, flexible design, effective management by the UP Land Development Corporation, strong state government support, and effective and adaptable World Bank supervision.

Source: Project Documents (World Bank).
(India - WRM Sector Review, World Bank, 1998).

Box A1.9
Increases in Reported Irrigated Area in Andhra Pradesh After Formation of WUAs



The Sriramsagar Project in Karimnagar, AP.

Even in the first year of its irrigation reform program, the irrigation sector in Andhra Pradesh is beginning to demonstrate gains in efficiency and irrigated area. These gains appear primarily due to the irrigation management transfer (IMT) program that is underway: handing over management and O&M responsibilities to farmers organized in WUAs. The WUAs were formed in June 1997, and were given the responsibilities for maintenance from July 15, 1997.

The data from the Sriramsagar Project above demonstrates the dramatic increase in reported irrigated area experienced after the handover to WUAs in June 1997. Piloting of WUAs in Sriramsagar began on about 8,000 has. two years earlier, but was not extended to the whole scheme until June 1997. There was no increase in total water supplied to the scheme. In fact, less water was used than previously. The total water consumed in the Project during 1997 was 28,000 m^3, while in 1996, 43,000 m^3 were used. The figures in the chart above show more than a doubling of gross irrigated area (kharif plus rabi seasons), with two-thirds as much water.

At this stage, care is needed in interpretation of these figures. It is likely that the doubling in reported area is a combination of two factors. First, it likely illustrates that under WUA management farmers are more willing to report irrigated area than previously. This will have direct impact on cost recovery. Secondly, from interviews with farmers, the area actually irrigated appears to have increased. The exact contribution of each of these factors, and other influences that may apply, has yet to be determined. Clearly, this is one area of study that should be followed up; on this and other schemes undergoing IMT and irrigation system improvements.

APs success with IMT is critical to its current policy of broad scale irrigation reforms. Past experience with IMT, from pilot phase activities during the Andhra Pradesh Irrigation III Project, demonstrated the potential of WUAs as a viable mechanism for irrigation management. Critical to success is the concerted effort to break the vicious circle through multiple, simultaneous reforms at the critical points of intervention (see main text figure 2.2).

Source: Data from Raymond Peter, Additional Secretary GOAP.
(India - WRM Sector Review, World Bank, 1998).

Box A2.1
An Australian Journey to a Financially Sustainable Irrigation System

The past and ongoing irrigation management reforms in Australia offer development of a management model which largely is independent of government; commercial in focus; financially autonomous; close to and responsive to customers and other stakeholders including environmental ones; and providing high quality services that are wanted by customers and for which they are prepared to pay. Farmers have benefited from an increase in the reliability and predictability of water supplies--in turn, allowing for better irrigation planning at the farm level--and enhanced equity in water distribution. The decade from 1984 to 1994 was a period of major reform in the Victorian irrigation industry. The State Rivers and Water Supply Commission, the authority responsible for irrigation since 1905, was abolished in 1984 following an inquiry by the Public Bodies Review Committee of the Victorian Parliament. Policy and regulatory functions were transferred to the newly created Department of Water Resources, and a more commercial Rural Water Commission established to operate the irrigation systems.

The history of irrigation in Victoria provided the new organization with particular challenges. The objectives of closer settlement in rural Australia had a great influence on the development of irrigation. Unfortunately the lack of financial discipline inherent in these policies left a legacy of irrigation enterprises of low profitability, small farms, financially unviable irrigation authorities, aging irrigation infrastructure, a large public debt, and environmental degradation through salinity and water logging. Any reform of irrigation would have to overcome this inheritance.

Agreeing on clear financial targets with the Victoria Government, and attention to strategic planning were the first steps in setting a new course to overcome the burdens of the past. Ultimately the target of reducing the shortfall of revenue against business costs from US$66.9 million in 1984 to zero over twenty years was agreed with the Government. Business costs were defined as the total of operating, maintenance, administration, any finance charges, and a renewal annuity to fund replacement of the aging irrigation infrastructure. The Rural Water Commission now had a clear target to use as the basis for strategic planning. The target was to be achieved by a combination of cost reductions and increases in water prices, with emphasis on the cost reductions.

Use of a new annuity as a measure of capital consumption instead of current costs depreciation was a major step forward. A more constructive debate with the irrigation community on the risk, level of service and cost trade offs has created better relationships and opportunities to progressively deliver more cost effective services.

In order to achieve the long term target of financial self sufficiency a series of financial and business plans were developed. The Financial Management Strategy covered the four years from 1985/86 to 1988/89. Recurrent expenditure was held constant in nominal dollar terms in a period of 7% to 8% inflation. In the end a 30% reduction in recurrent expenditure was achieved. Even with these last reductions in recurrent costs, real increases in water prices of 2% annually were required over the twenty years to achieve self sufficiency. Use of inflation forecasts that underestimated the actual inflation resulted in under achievement of the pricing target. Real prices increased by 0.9% annually over the four years.

A Business Plan covering the five years from 1990/91 envisaged further efficiency improvements, increases in asset maintenance and renewal, and real price increases of 2.8% annually. The price increases were now based on the actual inflation in the preceding year.

In 1991 prices for agricultural commodities fell and the increases in water prices became the focus for the irrigators' concerns. A "Rate Protest" was organized to withhold some USD$30 million of

water rates. The Government decided that an inquiry into water pricing and the efficiency of the Rural Water Commission was the best way to resolve the impasse, and established the Future Management Review. After extensive consultation with water users the Review supported the target of financial self sufficiency, and made recommendations to create the Rural Water Corporation out of the Commission as a government business enterprise outside the Victorian Public Service. The Corporation would have much greater flexibility to achieve large gains in operating efficiency. The Review concluded that despite these large potential gains in efficiency real price increases of 2.1% annually were still required.

The Future Management Review supported the appointment of expertise based boards to manage the irrigation systems. A wider range of skills, including commercial skills, was introduced to the irrigation authority. In fact the Act that transformed the Rural Water commission into the Rural Water Corporation in July 1992 specified the range of skills to be considered by the Minister when appointing board directors. the skills of the new board directors played a vital role in the ongoing reform process.

The expected efficiency gains were made, and the shortfall of revenue against business costs was reduced to $13.3 million by June 1994, within sight of the ultimate target that had now been brought forward to the year 2001. Some 62% of the improvement in financial performance came from efficiency gains, and 22% from price increases to the irrigators. The remaining improvement came from broadening the revenue base including hydroelectric power generation. For an irrigation authority to make such improvement in financial performance, and to come within sight of long term financial viability is a major achievement.

During the implementation of the financial plans the Rural Water Commission and its successor were active in other reform areas. Steps were taken to create a market for water in order to stimulate improvement in the profitability of irrigation. New, more profitable irrigation enterprises would be able to gain access to water, and the opportunity cost of water would be exposed for the first time. Temporary transferability of water entitlements was introduced in 1987 and permanent trading started in 1991. In 1988 the rural Water commission organized what is believed to be the first auction of water entitlements in Australia. By 1994 a market for water was emerging.

New technology was introduced to improve the efficiency of irrigation deliveries so that more responsive and new services could be provided to irrigators to take advantage of the opportunities offered by water trading. Central communication and planning of water deliveries was successfully implemented, and a water management system using surveillance control and data acquisition technology was conceived and introduced. The water management system had the potential to fundamentally change the way the irrigation systems were operated to produce a more customer focused, commercial approach.

The Rural Water Commission and its successor corporation became leaders in staff training with the objective of supporting the introduction of new technology and other initiatives to improve service and efficiency. The Commission achieved the status of a private provider of courses so that its training was recognized nationally. The career structures and employment conditions were reformed resulting in one industrial award for the staff with four levels to create a more efficient multi-skilled workforce that was rewarded for the acquisition and use of skills. these initiatives made a significant contribution to the reduction in cost described.

The Victorian Government, after an inquiry into salinity, adopted the concept of community leadership in the development of salinity mitigation plans. The technical experts in the irrigation authority became advisors to the community groups. A series of plans were developed that have the potential to progressively halt the spread of salinity.

The strategy implemented in Victoria over this decade brought about significant improvements in irrigation. Furthermore the experience gave those involved important insights into the conception and implementation of a complex reform program. If the reforms can be repeated in other parts of the world, significant economic and environmental benefits will flow through the global economy. the Australian experience is not to be taken as a prescription to treat the maladies that have beset irrigation over the centuries, but rather a roadmap with signposts to indicate the way for those facing similar challenges and who must make the same journey.

Source: Adapted from Langford, K.J., C.L. Foster, and D.M. Malcolm. 1998. An Australian Journey to a Financially Sustainable Irrigation System. World Bank Technical Paper No. (to be determined). Washington, D.C. (India - WRM Sector Review, World Bank, 1998).

Box A2.2
Comprehensive Irrigation Sector Reform in Mexico

Mexico's irrigation management transfer program is breaking new ground in redefining the relationship between the irrigation users and the State. It has successfully turned around a former situation of inadequate cost recovery, inadequate maintenance, declining infrastructure, declining services and farmer dissatisfaction, substantially analagous to the 'vicious circle" present today in many of India's states.

Progress with Irrigation Management Transfer (IMT): The transfer of Mexican "Irrigation Districts" (DIs) (10,000 to 270,000 ha or equivalent to a small to larger sized "major" irrigation command in India) to Water User Organizations (WUOs) began in 1991, essentially on a pilot basis. The original program aimed to transfer 21 DIs comprising 1.9 million hectares up to 1996. Based on successful experience, the program was expanded from the original 21 DIs to 80 DIs. There are now 58 DIs transferred, covering about 3.0 million ha, and a further 28 DI s are in process of irrigation management transfer.

The Prior Situation: Serious Decline of Infrastructure and Services. In Mexico about 6.1 million ha are under irrigation, of which about 3.3 million ha are in 81 large scale Irrigation Districts (DIs). These districts vary from 10,000 to 270,000 ha, and average farm sizes are about 6 ha, ranging from 4 to 20 ha. The irrigation systems serving these districts were developed by the public sector. Cost recovery declined over time, from 95% in the early 1950s to less than 18% by the late 1980s. The low cost recovery and inadequate budgetary appropriations by government resulted in poor maintenance, progressive dilapidation of the irrigation schemes, declining system performance and a serious reduction in agricultural output, a situation very similar to that found or developing in many states in India.

Facing the Problem: It was recognized in Mexico that government was not successfully managing the irrigation schemes, and did not have the funds to do so. The President of Mexico backed a radically new approach, centered on handing responsibility over to farmers. This required strong political commitment from the top, a key factor in Mexico's success. In 1989, the government instituted a program to transfer management from the National Water Commission (CNA) to farmers under Water User Organizations (WUOs).

The Transfer Process: Transfer is in two stages. First, the responsibility for O&M of lateral canals and minor drains is given to the users, in areas up to about 25,000 ha, which are organized in WUOs. CNA requires that the WUOs demonstrate their capacity to function before moving to the second stage. A minimum duration of at least one year is automatically imposed on stage one. During the second stage, which takes place depending on the size of the DI, WUOs form an Enterprise Association (Sociedad) which takes over the O&M of the headworks, main irrigation and drainage canals, as well as the government machinery and equipment required for O&M. Only the dams and the major headworks are left with the government (CNA). Water charges are collected by each WUO at the beginning of the season, covering the combined O&M costs of the system in control of CNA, Sociedad and the WUO. The WUO then pays the CNA and Sociedad their shares.

Impact of Irrigation Management Transfer. The main observation is that the "service concept" has improved substantially. Maintenance, repairs, and operations are professionally performed and on schedule. Money is available in a timely fashion to the WUOs, Sociedads and CNA. Modern, efficient technology was introduced; and WUO/Sociedad staff are both trained and motivated. As a result irrigation deliveries are more responsive, drains work better, and roads provide better traffic conditions year round.

Most WUOs/Sociedads have proven capable of jointly operating and maintaining their irrigation schemes, even up to sizes in excess of 50,000 ha (excludes in most of the cases the major headworks still managed by CNA). Water tariffs collected by the users (in excess of US$150 million in 1995) have supported not only the water user's operation and maintenance (O&M) activities but also the majority of the O & M activities by CNA staff. Most importantly, the maintenance activities carried out by the WUOs have stopped the deterioration in the infrastructure and hence have accomplished one of the major objectives of the transfer program. This is in sharp contrast to the previous situation when the systems were heavily dependent upon government subsidies and consequently were deteriorating rapidly due to lack of stable funding.

A "new deal" between users and CNA also developed, making it possible to begin a new cycle of improvements in the sector. The improvements include co-financing of public works in DIs between the WUOs/Associations and the government (CNA). Under the Irrigation Modernization Program (IMP), the government grants 50% and the WUO funds an equal share. A new culture is now growing in the DIs, of self reliance and self-help. As a consequence, a strong modernization program is now on-going and is beginning a desirable transformation in the sector that would not have been possible with only public funds. The IMP is now considered as a second step after the transfer stage. Impact on Staffing and Staff Quality: The number of CNA staff dedicated to DIs has reduced significantly. The WUOs/Sociedads have, however, put emphasis on staff quality, and have tended to recruit staff with higher levels of training. The elimination of unionized staff controlling O&M activities has removed one of the major past complaints of the farmers. It has been reported that the ability to hire and fire their own staff has improved the responsiveness of the operational staff to the needs of the users. With increased O&M budgets including more funds for maintenance, and more responsive staff, the transfer program has created a situation that is much more sustainable than previously.

Some Issues Needing Attention. The Need to Refine Water Charges and Build Financial Strength: Additional changes are required to ensure that Mexico's program is sustainable over time. The current system of water fees is being changed so that the DIs develop a reserve fund for improvements, modernization, emergencies, future replacement, and rehabilitation. DIs are also shifting to a billing mechanism where the DI collects a set amount to cover fix costs (staff, facilities, etc.) as well as a volumetric fee to cover the variable costs of water delivery.

The Need to Clarify Water Rights and Develop Water Markets: Mexico's population growth rate, as well as the structural transformation from an agricultural society to an industrial nation, means that competition for water is increasing. For instance, in the case of the Bajo Rio San Juan Irrigation District, a major city expropriated its water supply, even though the DI was operating under a legal water concession. This illustrates that the DIs are in potentially vulnerable positions. Mexico's legal system does not clearly specify what water rights exist for irrigated agriculture and how those rights can be protected against demands for water from municipal as well as industrial users. The government has recognized the problem and is presently working to clarify terms of the law pertaining to water concessions to reduce future water conflicts between agricultural, municipal, and industrial users. Formal water markets are also being piloted as a way of enabling transfer of water under remunerative terms to farmers.

Source: Prepared by Jose Simas; adapted by M. Munshi and K. Oblitas (World Bank) (India - WRM Sector Review, World Bank, 1998).

Box A2.3
Successful Transfer of Irrigation Management in Turkey

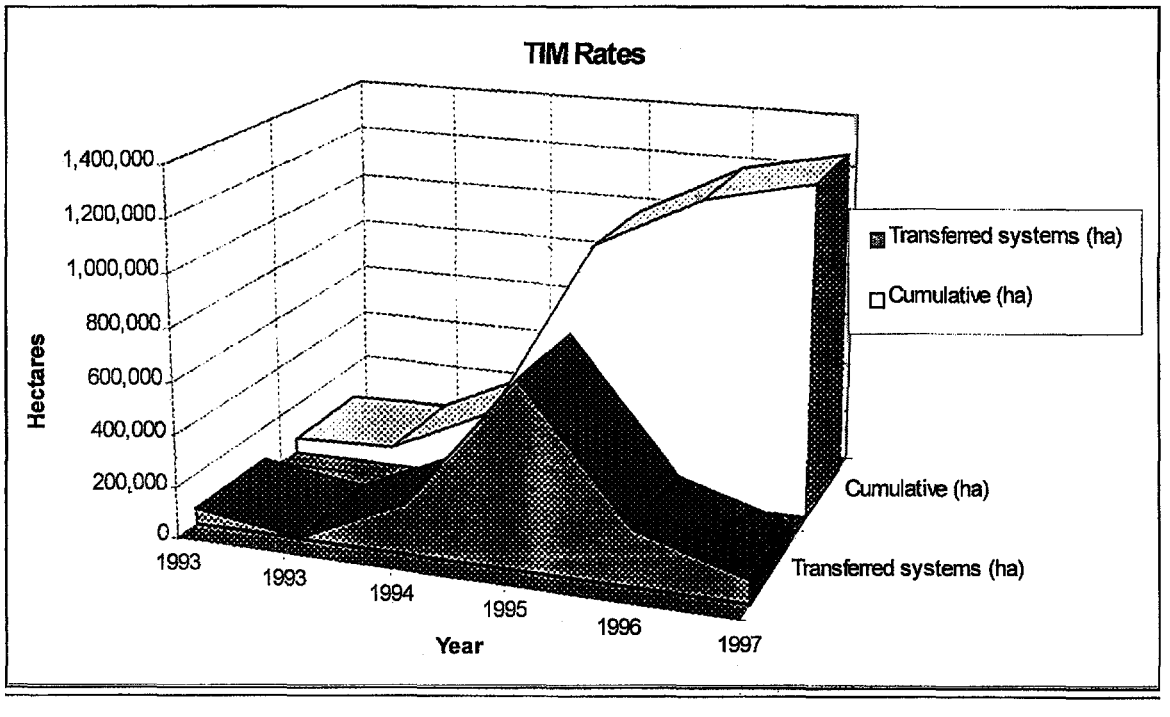
Background and Issues. A World Bank review of Turkey's irrigation sector in the early 1990s showed that the vast irrigation systems completed and managed by the government faced the problem of inadequate operation and maintenance (O&M). The paucity of O&M funds resulted in the deferral of maintenance, the deterioration of the irrigation system, and the growing dissatisfaction of users. The main contributing factor to this problem was declining government funding for irrigation O&M combined with declining cost recovery. These factors were aggravated by the demands for very high pay from the unionized government employees responsible for carrying out O&M.

Envisaged Solution. Considering the positive results of transfer of the irrigation O&M responsibility to users in Mexico in the early 1990s, and considering the encouraging results of the limited transfer activity in Turkey, it was concluded that the most effective and sustainable solution to the problem would be to transfer irrigation management (TIM) to users.

Decision to Transfer Irrigation Management to Users. With the World Bank's persuasion in mid-1993, the State Hydraulic Works General Directorate (DSI) of Turkey started a large-scale TIM program.

Progress on TIM. As shown in the following table and chart, TIM proceeded successfully at a very fast rate.

Year	Until 1993	1993	1994	1995	1996	1997
Transferred systems (ha)	62,620	9,422	195,320	711,214	211,758	88,705
Cumulative ha)	62,620	72042	267,362	978,576	1,190,334	1,279,039



Type and Number of Water User Organizations (WUOs). In Turkey WUOs consist of Water User Associations (WUAs) that are called Irrigation Associations, village organizations (democratically elected), municipalities, cooperatives and others like universities. The following table gives the number and area transferred to these organizations as of December 31, 1997.

Type of WUO	Number	Total Area (ha)	Percentage
WUAs (ranging in size from a few hundred to 34,000 ha)	222	1,162,634	90.9
Village Organizations	209	30,488	2.4
Municipalities	105	51,607	4.0
Cooperatives	31	33,353	2.6
Universities & Research Centers	3	957	0.1
Total	570	1,279,039	100

Results of TIM. The main results of TIM are: (i) improved and reliable availability of funds collected and managed by WUOs for irrigation O&M -- the annual budget met from the payment by the members for large WUOs is in the range of $1,000,000; (ii) improved and more equitable distribution of irrigation water to users; (iii) more efficient performance by the pumping stations managed by WUOs; (iv) improved maintenance of transferred irrigation systems; (v) radically improved O&M cost recovery--the rate of recovery of O&M cost (including late payments recovered with penalty) by WUOs from members approaches 100%, whereas the rate of recovery from government managed systems with adjustment for inflation is closer to 20%; (vi) substantial improvement in distribution in water-scarce areas; (vii) major reduction in the number of irrigation-related complaints (from about 400 to about 10 per year); (viii) substantial increase in production as stated by users and DSI officials; and (ix) major reduction in government spending on irrigation O&M as shown in the following table:

Year	Area Managed by DSI (not transferred yet) in ha	Government O&M Cost US$
1990	1,251,251	55,769,806
1991	1,269,571	63,234,274
1992	1,300,561	55,225,825
1993	1,341,495	70,122,713
1994	1,188,534	70,969,964
1995	543,650	48,173,094
1996	413,813	27,373,973
1997	367,991	20,349,803
1998	398,807	
Note: Increase in the area in 1998 is due to development of new area by government (DSI).		

Contributing factors to the success of accelerated TIM are the following: (i) declining O&M funding (which is common to many countries as demonstrated by the need for repeated rehabilitation); (ii) unreasonable pay demands by unionized workers; (iii) decline in the service and condition of irrigation systems; (iv) importance of irrigated agriculture for farmers; (v) basing the TIM program on the enabling conditions in the country, including positive experience in small scale TIM, availability of capable national staff to carry out the program and enabling legislation; (vi) conviction of a small number of DSI officials that TIM is the right solution, and building a team with such officials and those who were not opposed to TIM to promote the idea and implement the program; (vii) assisting concerned officials with building confidence in carrying out large-scale TIM by

visiting TIM experience in Mexico; (viii) successful initiation of the program by the above team in a simple and flexible manner; (a) dedicated work by the team members; (b) excellent cooperation of users (farmers) and excellent performance by them in establishing WUAs without any financial assistance from outside the associations; (c) Bank's persuasion and consistently promoting it mainly through participation and advice, that contributed to initiating the process, and its speedy progress. Also, Bank's readiness to finance the purchase of O&M equipment for WUOs was an incentive for users to participate.

Strengthening of WUOs and Transfer of Irrigation Investment Capacity to Users. An important issue with TIM in Turkey was that the responsibility for irrigation O&M was transferred to WUOs without the transfer of related O&M equipment. DSI assisted the WUOs by providing them with maintenance equipment on ad hoc basis, but this is not a sustainable and efficient arrangement. To address this and the related issues, the Bank-financed "Participatory Privatization of Irrigation Management and Investment Project", has been recently made effective, which, among other activities, is assisting WUOs to purchase required O&M equipment, while financing on average about 70% of the cost. The balance of the cost (average of about 30%) will be granted by the government using the Bank loan. The project has just started and indications are that it will contribute to solving the above O&M equipment and related problems. The two main features of this project are: (i) strengthening the WUOs and consolidating their role; and (ii) transferring the irrigation investment responsibility from government to users.

Source: Joma Mohammadi, 1998. World Bank.(India - WRM Sector Review, World Bank, 1998).

Box A2.4
IMT in the Philippines, Mexico, and Turkey: Lessons for India

While turn-over and IMT are now a worldwide phenomenon, the experience of the Philippines, Mexico, and Turkey in this regard is of particular interest to India as it presents a range of effective strategies and approaches highly relevant for India.

The Filipino case represents a gradual but bottom-up approach to IMT. It demonstrates the indispensable need to organize and train farmers prior to IMT especially using NGOs and community organizers. The Mexican case exemplifies a top-down but big-bang approach. It shows the strategic advantages in concentrating on more organized and commercialized irrigation districts so as to achieve a quick and effective IMT. Notably, the Mexican turn-over program has also led to considerable staff reduction. Interestingly, most of the reduced staff were subsequently employed by WUAs. The Mexican IMT program had a strong institutional and legal back-up with the creation of the National Water Commission (1989) and the enactment of the National Water Act (1992) as enabling legislation.

IMT in Turkey, however, is a mix of bottom-up and top-down approaches. The irrigation systems, depending upon their size and spread, were turned-over to both newly created WUAs as well as local governments at village and municipality levels. As to the incentive structure, while Turkey relied extensively on subsidies (e.g., water fee discount and maintenance subsidy), Mexico has effectively combined the carrot (e.g., 20-year concession) and stick (e.g., threat of service discontinuity and the associated production risk) policies. As a result, although the IMT process in Turkey has been as fast as that of Mexico, it was not as comprehensive.

Sources: Groenfeldt, 1997. World Bank. Joshi, 1997. MOWR (India - WRM Sector Review, World Bank, 1998).

Box A2.5
Self-Financing Irrigation and Drainage Districts: the Yangtze Basin, China

The Bank-supported Yangtze Basin Water Resources Project intends, among other objectives, to introduce institutional reforms that would improve water resource management and cost recovery, and enhance self-financing and self-management of irrigation projects. To this aim, the project would establish Self-financing Irrigation and Drainage Districts (SIDDs). Each of them would comprise a water supply corporation, that will build, operate and maintain the reservoirs and main branch canals, and several WUAs, that will operate and maintain the lower-level irrigation systems. The latter would purchase water in bulk from the former; collect water charges and labor contributions; pay full capital and O&M costs, and exert a major influence over decisions on design, construction, maintenance and operations of the distribution systems.

The SIDDs would be legal entities under unified management for each irrigation command, based on hydraulic instead of administrative boundaries, and under the ownership, management control, and responsibility of the water users--mostly, farmers. They are expected to be more responsive to user demands and needs, and provide the basis for future expansion of this concept to other projects and provinces. They are expected to reduce and eventually eliminate dependency on government subsidies on water charges, and be freed from the limitations and uncertainties of government budgets.

Besides some country-specific constraints, like administered commodity prices, the main constraints to establish the SIDDs have proved to be: Lack of incentives for farmers to participate; fragmented responsibilities for water supply management and water charge collection; poor physical condition of existing irrigation structures in the pilot area, and complete lack of a system of enforceable water rights. Systems' design should be such that they can be operated at the lower end by WUAs, and that they can deliver to these the agreed amounts of water--which in turn requires remote sensors and cross structures, and upgraded institutional organization at the corporation level, and its expertise and skills.

Currently water charges are generally insufficient to cover the full costs of the irrigation service, the difference being met by a government subsidy. But since such subsidies are expected to decline in the future, establishing SIDDs is important to ensure the long-term viability of the irrigation and drainage schemes.

The following incentives for farmers have been set. WUAs would be allowed to assume all decision-making and management roles, along with liability for O&M and debt repayment, which gives them a real element of control over the system on which they depend and for which they will take responsibility. They will be assured, through upgrading of the physical and institutional facilities managing the main dams and canals, of a reliable water supply. Water charges would be reduced in the amount of labor they contribute to operate and maintain both the lower reaches under their control, and the upper reaches under the control of the corporation. They will also be allowed to sell water to non-members. And the current subsidy level, even though it is expected to decline over the years, will be maintained for the pilot SIDD areas at the same level as for the non-pilot areas to avoid discrimination against participating farmers as compared to farmers in non-project areas.

Source: Project Documents, World Bank.
(India - WRM Sector Review, World Bank, 1998).

Box A2.6
Successful Farmer Managed Irrigation Systems in Nepal

Nepal has two types of irrigation schemes, classified by ownership and management. Over 75% of the irrigated area of about 1.0 million ha are developed, owned and managed by farmers and are known as **Farmer Managed Irrigation Systems (FMIS).** The remaining 20% to 25% are owned and managed by public irrigation agencies, mainly by the Irrigation Department.

The New Irrigation Policies. The poor performance of the public irrigation schemes, which are under-funded for O&M, led the Government to adopt in thelate 1980s a new **Irrigation Policy (IP)** which sought to improve the management of the irrigation systems by involving water users in the design, construction, operation and management, and to enhance the private sector role in management of the public system.

Developing a Participatory Approach. The participatory based IP gives central impetus to beneficiary participation in all irrigation development works supported by the Government. It is in this context that the World Bank has provided pilot funding to an **Irrigation Line of Credit (ILC)** under the two ongoing irrigation projects to test the policy on the ground. The experience with the ILC projects has been positive on the whole. To date 240 small and medium surface irrigation schemes on about 24,000 ha and 271 medium and deep tube wells in 18 clusters covering about 4220 ha have been completed successfully under the ILC.

Demand-Led Investment with Cost Sharing. Based on the successful pilot experience, the Nepal Irrigation Sector Project (NISP) would continue financing viable private and public irrigation schemes as a first stand-alone project for this purpose. Following the Irrigation Policy, schemes would be considered eligible for funding under NISP when written demands and financial commitments for investment cost sharing are made by beneficiary farmers. A **"no payment-no project"** policy would be adhered to. Viability will however be assessed by specific technical, economic, social, and environmental merits and criteria. The minimum amount of the required labor/cash contributions varies as per type of schemes (private or public), types of development (rehabilitation or new) and source of supply (surface or ground water) prescribed under the Irrigation Policy.

Impact of the New Approaches. A mid-term review, in 1997, of a sample of 32 schemes under the ongoing ILC pilot surface and groundwater FMIS, indicated average increases in: (i) cropping intensity of over 30 % mainly in dry season; (ii) use of improved crop varieties of 47 %; (iii) chemical fertilizer use of 22 %; (iv) composite yields of 40 %; and (v) farm income per cultivated hectare of 117 %. The economic rates of return range from 15 to over 70 %. The experience with the turnover and participatory joint management in public irrigation schemes like Bhairawa Lumbini Groundwater Project, in Mahakali Irrigation I Project, and in Sunsari Morang Irrigation II Project is also very positive. Crop intensities have exceeded the projections of 180% (mainly in the dry season) and farmers incomes have increased by more than 100%. Net farm incomes increased to NRs 17,000 -24,000 per ha. Farmers' contributions to the capital investment costs vary from 12% to 14% which is about $40 to $50 per ha equivalent. The estimated employment generated per hectare is around 108 to 170 labor days. In all cases the economic rates of return range from 14% to 18%. In most cases the beneficiaries have taken over the O&M of the systems (fully or partially) so that the funding requirement on the Government has been relieved. The long established characteristics of the Nepali farmer managed irrigation systems (getting organized, having communal ownership sense, mobilizing resources for improvements and O&M of irrigation systems) has proven advantageous in launching the ILC and NISP programs.

Source: Ohn Myint-World Bank. (India - WRM Sector Review, World Bank, 1998).

Box A2.7
Restructuring the Irrigation and Drainage Public Sector in Pakistan

Pakistan has recently embarked on a major reform of the management of its irrigation and drainage system. The reforms include a major restructuring of the public sector institutions (notably Provincial Irrigation Departments (PIDS)) to provide them with new institutional incentives and structures which would enable them to be financially viable, improve operational efficiency, and promote and facilitate beneficiary and private sector participation. The reforms also include a gradual management transfer of the secondary irrigation and drainage system (below the minor/distributary level) to farmer groups.

The Indus Basin Irrigation System of Pakistan is the largest integrated irrigation network in the world, covering nearly 40 million acres. The salient features of the system are three major storage reservoirs, 19 barrages or headworks, 12 inter-river link canals, 43 irrigation canal commands (canal length: 61,000 kms) and over 107,000 watercourses (length of watercourses, farm channels, and field ditches: 1.6 million kms). Currently the irrigation and drainage system is substantially operated and managed by four PIDs, which are funded directly by the treasury and operated as government departments; and a federal agency viz., the Water and Power Development Authority.

The problems in Pakistan's irrigation and drainage system are similar to those in many other countries (as summarized in the 'Vicious Circle' diagram in Figure 2.1 of this Report). A detailed description of the major problems, their origins, and diagnosis, and the new sector strategy are outlined in, "Pakistan: Irrigation and Drainage: Issues and Options",World Bank, 1994. Some of these problems are being addressed under a World Bank assisted project, Pakistan: National Drainage Program Project (NDP), 1997. The essential elements of the institutional reforms under NDP are to: (i) redefine the roles and functions of various irrigation agencies, (ii) decentralize roles and responsibilities; (iii) streamline functions and procedures; (iv) transfer management responsibilities for those functions which should be managed by other entities; and (v) build capacity of new public and private agencies.

Public Sector Restructuring: Each of the four PIDs have been converted into autonomous public utilities called **Provincial Irrigation and Drainage Authorities (PIDAs).** Autonomous public utilities called **Area Water Boards (AWBs)** would be progressively established for management of the irrigation and drainage system of each canal command. The PIDAs and AWBs have been/will be established under the PIDA Acts enacted by each Province, and have the necessary institutional structures to manage the irrigation and drainage system on sound business principles, especially in the following aspects: (i) the PIDAs and AWBs are operationally and financially autonomous entities, and will retain their own revenues and be responsible for their own expenditures. The PIDA Acts mandate that subsidies to these entities would be progressively phased out in seven to ten years; (ii) a clear separation of the roles of government policy-making, ownership of the entities, and operations/management functions has been established to clearly define the government's role in the operation of these entities. The PIDA Acts mandate that any losses to the PIDAs/AWBs resulting from governmental directives or waivers would be fully compensated by the government. Similarly, the Government's interests as owner would be exercised through the Authority/Board of Directors of the PIDAs and AWBs which would only be responsible for establishing policy and exercising overall control and accountability, as distinct from day-to-day operations and management which would be the responsibility of management headed by a Managing Director; (iii) beneficiaries and the private sector would be involved in the oversight of the PIDAs and AWBs through their representation on the Authority/Board of Directors; (iv) since the PIDAs and AWBs are independent entities operating outside of rules and regulations applicable to government departments, they have the necessary flexibility to formulate and implement policies for providing irrigation and drainage services in line

with standard business practices, and to improve operational efficiency through professionalization, modernization, partnerships with the private sector and NGOs, and establishment of proper business and human resource policies; and (v) there would be financial and operational transparency, including preparation and publication of financial statements and operational performance (including water distribution) in line with standard corporate practice. All the above measures are expected to improve the accountability and incentive structure of these public sector institutions, and enhance their efficiency and effectiveness.

Management Transfer to User Groups: Management of the irrigation system below the minor/distributary level and the corresponding drainage system would be transferred to user groups which are in a much better position to operate the local system themselves. This would be done through progressive formation of Farmer Organizations, which would be responsible for operation and maintenance of the system, water distribution among their members, collecting user charges, and paying the PIDAs/AWBs for the irrigation and drainage services provided by these entities.

Source: Trichur Balakrishan. Substantially adapted from Staff Appraisal Report and Implementation Volume of Pakistan National Drainage Program (NDP) Project, 1997, World Bank.

Box A3.1
Government Commitment to Irrigation Reform in Andhra Pradesh

The strength of government commitment in Andhra Pradesh to irrigation sector reform is remarkable. It has been centrally important to the bold beginnings of its irrigation sector reform program. The following are excerpts from a speech given by Sri N. Chandrababu, Honorable Chief Minister of Andhra Pradesh, on the floor of the AP legislative assembly on April 2, 1998, regarding the strategy of Water User Associations (WUA) in the state.

"Our government have accorded the highest priority to the Irrigation Sector with a view to promote economic prosperity and agricultural development of the State. The strategy adopted is to not only complete the ongoing irrigation projects in the shortest possible time but to do so with the active involvement and participation of the farmers. Though Government have invested substantial public resources for the construction of a large number of irrigation schemes, the people have not derived full benefits thereunder due to inadequate maintenance and management and also due to deficient water regulation. Government has, therefore, taken the bold decision to hand-over the management and maintenance of all the irrigation schemes to the farmers' organisations. For this purpose, we have enacted the AP Farmers Management of Irrigation Systems Act, 1997."

"In June, 1997, elections were conducted to 10,292 WUAs for all major, medium and minor irrigation schemes. In November, elections to 173 Distributory Committees were also completed. In the near future, Project Level Committees will also be constituted to translate into action a total transfer of management to the farmers' organisations."

"Our Government have decided to give complete functional and administrative autonomy to these bodies and to make the Irrigation Department accountable to the farmers organisations. To begin with, the laskars working on the irrigation canals will be brought under the administrative control of the WUAs. The Irrigation Department is directed to assist the WUAs in the improvement of the irrigation systems and in the preparation of operational and maintenance plans. The functioning of the WUAs will be transparent with a high degree of social and financial accountability."

"An Action Plan has now been drawn up by the Government for taking up essential repairs and maintenance works in all irrigation systems in the State in the three months period commencing from April 1998." [Mr. Chandrababu then included a detailed account of the specifics of implementation and the financing arrangements included in the plan].

"In order to create a movement which is centred around the people and the farmers, District level conferences will be conducted to educate the farmers and particularly the WUAs in the efficient use of irrigation and to improve the agricultural production. This will be followed by a State level conference. Through this, our Government proposes to educate and also disseminate information and technology to the farmers and make them aware of their rights and responsibilities."

"Our government is for the first time embarking on creating a democratic, decentralised structure under the irrigation sector which will be totally managed by the farmers themselves. Our Government seeks the cooperation of the august House in making our efforts succeed."

Source: From N. Chandrabu, Chief Minister of Andhra Pradesh. Excerpts from speech to AP Legislative Assembly, April 2, 1998. (India - WRM Sector Review, World Bank, 1998).

Box A3.2
The Irrigation Sector Reform Program in Andhra Pradesh

India's Andhra Pradesh has recently initiated a major irrigation sector reform program. The reforms are centered on Irrigation Management Transfer (IMT) to farmers' water user organizations, and are associated with policy, pricing, legislative, public expenditure and institutional reforms. These are being followed through with a state-wide program to support the institutional and technical development of the new water user associations (WUAs), help the WUAs upgrade the irrigation and drainage systems, and help them to improve their agricultural productivity. The program is receiving financial assistance under the World Bank assisted Andhra Pradesh Economic Restructuring Project - Irrigation Component (APERP-IC) CR-3103-0 IN, LN-4360-0 IN).

The program has some similarities to the Mexico reform program (Box A2.2). The differences include that in Andhra Pradesh's program, emphasis was on simultaneous establishment across the state of grass-roots Water User Associations, with progressive subsequent establishment of the higher institutions. In Mexico, WUAs were established more progressively, though also under a fast paced program, but were followed closely by establishment of the higher farmer institutions.

The Prior Situation

The prior situation in Andhra Pradesh (AP) is analogous to common situations throughout India and many other countries, including Mexico and Turkey before their reform programs (Boxes A2.2 and A2.3). It was characterized by the "vicious circle" (main text, Figure 2.1) of government run systems, inadequate funds for maintenance, inadequate maintenance, deteriorating infrastructure, poor performing irrigation and drainage systems, farmer dissatisfaction, low water charges, inadequate revenues, and again, inadequate O&M expenditures, also compounded by limited access by farmers to improved agricultural technologies.

Government of Andhra Pradesh (GOAP) had spent large amounts on its irrigation sector (Rs. 25 billion (US$700 million), 24% of State Plan Expenditure in the last 5 years), but without achieving the desired gains in productivity. Past expenditures were focused on investment and expansion and neglected funding for adequate O&M. Salaries were barely covered, leaving negligible amounts for actual maintenance works. Compounding the financing situation were low water charges, that recovered only 25% of O&M costs. The sector was dominated by a governmental approach with minimal linkages between water users and the Irrigation and Agriculture Departments. Agricultural extension was also ineffective. The above situation resulted in inefficient and inequitable distribution of water, low yields, environmental problems (waterlogging and salinization), and dilapidated and deteriorating systems. Perhaps the most dramatic illustration of the problem was Andhra Pradesh's finding that, despite its large investment expenditures in the sector, irrigated area was actually declining in the early 1990s: from 4.3 million ha. in 1991, to 3.9 million ha. in 1994.

Antecedents to Change

Growing realization of the need for change stemmed from the government's inability to manage the system, farmer dissatisfaction, and the absence of farmer involvement and ownership in the irrigation systems. This led, in 1996, to preparation by GOAP of a candid diagnostic of the state's irrigation sector issues, presented in a "White Paper", which was extensively discussed within the state. The question, then, was "How to change?" This question coincided with new found awareness and experience in irrigation sector reforms. At the end of the Andhra Pradesh Second Irrigation Project, and during preparation of the Andhra Pradesh Third Irrigation Project, water user associations (WUAs) were piloted on two commands covering an area of about 8,000 ha each. These pilots were successful. Thirty-two WUAs were established and the farmers showed keen interest, taking over

O&M, distributing water more equitably amongst themselves, and consequently irrigating about 25% more area. Other activities in India also provided experience, piloting of WUAs in Orissa, and Tamil Nadu under the Bank assisted WRCPs, exposure of several GOAP officers to best practices in other countries through study tours; the dialogue associated with the GOI/World Bank Water Resources Management sector work, and dialogue, and workshops on Participatory Irrigation Management in India sponsored by GOI and the World Bank (SASRD/EDI).

The most important feature enabling commencement of the reform program has been the strong and visionary leadership from the top. Andhra Pradesh's Chief Minister has taken a personal interest in the reform program, has gathered highly competent officers around him, and has urged radical approaches throughout (refer Box A3.1). It was decided, based upon previous experience, that farmer empowerment and management would be the heart of the reform program. It was also decided that a bold strategy was preferable to an incremental one; hence the formation of WUAs across the state (3.9 million ha.). In order to achieve this, the GOAP began a highly public and transparent change process, with all political parties involved and a massive public education campaign. Rural rallies and the media were used, as well as local NGOs.

Another important element was the careful working out of the reform strategy and its implementation features. Successive refinements of the approach, including use of workshops, and preparation of a state Irrigation Sector Policy articulating the vision and reform actions helped this process. The reform program has commenced on a number of fronts simultaneously: the development of farmer organizations; improvement of cost recovery and financial sustainability; and work on system rehabilitation and deferred maintenance.

Reform Actions to Date

Actions taken thus far by the GOAP, all in the last 15 months, have been extensive and rapid. They comprise:

- **Issuance of a new Irrigation Sector Policy**: This document "Reforming the Irrigation Sector for Sustainable Management and Development" was prepared in 1997 and after extensive discussion, was approved by the Cabinet in March 1998. It provides a diagnostic of the state situation, a discussion of the reform agenda and a detailed presentation of the short and medium-term implementation program.
- **Tripling of Water Charges:** AP tripled water charges in 1997. They now amount to some 75% of estimated O&M needs, and further revenues generation is expected from an ongoing campaign to increase collection percentages.
- **New Legislation for Farmer Management of Irrigation:** The "Farmers Management of Irrigation Systems Act"of 1997 provides a comprehensive legislative base for the reform program and for farmers organizations to take over management of the state's irrigation systems (refer Box A3.3). The "Operational Rules" for the FMIS Act were subsequently issued later in the year.
- **Community Outreach:** The new policy and opportunities were extensively discussed throughout the state, including rural rallies in every district addressed by the Chief Minister, state-level large conventions, and smaller workshops including NGOs. Farmer views helped crystallize the policy and program, and the process built substantial consensus and commitment, both in the community and at political levels.
- **Creation of Water User Associations Across the State:** In June 1997, following intensive preparation and mobilization of the entire district-level government apparatus, elections were held for Water User Associations (WUAs) for all major, medium and minor surface irrigation

schemes in the state. In all, 10,292 WUAs were created, covering an irrigated area of 4.9 million ha. In November, 1997, elections were in turn held for "Distributary Committees" each comprising a group of WUAs in a hydraulic system. Elections will later take place for "Project Committees" (federations of Distributary Committees at scheme level). Then, elections to an "Apex Committee" are planned, which will represent farmers in state-level decisions on irrigation policy and priorities (WUA logo at Box A3.4).

- **Establishment of a Water Pricing Institution:** A "Water Charges Review Committee" (WCRC) was created in December 1997 (refer Box A3.5). The WCRC is a permanent body with responsibility to undertake annual review of financial performance, O&M needs and expenditures and water charges, and to guide the transition to collection of water charges directly by WUAs and I&CADD, retention of such fees to cover respective O&M costs to ensure their financial viability, and transition to use of volumetric charges (refer Box A3.5). WUA representatives are included in the WCRC.
- **Major WUA, Staff and NGO Training Program:** Following preparation of detailed training modules, and training of trainers, a major training campaign was launched in October 1997, using rural facilities throughout the state. The campaign is seen as needing a continuous major effort of general, specialist and repeater training for all parties involved. Several rounds of training have already been conducted at WUA levels, involving all 10,000 plus WUAs. Staff and NGO workshops and training have also been conducted.
- **Joint Farmer-I&CADD Walkthroughs of all Systems:** In late 1997/early 1998, joint "walkthroughs" were undertaken of all irrigation systems involving the WUAs and the I&CADD staff (from henceforth AD staff should also be involved in such planning and discussion for a). The walkthroughs enabled joint diagnostic of scheme deficiencies and needs, and were the basis of the subsequent minimum rehabilitation and maintenance program (see below).
- **Launching the First Field Campaign**: It was recognized that early activity by the WUAs, and early experience of benefits would be important to WUA confidence and further change. A major field campaign was thus launched in early May 1998 to undertake deferred maintenance and minimum rehabilitation on as broad a scale as possible to get some benefits even from the July 1998 Kharif season. In the six weeks up to end June 20, 1998: (i) Rs 1076 million (US$27.2 million) were released to WUAs for WUA implemented works on tertiary systems, of which about 80% had been spent by the WUAs; (ii) Rs 620 million were released for main system works of which Rs 430 million were spent. (Of note is that WUA interest resulted in a substantial part of these works--desilting, some structure repairs--were done by the WUAs, whereas it had been anticipated that they would be done by government (I&CADD). I&CADD thus concentrated on more complex works such as repairs of cross regulators and gates.); (iii) release of Rs 380 million (US$9.6 million) for WUA maintenance works on minor schemes.

The APERP-IC Program

The Irrigation Component of the Andhra Pradesh Economic Restructuring Project is designed to operationalize AP's Irrigation Sector Policy Statement. Various advance implementation actions were undertaken by AP during the project preparation period (refer above). Project components comprise: (i) Irrigation Performance Improvements through minimum rehabilitation of all major and medium irrigation and drainage schemes (2.4 million ha), a state-wide maintenance program; and a pilot program for more intensive scheme modernization; (ii) a program to support agricultural intensification through upgraded agriculture department capabilities directed to the WUAs; and (iii) support to institutional strengthening and evolution for WUAs, I&CADD and WCRC. The

project includes various studies and study tours to prepare for subsequent phases of Andhra Pradesh's reform program.

Likely Key Features for Success

Some of the key elements are likely to be: (i) continued political and government commitment, particularly until WUAs are strong enough to themselves lead change; (ii) quick realization of full financial viability and self reliance for both WUAs and I&CADD (on O&M); (iii) successful build-up of the higher level farmer entities (distributory and project committees); (iv) use of a "demand-led" approach in investment and provision of services, with WUAs sharing investment costs, fully paying for the irrigation service, and with the service provider (I&CADD and eventual WSAs) responsive to and accountable to the client (WUAs); (v) continuous monitoring and reassessment of progress and results, and continuous adaptation based on lessons of experience; and (vi) willingness of the state government to effect further institutional change once the initial demands of the first phase of reforms enables effort to follow-on steps.

Options for the Future

The menu of future options are largely discussed in the main text of this report. They include in particular the further evolution likely desirable on the institutional side. I&CADD and the WUAs should consider the further options for unbundling, restructuring, decentralizing, corporatizing and commercializing I&CADD, including establishment of client-driven Water Service Agencies (WSAs), and autonomous irrigation commands. WCRC also has room for further evolution into a more independent regulatory body, with possible lessons from the Orissa power sector reform program (Box A3.6).

Source: Adapted from: Keith Oblitas: "Commencing a Reform Program for Farmer Management of Irrigation Systems - The Case of Andhra Pradesh"; presentation for World Bank Rural Week (March, 1998); APERP Project Appraisal Document, Report No: 17710-IN, May 1998, World Bank; and I&CADD, GOAP. (India - WRM Sector Review, World Bank, 1998).

Box A3.3
The Legal Framework for Farmers' Organizations in Andhra Pradesh

Since the Constitution of India has prescribed that water, as a general rule (except where List I, Entry 56 of Schedule VII of the constitution may be relevant), is a state matter, the legal framework for establishment and operation of water users' associations (WUAs) has consequently fallen in that category. To give some guidance, the central government has issued the National Water Policy which is not a legislation, but a policy statement of best practices aimed at influencing legislation, policies and practices of the states of India on water related matters. On participatory irrigation management, the National Water Policy urges that "Efforts should be made to involve farmers progressively in various aspects of management of irrigation systems, particularly in water distribution and collection of water rates. Assistance of voluntary agencies should be enlisted in educating the farmers in efficient water use and water management."

Initiatives in Various States. Until 1997, none of the states in India had passed a specific law on WUAs. In the absence of a basic law specifically on water or on WUAs, irrigation departments in some states relied on different laws for establishing WUAs. In Maharashtra, WUAs are established and registered as co-operative societies under the "Co-operative Societies Act." On the other hand, in Tamil Nadu and Orissa, WUAs are established and registered as societies, under the "Societies Registration Act." Societies, including WUAs, established and registered in any state in India under the Co-operative Societies Act, or the Societies Registration Act, are legal entities capable of contracting, opening and operating bank accounts, and instituting and answering suits. However, because of their nature, those two Acts do not address WUAs related issues that are usually addressed in the basic water law or the law establishing WUAs. In some states, e.g., Tamil Nadu and Orissa, WUA model bylaws and a Memorandum of Understanding between WUAs and the irrigation agency have also been drawn up.

The Andhra Pradesh FMIS Act. Andhra Pradesh made history by becoming the first Indian State to adopt a law specifically designed for farmers' organizations. **The Andhra Pradesh Farmers' Management of Irrigation System Act, 1997**, came into force on April 9, 1997. The Act was subsequently followed by the issuance on April 30, 1997 of **The Andhra Pradesh Farmers' Management of Irrigation System Rules, 1997**, which laid down detailed implementation provisions to the 43 articles of the Act. The Act and the Rules apply to the entire state of Andhra Pradesh, and define 'farmers organizations' to include water users' associations at the primary level, distributory committees at the secondary level, and project committees at the project level. Every farmers' organization is considered a body corporate vested with the powers of entering into contracts, and of doing all things necessary for the purposes for which it is constituted, and it can sue and be sued in its corporate name.

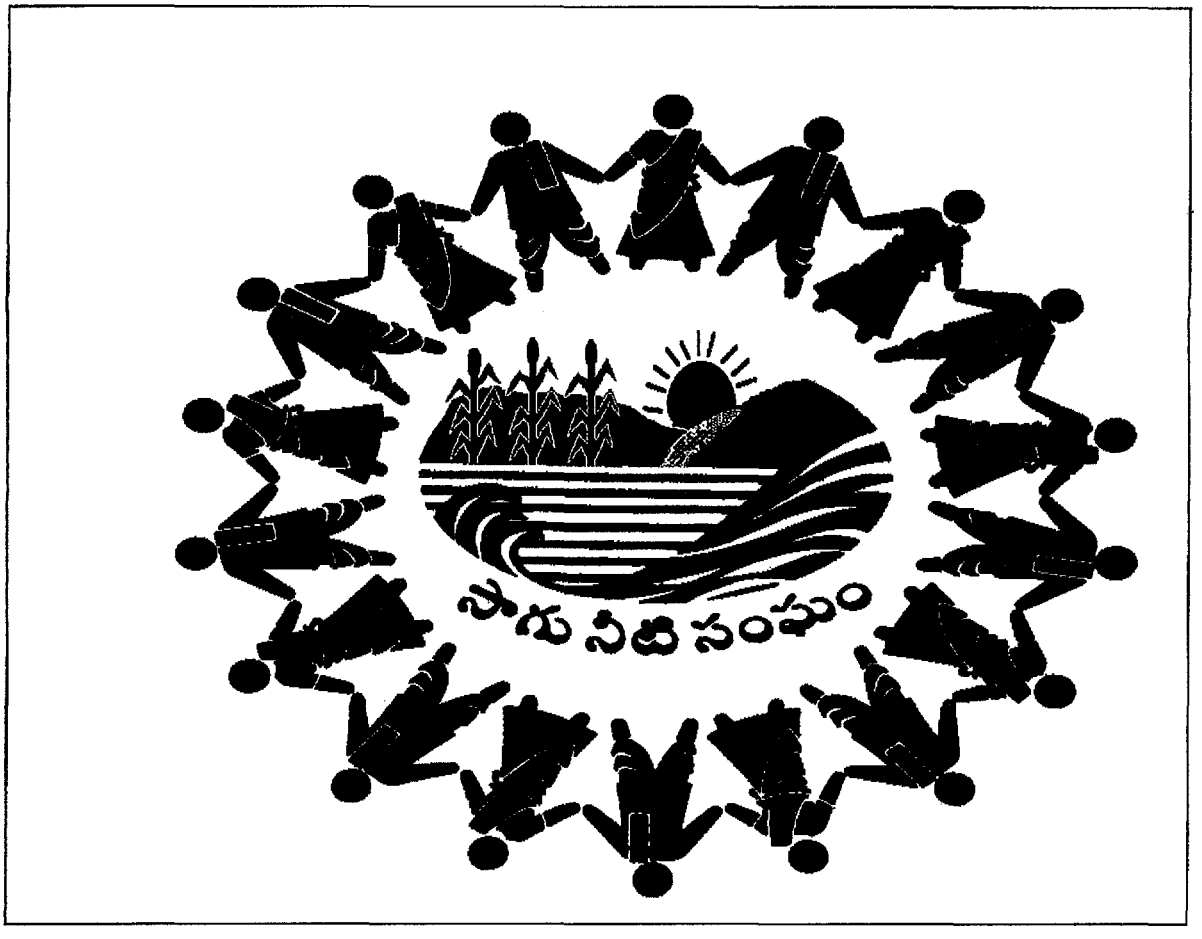
The Act lays down the functions of the WUAs which include preparation and implementation of a rotational water supply schedule for each irrigation season, preparation and implementation of a plan for the maintenance of the irrigation system, regulation of water use, monitoring flow of water for irrigation, regulation of the use of water among the various pipe outlets and collection of water rates, and conducting of regular water budgeting. The functions of the distributory committee include preparation of an operational plan based on its entitlement area, preparation of a maintenance plan of both distributories and medium drains, and regulation of the use of water among the various members. The functions of the project committee are largely similar to those of the distributory committee, but limited to the project area. In addition, the Act authorizes the establishment of an Apex Committee for the purposes of laying down policies for implementation of the provisions of the Act, and giving such directions to any farmers organizations as may be considered necessary.

Model Farmers by-laws and **Memorandum of Understanding** between the Farmers' Organization and the Irrigation Department have also been issued. Also, Andhra Pradesh passed on April 14, 1997, **The Andhra Pradesh Water Tax (Amendment) Act, 1997**, which tripled irrigation water charges to: (i) Rs.200 per acre for monsoon wet crops, and Rs.150 per acre for dry season wet crops; and (ii) a uniform rate of Rs.100 per acre for dry crops, irrespective of the season of cultivation. A **Water Charges Review Committee** has also been established, to undertake reviews of collection, revenues and O&M expenditure needs.

The steps so far by Andhra Pradesh make it the first Indian state that has established a comprehensive legal framework for, and taken such significant steps in, the area of, participatory irrigation management.

Source: S. Salman, World Bank.(India - WRM Sector Review, World Bank, 1998).

Box A3.4
Logo Representing the Andhra Pradesh WUAs:
Symbolic of Success and Efficiency Through Collective Action



The WUAs of Andhra Pradesh have created a logo to represent their more than 10,000 groups. The above logo is described by the WUAs as:

> "...a visual depiction of the complete water management system, with its various components coming together in an integral mnemonic. It attempts to capture the essence of the entire system."

The system has its origins in nature, visually depicted by the rising sun in the horizon of a bright sky and green earth. A river shown emanating from this horizon forms the input source of the water management system. The next layer in the logo is a bund which indicates a storage of water, visually depicted by bold horizontal lines, indicating the static nature of stored water. This is followed by a wave leading to a crop which indicates efficient management of the available water. Therefore, this logo covers the system right from its origin to the end use. The human chain depicts the harnessing of the resources by the members through collective action for their common good.

(A color version of) "the logo has bright, warm and lively colors, depicting happiness and prosperity. Happiness and prosperity that accrues as a member of the Water Users' Association "Saguenetti Sangham".

Source: Andhra Pradesh Water User Associations Manual. (India - WRM Sector Review, World Bank, 1998).

Box A3.5
Government of Andhra Pradesh: Order Forming the Water Charges Review Committee to Fully Cover O&M Costs for Irrigation

The state of Andhra Pradesh, with full awareness of the inefficiency, ineffectiveness and substantial costs of its irrigation sector, began a reform program to bring about the long term goal of financial self sufficiency for the sector. One element is to achieve pricing to enable the sector's financial self-sufficiency. Andrah Pradesh tripled water charges in 1997. It was also recognized that an institutional capacity was needed to undertake annual reviews of revenues and O&M costs. This led to establishment of a Water Charges Review Committee (WCRC). As described in the Government Order below, by establishing WCRC to annually review water rates, the linkage between costs and quality of service was restored, and a critical point of intervention in the vicious circle taken to help bring about a reform to the virtuous circle.

Subject: Water Charges Review Committee (WCRC) - Fixing and Review of Water Charges to Cover Full O&M Costs - Constitution of WCRC - Orders - Issued.

G.O.Ms. No. 225 Date:08-12-1997

"1. It is a matter of concern that irrigation projects completed at substantial cost have over the years failed to provide irrigation to the ayacut originally contemplated as a result of poor maintenance of the entire system. Inadequate budget provision for maintenance of the systems has not only created problems of water being provided only for a part of the contemplated ayacut but also generated problems of excess utilisation of water in the head reaches resulting in problems of drainage and salinity etc. One of the main reasons for insufficient budget provisioning is the competing demands from various sectors for scarce resources and absence of linkage between the water rates collected and application of those funds for maintenance of the irrigation system. The problem is further compounded by the present rate structure, which does not cover even a portion of the cost of desirable levels of maintenance.

2. The Finance Commissions appointed once in five years by the Government of India to determine the shares of states in the revenues raised by the Union Government examined the issue of neglect of maintenance of irrigation projects/schemes and made recommendations regarding the desirable levels of maintenance expenditure and made suitable provisions in their forecast of States expenditure commitments for the five year period. They had also recommended that the expenditure on maintenance of the irrigation sources should be met by a corresponding increase in levy and collection of water rates from the beneficiaries of the irrigation systems. Though the State has been increasing the maintenance grant periodically, it has been found to be inadequate to meet the full requirements of maintenance due to steep increases in staff expenditures and cost of materials, wages of the labour etc. The water rates have also not kept pace with the increasing requirements for maintenance and in view of the various commitments of the State on limited revenue resources the budgetary support for maintenance of the irrigation system has been found to be inadequate.

3. The Government is of the view that there is urgent need for greater attention paid to the maintenance of the irrigation projects/schemes already commissioned and the water rates should be enhanced periodically to meet the increasing maintenance requirements. Government hereby constitute a Standing Water Charges Review Committee (WCRC) as indicated below:

Principal Secretary Irrigation	Chairman
Principal Secretary Revenue	Member
Secy. to Commissioner, Land Revenue	Member
Secy. Finance & Planning (Finance Wing)	Member

Secretary Energy	Member
Secretary Industries	Member
Secretary Panchayat Raj	Member
Secretary Municipal Administration	Member
Secretary Irrigation (CADA)	Convener
Secretary Agriculture	Member
Director, Ground Water Deptt.	Member
Commissioner, CADA	Member
Engineer-in-Chief (Irrigation)	Member
3 Nominees from Apex Committee	Members
Consultant (appointed by Govt.)	Member

4. The three Members referred to above from "Apex Committee" (constituted under the Andhara Pradesh Farmers Management of Irrigation Systems Act 1997) shall be nominated by the Apex Committee as their representatives on the WCRC.

5. The consultant referred to above will be appointed by the committee and will have expertise in economic and financial disciplines. The consultant will undertake periodic (as required) and an annual analysis and review report each year and the direction of the committee, and provide other analytical advisory services to the committee as may be required by the committee.

6. The WCRC shall also have a small core-working group termed the WCRC Technical Working Committee to undertake the analytical and report preparation work required by the WCRC. The Technical Working Committee shall comprise the Commissioner CADA (Chairman), the Additional Secretary, Irrigation (Convenor) and the Consultant plus other invited Members or subject specialists as may be required from time to time.

7. The objective of the review of the water charges is to ensure that the water charges and their collection rates provide revenues sufficient to cover:

(i) the desirable level of maintenance works required to maintain the system to ensure that irrigation systems operate at the optimum level as well as;

(ii) the establishment cost and other recurrent costs (e.g., fuel, electricity and other overheads) required for operating and maintaining the systems in a reliable, economical, equitable and predictable manner; and

(iii) phased introduction of an affordable presentable addendum to water charges to be placed in a reserve fund for future contingencies and renewal of the infrastructure; and

(iv) passed transition from the present system whereby revenues assessed on per acre basis are collected by the Revenue Department to volumetric assessment of water charges collected by WUAs, with agreed share retained by WUAs, distributory committees, project committees, apex committee and I&CAD.

8. In making its recommendations, the committee shall:

(i) review data on operation and maintenance expenditure incurred at the time of review;

(ii) evaluate the adequacy of maintenance carried out and identify the causes of inadequacy, if any, and determine the levels of maintenance requirements;

(iii) review the water charges, collection rates and total revenues received, including from services (e.g., bulk water supplies) to non-agricultural users;

(iv) assess appropriate measures through publicity, extension campaign and incentives to achieve high collection percentages;

(v) monitor and make periodic recommendations relative to the phased transition to farmer and I&CAD managed collection of water charges and volumetric charging (para 7 (iv));

(vi) examine the structure of staff and work charge numbers and costs relative to actual requirements for O&M and identify any excess staff costs not to be borne by water users and to be subsidized or otherwise dealt with by Government and make recommendations on how to increase O&M efficiency and reduce excess staff cost burdens; and

(vii) annually share the findings of its analysis and recommendations with the "Apex Committee" constituted under the Andhra Pradesh Farmers Management of Irrigation Systems Act, 1997.

9. The WCRC shall meet at least once in a year (its Technical Working Committee would require meeting frequently for guidance of studies and analysis) for undertaking various studies and make recommendations to the Government on an annual basis the water rate to be levied the expenditure requirements for the maintenance works of the irrigation systems and other recommendation areas as described in paras 7 and 8 above."

Next Steps for Consideration: As indicated in the Government Order above, establishment of The WCRC represents a tangible beginning in the Andhra Pradesh's irrigation sector. Currently, the WCRC does not have the desired level of autonomy for setting water rates, but does provide expert input to the process. Future steps in the evolution of Andhra Pradesh's reform program should include: Granting the WCRC full autonomy to set water charges; vesting the WCRC with regulatory authority over the irrigation sector, and the continued decentralization and privatization of the sector. This process is not new to India, and is being successfully initiated for the power sector in the state of Orissa.

Box A3.6
Orissa State Power Sector Reform: An Example for the Irrigation Sector

Orissa, as a pioneer among the states in India, is restructuring and substantially privatizing its power sector. The government's ultimate objective is to withdraw from the power sector as a utility operator and initiate competitive, privately managed utilities to take over the operations in an appropriately regulated power market. The following story is both interesting and applicable to the irrigation sector. The regulatory commission, a critical part of Orissa's power sector reform, is a fully autonomous example for the Water Charges Review Committee (WCRC) currently in Andhra Pradesh or for initiatives in other states.

At the state level, Orissa has enacted an amendment to India's national electricity acts of 1910 and 1948. Enabling legislation for reform, the Orissa Electricity Reform Act became effective on April 1, 1996. The Orissa Electricity Regulatory Commission (OERC) an autonomous regulatory commission as provided for under the law, was subsequently established. The OERC was formed to ensure the operational, managerial and financial autonomy of the new utilities and companies in Orissa's power sector. The commission is also charged with promoting transparency, efficiency, and economy; and to help Orissa attract private capital for power sector development while safeguarding the interests of the consumers.

The OERC, India's first state-level regulatory commission in the power sector, consists of a Chairman and two additional members. The commissioners' qualifications and appointment procedures and the conditions of appointment are specified in the legislation to ensure the selection of qualified persons. The Government is committed to allowing the new OERC to operate with the level of autonomy and independence provided for in the legislation. The costs of regulation will be met by the Government.

The OERC has the authority, and responsibility, to issue licenses to electricity distributors. Drafts of such licenses have been prepared. The Regulator would regulate licenses in the performance of their statutory and license obligations. This includes: (i) the setting of retail tariffs of distribution companies and bulk supply and transmission tariffs; (ii) related performance standards in the supply of electricity; (iii) performance standards in the promotion of efficient use of electricity by consumers to be achieved by the licensees; and (iv) settlement of certain disputes between licensees and consumers. The legislation authorizes the OERC to vary the principles to be used in regulating licensee's charges from those contained in former law. Most importantly, passing through of costs irrespective of performance is no longer automatic and the rate of return is not guaranteed, but is conditional upon performance. The OERC need not issue licenses to generators or directly regulate the tariffs or quality of service of generating companies operating in Orissa. This will possibly be accomplished through the main distributor (GRIDCO), which in its license is not able to automatically pass on costs, specifically under unreasonable power purchase agreements. Therefore, the licensing process, in and of itself, has begun a process of internal regulation within the power sector.

The regulatory functions are conducted, with transparency and fairness, and with the participation of stakeholders and feedback mechanisms with power suppliers providing information to the Regulator on their performance and costs. The OERC ensures that: (i) utilities operating within agreed parameters earn a commercial rate of return on the shareholders equity and are able to raise a reasonable share of their financing requirements for future investments through internal cash generation after meeting income tax and dividend requirements; and (ii) the rights of all categories of consumers are protected, e.g.,. with respect to the cost, efficiency and quality of service.

The OERC is underway, having announced its first tariff decision and issued licenses to the transmission and distribution company (GRIDCO) in March 1997. The Commission's Tariff Order authorized GRIDCO to adjust its tariffs effective from April 1, 1997, including a demand for restructured residential and agricultural tariffs, so as to contain cross-subsidization. The example provided by Orissa's power sector reform program is being used currently in Haryana, which is commencing a power sector restructuring program based upon the experience in Orissa.

This sectoral reform model should be seen by the irrigation sector as a comprehensive one, demonstrating a method for achieving sectoral restructuring, corporatization, commercialization, privatization, competition, tariff rationization and autonomous regulation. These activities all directly pertain to the future of irrigation sector reforms in India. The example has been partially used in current reforms in Andhra Pradesh, with its WCRC potentially evolving to an autonomous regulatory body in the irrigation sector.

Source: India, Orissa Power Sector Restructuring Project. Staff Appraisal Report. World Bank, 1996. Report No. 14298-IN. India , Haryana Power Sector Restructuring Project. Project Appraisal Document. World Bank, 1997. Report No. 17234-IN. India, Country Economic Memorandum. "Sustaining Rapid Economic Growth." World Bank, 1997. (India - WRM Sector Review, World Bank, 1998).

Box A3.7
Orissa and Tamil Nadu: Institutional Reorganization - Part of Irrigation Reform

In 1994 and 1995, based upon preliminary Institutional Studies for their respective WRCP projects, Tamil Nadu and Orissa undertook reorganizations of the institutions that administer their irrigation sector. In Tamil Nadu, the state Public Works Department (PWD) was bifurcated into a Water Resources Organization (WRO) and a PWD for non-water related public works. In Orissa, the Irrigation Department (ID) was restructured into a specialized state water agency, called the Department of Water Resources (DOWR).

The need for organizational reform was brought out through the comprehensive institutional studies undertaken by both states. These studies found that the institutional structures in both states had numerous lines of authority and their functional capabilities were diffused throughout the organizations, with overlapping technical and geographical jurisdictions. An example of this was that the Chief Engineers in Orissa all had responsibilities for both construction and maintenance, with no specific unit for setting standards and monitoring program performance. Because of the frequent transfers of technical personnel without regard to functional expertise there was a marked lack of specialization to meet the challenges of a technological world. These conditions were exacerbated by the lack of certain corporate management concepts (in both states) such as programming and budgeting, cost accounting, monitoring and evaluation, and management information systems. There was also a lack of basin management practices and of decentralization of responsibilities and authorities to basin levels. Finally, the skills mix in both states was almost entirely limited to engineers, with only limited presence of other disciplines such as financial, corporate and personnel management, economics, other social sciences (anthropology, sociology, gender and community organization skills), agriculture, environmental management, R&R, statistics, monitoring and evaluation, computer skills, public information and outreach skills, etc. Even within the engineering cadre, civil engineering predominated, with limited skills in hydrology, hydraulics and basin modeling. O&M as a professional discipline was not commonly found and lacked modern O&M management and planning practices. Women cadres were a rarity. These conditions were encountered in both states, where it was concluded that institutional arrangements could not adequately embrace the modern management requirements which include the devolution of decision making authority to the lowest possible level, water management on basin principles, personnel development, specialization, corporate management techniques, career structure for all staff and a broader range of disciplines than engineering alone.

The overall objectives of the institutional restructurings were to:

- broaden responsibilities sector to include technical responsibility for basin planning;
- decentralize management along river basin lines including substantial transfer of decision making to field basin managers (CE rank);
- create functionally specialized and separate line and administrative units. The line units were made responsible for key functions of operations (water planning, project planning and formulation, design and research, water service, hydrometry, etc.), and administrative units were also created (management information systems, programming and budgeting, monitoring and evaluation, procurement, public information, personnel management and training, etc.),
- create a decision forum and a specialist technical secretariat for multi-sectoral water allocation, planning and management (The Water Resources Board, chaired by the Chief Secretary and serviced by the Orissa Water Planning Organization in the case of Orissa, and the Water Resources Control and Review Council, chaired by the Chief Minister, and serviced by the Institute of Water Studies in the case of Tamil Nadu; refer to the WRM Report on

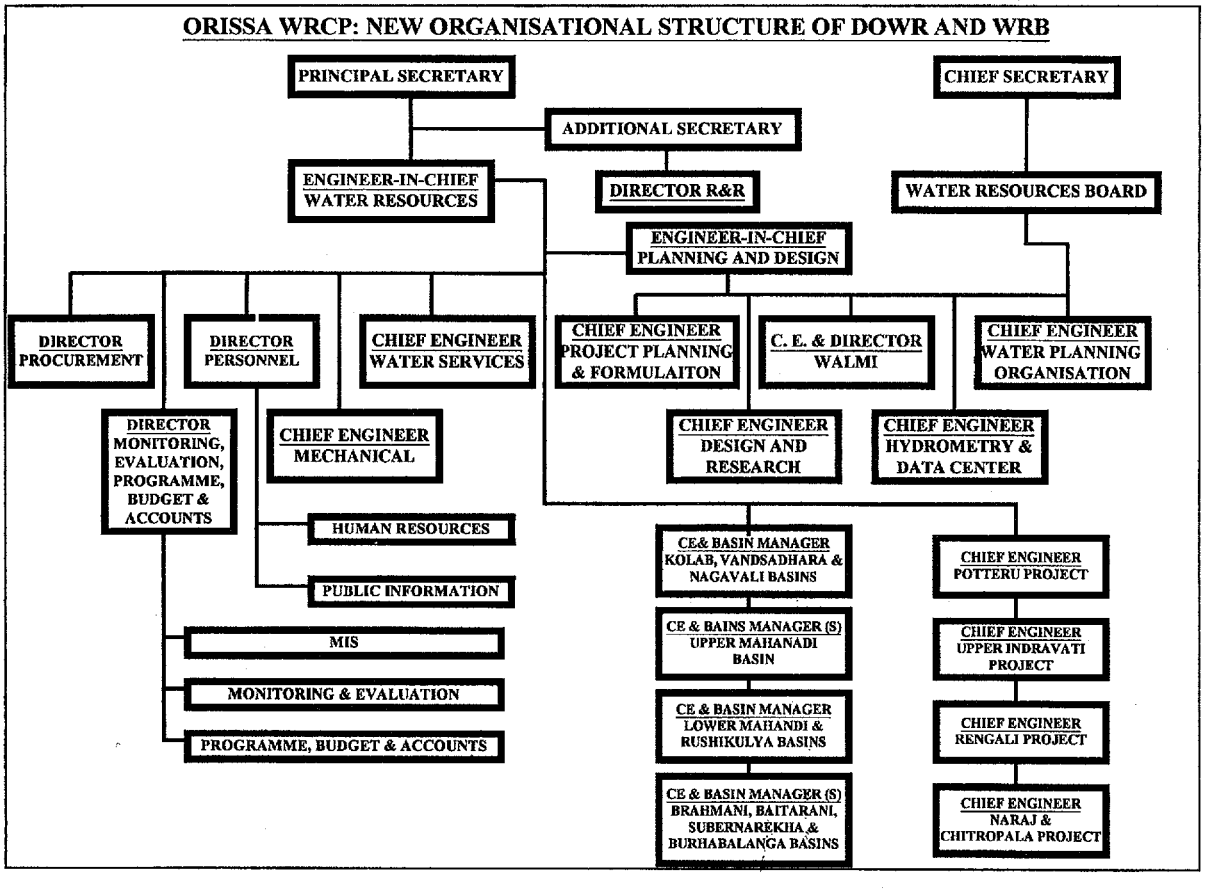
Intersectoral Water Allocation, Planning and Management (World Bank, 1998) for more detailed discussion); and

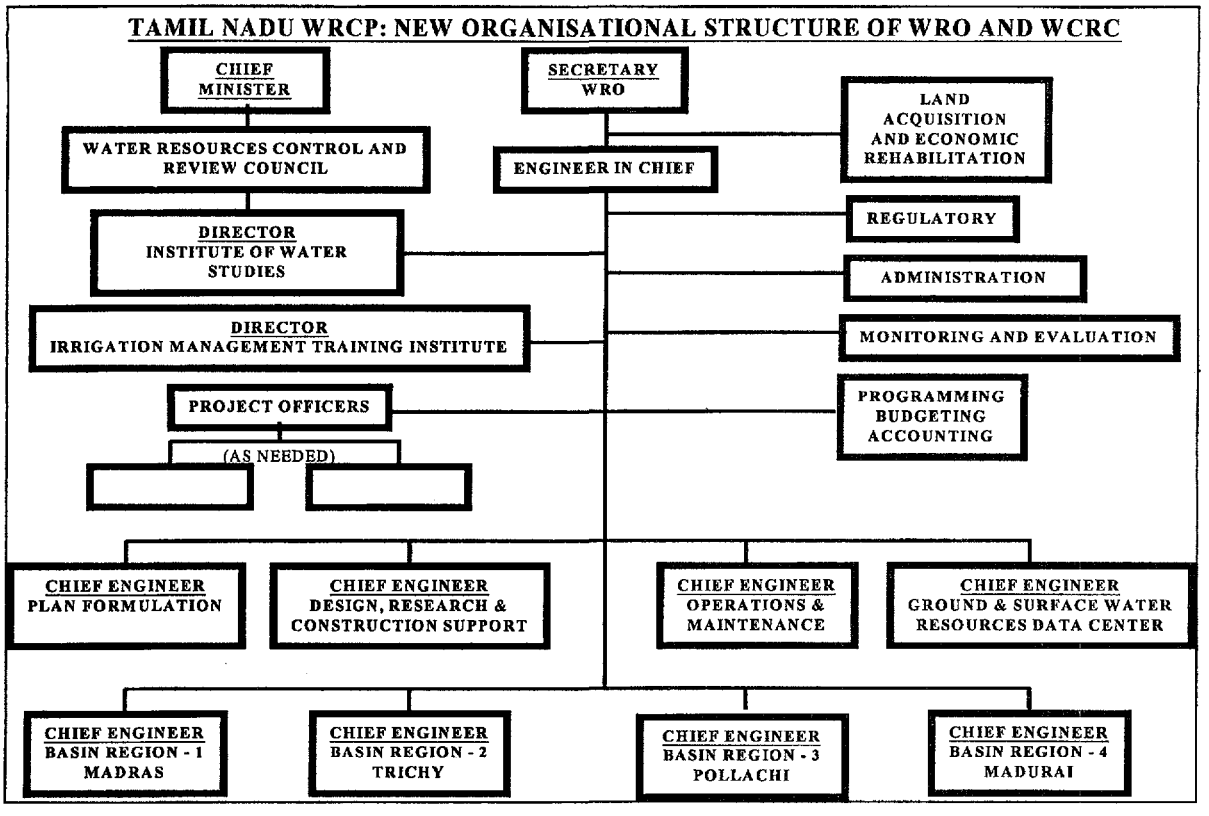
- create institutional capacity for implementing water sector related R&R and environmental management.

Examples of the resultant organizational structures in Orissa and Tamil Nadu after reorganization are presented below. While the DOWR and the WRO are new institutions, their impact on the sector is already felt. In Orissa's case, the restructuring was relatively straightforward and beneficial impact was almost immediate; with marked acceleration and improved quality of civil works, new capacity in basin planning and environmental management, and developing farmer organizations, corporate management and O&M skills. The major decision in Tamil Nadu to bifurcate PWD was both a courageous decision (implemented despite concerns of many staff), and has required longer to settle down. The presence now of an engineering cadre solely concerned with water is, however, beginning to pay off.

Both organizations, and other states, should begin to think of next steps. Models include the evolution that has taken place in Australia (See Box A2.1.), and the Orissa Power Sector Model (See Box A3.6). As discussed in the main text, Indian states should now be thinking not only of the above, but also of creation of financially autonomous irrigation or water service agencies, much broader transfer of management to WUAs as being done in Andhra Pradesh (see Box A3.2), unbundling of certain activities for private sector involvement, and strengthening of resource management along basin lines.

Source: India, Orissa WCRP, Staff Appraisal Report. 1995. World Bank, Report No. 14888-IN. India, Tamil Nadu WRCP, Staff Appraisal Report, 1995. World Bank, Report No. 13506-IN. (India - WRM Sector Review, World Bank, 1998).




TAMIL NADU WRCP: NEW ORGANISATIONAL STRUCTURE OF WRO AND WCRC
CHIEF MINISTER
SECRETARY WRO
LAND ACQUISITION AND ECONOMIC REHABILITATION
WATER RESOURCES CONTROL AND REVIEW COUNCIL
ENGINEER IN CHIEF
REGULATORY
DIRECTOR INSTITUTE OF WATER STUDIES
ADMINISTRATION
DIRECTOR IRRIGATION MANAGEMENT TRAINING INSTITUTE
MONITORING AND EVALUATION
PROJECT OFFICERS
PROGRAMMING BUDGETING ACCOUNTING
(AS NEEDED)
CHIEF ENGINEER PLAN FORMULATION
CHIEF ENGINEER DESIGN, RESEARCH & CONSTRUCTION SUPPORT
CHIEF ENGINEER OPERATIONS & MAINTENANCE
CHIEF ENGINEER GROUND & SURFACE WATER RESOURCES DATA CENTER
CHIEF ENGINEER BASIN REGION - 1 MADRAS
CHIEF ENGINEER BASIN REGION - 2 TRICHY
CHIEF ENGINEER BASIN REGION - 3 POLLACHI
CHIEF ENGINEER BASIN REGION - 4 MADURAI

Box A3.8
Expenditure Prioritization in the Irrigation Sector: General Principles in Orissa and Andhra Pradesh

Expenditure re-prioritization programs have been undertaken, in Orissa and Andhra Pradesh. Previously, expenditure was spread too thinly over a wide array of construction sites to the detriment of speedy completions and the early generation of benefits at any site. More critical, as in most states in India, maintenance was severely underfunded, and inadequate funding was going to rehabilitating and improving existing systems. The new priorities are in effect, a complete reversal of the past order of priority in the composition of public expenditure in irrigation. The priorities will now first jointly emphasize capacity development through training and institutional reforms, and O&M, then rehabilitation and modernization; and, finally, highly targeted new construction and completion of ongoing projects. Now, budget funds are allocated in the following order of priority:

- joint equal first priority to be: (i) institutional strengthening activities to better manage the state water resources; and (ii) assured of full funding for operations and maintenance activities;
- secondly, rehabilitation and modernization of irrigation systems, including turnover to WUAs;
- thirdly, completion of viable ongoing projects on a priority basis. New construction undertaken only after the above budgetary items have been met.

The first two items have first call, and demand full funding under any reasonable scenario of the state's financial situation. Then, completion of ongoing schemes and selective new investment is an area where difficult priority decisions are required. The sizable backlog proposed and ongoing projects must face up to the overall program's budgetary limitations, and the need to assure that all projects are prepared according to acceptable engineering, economic, environmental, and social criteria, and in the context of the state's individual river basin and overall state water plans. In fact, basin planning, project planning, and expenditure prioritization are now interactive processes, each feeding into each other.

The new expenditure prioritization approach is establishing the following "drivers" as well: (i) annual examination of expenditures using the above prorate ranking. A zero-based budgeting system will be introduced for analysis; (ii) introduction of discounted cost-benefit procedures to evaluate investment proposals, and more rigorous technical evaluations; (iii) introduction of cost sharing and requirements for community participation as a basis for investment. These activities will help foster a sense of community ownership which is critical to the functioning of inbuilt self-selection processes regarding expenditure prioritization; and (iv) progressive development of improved hydrological assessments and comprehensive basin and state water planning, to establish a technical and social development framework within which to evaluate the state's water investments as a whole.

Source: Adapted from: (India, WRCP Staff Appraisal Report. World Bank, 1995. Report No.-14888IN. and India, APERP Irrigation Component. World Bank, 1998). (India - WRM Sector Review, World Bank, 1998).

Box A3.9
Expenditure Prioritization: The Case of Harabhangi Project in Orissa

While preparing the Orissa WRCP, it was determined that there were extreme weaknesses in the expenditure prioritization of the Orissa ID. Investment was widely dispersed over too many construction sites, with insufficient funding for each. Even more serious was the past neglect of maintenance of existing schemes, many of which had become dilapidated. The analysis yielded a great many stories that are similar to the Harabhangi irrigation project, presented here as an example. The above situation is a common story in states throughout India.

Started in 1979/80, the Harabhangi project was due for completion before the end of the 8th Five Year Plan (1996/97). After more than 20 years under construction, Harabhangi provides an example of a typical profile of construction. Expenditure, in real terms, had been distributed more or less evenly over the (excessively long) life of the project. The reason for the low and more or less even expenditure profile can be explained by the deployment of a fixed number of labor divisions with fixed expenditure norms, over the life of the project. Therefore, the funds trickled trickled in annually, for continuous low activity new construction over a very long project life, while maintenance of the previously constructed sections was functionally deferred. There was even risk that mounting rehabilitations needs would become as large as annual construction expenditures.

The expenditure profile for Harabhangi is presented below (in constant values).

Year	% per year	% to date
1979/80	1	1
1980/81	4	5
1981/82	4	9
1982/83	1	11
1983/84	3	13
1984/85	2	15
1985/86	3	18
1986/87	4	23
1987/88	4	27
1988/89	6	33
1989/90	6	39
1990/91	7	46
1991/92	6	52
1992/93	5	57
1993/94	6	63
1994/95	(9)	(72)
1995/96	(12)	(84)
1996/97	(10)	(94)
1997/98	(6)	(100)

The above expenditure profile was indicative of the situation with most construction projects in Orissa prior to the WRCP. The funding for long-term construction was victim to an annual funding allocation process that reflected the distribution of laborers rather than the implementation plan for the project itself. The result of this funding mechanism was inefficiency, time overruns, high costs, limited actual completion of investments, and low productivity of existing schemes. The WRCP changed the funding program in 1994, emphasizing funding of O&M as the first state priority, system improvements and farmer turnover for existing schemes, and channeling of available resources for construction to a more limited set of construction sites, each fully funded. Amongst them, the Harabanghi project was seen as a viable scheme and efforts were made to shift the investment pattern

to complete the scheme and increase the rates of return, which were calculated around 19%. Expenditure levels on Harabanghi were doubled and the scheme is now nearing completion.

Source: India, Orissa WRCP Preparation Reports. "Preliminary Review of the Orissa Irrigation Department Expenditure Program." World Bank, FAOCP, 1993, and World Bank Supervision Reports. Adapted by Keegan Eisenstadt, World Bank. (India - WRM Sector Review, World Bank, 1998).

Box A3.10
Private Initiatives in the Water-Agriculture Interface

The benefits that farmers can obtain from (i) an integrated approach to water and agriculture and (ii) working with private and public sector players can be demonstrated using the experience of Kulbi Block, 24-Parganas District, West Bengal.

The Bharat Chamber of Commerce (BCC), Calcutta has facilitated the formation of WUAs that has, in turn, resulted in an improvement in the use of available water as well as the adoption of high-value crops and innovative farm practices crops. The experiment was initiated by the BCC, a part of the Federation of the Indian Chamber of Commerce and Industries, FICCI) with active involvement of other actors like private irrigation pumpset companies, Allahabad Bank, and the Council for the Advancement of People's Action (CAPART).

While farmers cannot rely on groundwater (being saline), they can use the water in drainage canazls for raising crops during the Rabi season. Under the experiment, the drainage canals were desilted to increase their water storage capacity, and diesel-operated pumps (some of them are also boat-mounted) were installed to lift and distribute water to 350 farmers with a total area of 100 ha. While the initial cost of the scheme was met partly by a CAPART grant and partly by a bank loan, the operation, maintenance, and management (including fee collection and water allocation) are being done by a registered WUA.

Due to a combination of collective pressure and penal rates, the crop pattern has shifted from water-intensive paddy to less water-using but high-income yielding crops like vegetables during the Rabi season. The cultivation of hybrid tomato, a crop previously unknown in this area, is spreading fast thanks to the efforts of the BCC, which arranged the visit of select farmers to the hybrid tomato farms of the Indo-American Hybrid Seed Company in Bangalore.

The dovetailing of investment, organization and agricultural technologies within a participatory process has led to remarkable changes in water utilization and crop production in the area. The experience of the Bharat Chamber of Commerce in West Bengal shows the benefits that farmers can obtain from: (i) an integrated approach to water management and agricultural innovations; (ii) a mix of farmers' contribution and external, non-subsidy-based, private sector, credit support; and (iii) a broader concept of participation with multiple actors--both public and private.

Source: J. Olivares, World Bank. (India - WRM Sector Review, World Bank, 1998).

Box A3.11
Floating Bonds to Mobilize Private Sector Funding in Irrigation: The Case of Maharashtra

Charged with completing works in progress and fully developing the basin's irrigable area by year 2,000, the Maharashtra Krishna Valley Development Corporation (MKVDC), placed almost 300 million dollars in bonds.

The first issue[1], placed to institutional investors with the help of a financial consulting firm in July 1996, was over-subscribed by 300%. A second issue[2] in November 1996 was over-subscribed as well. A third one, on the same amount and terms, was privately placed in February 1997 among the investors which had demonstrated interest in the previous two issues. The bonds were rated AA-(so) by CRISIL, a credit rating firm[3]. The bonds pay a high interest rate (17.5%) and carry a guaranteed mechanism for servicing, namely, a Designated (escrow) Account maintained by the State Bank of India in which MKVDC deposits all proceeds from sale of water for irrigation and power generation. In case of a shortfall, GOM's Finance Department would automatically transfer into the Account the funds needed to make up for it.

[1]GOM granted the Corporation the right to set adequate water charges; the Corporation is planning to increase them substantially in order to raise the funds needed to serve the bonds. If done, this would place the Corporation on better footing than its Karnataka equivalent, the Krishna Bhagya Jala Nigam (KBJN) which, albeit with similar purpose, was granted jurisdiction over only one project in the basin. Therefore, its capacity for setting water charges is constrained by what the GOK decides for other commands in the basin. It is worth recalling that a previous attempt, the Andhra Pradesh State Irrigation Development Corporation, failed in securing bank financing precisely because it did not, or could not, adequately increase what it charged for water.

The ability, or lack thereof, to set water rates that ensure sufficient cost recovery to service the debt on bonds issued is the critical factor in whether the bond market can provide a sustainable source of financing for irrigation. If water charges are not rationalized to provide for full cost recovery of O&M and depreciation on investment (including servicing the interest rates set on the bonds), then the bond market is nothing more than a financial mechanism that increases sectoral debt.

The issue for MKVOC and other actual or potential bond issuers, is thus to raise water charges so that bond issues can be serviced by the agency from its own revenues.

1 Rs 1.5 billion (150 crores, or US$ 43 million), 7 years at 17.5%, semi-annual coupons, with option to retain over-subscription.
2 Rs 2.5 billion (250 crores, or US$ 71 million), same terms, with option to retain over-subscription to the extent of Rs 50 crores.
3 This rating indicates high degree of certainty regarding timely payment of financial obligations on the instrument.

Source: Project Documents. World Bank, 1997. (India - WRM Sector Review, World Bank, 1998).

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Box A4.1
The Potential Contribution of Low Cost Drip Irrigation to the Improvement of Irrigation Productivity in India

Since 90% of the fresh water diverted for human use in India goes to irrigation, improving irrigation efficiency is the most direct way to address growing sectoral and regional water shortages. The most efficient irrigation method, drip irrigation, represents less than 1% of irrigated acreage in spite of the relatively rapid adoption curve over the past 10 years. The key constraint to its wider adoption is the high cost of installation, especially for the 80% of Indian farmers who cultivate less than two hectares. To address this constraint, International Development Enterprises (IDE)--an international development organization has developed, field tested, and initiated rural mass marketing of low cost drip irrigation systems that start at Rs.180 (US$4.5) for a home garden sized area, as well as crops with one meter spacing like cotton, sugar cane, and vegetables which cost around Rs. 9,000 to 10,000/acre (US$225) as compared with Rs. 23,000 per acre for conventional drip systems in India. The use of drip irrigation in India increased rapidly from the time of initial testing at Tamil Nadu University in Coimbatore in 1970, to 55,000 ha under drip in India by 1992,[1] and is now estimated to be 225,000 ha[2]. Studies of comparative crop yield and water use for surface and conventional drip irrigation of different crops carried out at agricultural universities in India have consistently found water savings of 30% to 60% and yield increases of 20% to 40% favoring drip irrigation over surface methods. There are some 100 private companies producing and marketing drip irrigation systems in India[2]. The Indian Committee on Irrigation and Drainage estimates a potential for drip irrigation in India of 10.5 million ha[3].

To stimulate its wider adoption, the Government of India has provided subsidies for drip irrigation in the sixth, seventh, and eighth five-year plan. While the subsidy has encouraged some farmers to install drip systems, it has had paradoxical results. For example, delays as long as one year in releasing subsidy payments to manufacturers produce paradoxical price increases for subsidized equipment. Changing the design of effective drip systems so that they can be sold profitably by the private sector at a price lower than the existing subsidized price opens up the possibility of replacing subsidies with an alternative that produces the intended impacts without the disadvantages.

Though India has increased the total production from 50MT in 1951 to 198 MT in 1997, the average production per hectare is much less than that of many countries in the world. The total production of fruits/vegetables is second in the world but it is not sufficient to meet the increasing requirements of the population, and the production per unit area is much less than that of other countries. Therefore, it is essential to economize the use of water, to reduce the cost of irrigation water and at the same time to increase the productivity per unit area and per unit quantity of water. This can be achieved by introducing micro irrigation in a big way in the coming years. Micro irrigation can also improve the quality of produce which is the need of the hour, especially for exports.

Method and Cost: IDE, a non-profit organization specializing in affordable small-scale irrigation, has developed and field tested a variety of low cost drip systems for small farmers. The investment in plastic pipes was reduced by making it possible for each plastic pipe (lateral) to serve four to ten rows of plants instead of one. The cost was further reduced by replacing emitters with microtubes or baffled holes, which also are easier to unplug. This in turn made it possible to use simpler lower cost filters, and to lower system pressure. Costs for a stationary microtube system for crops like cotton

[1] Sivanappan, R. K., Rao, A. S., and Dikshit, N.K., *Drip Irrigation in India,* Indian National Committtee on Irrigation and Drainage, Jolly Reprographics, New Delhi- 110 008, 1994.
[2] Proceedings of the National Seminar on Micro Irrigation and Sprinkler Irrigation Systems, Delhi, April 28-30, 1998.
[3] Sivanappan et al, op cited, P88.

and vegetables with one meter spacing is Rs.9,000 to Rs.10,000 per acre, compared to Rs. 23,000 for conventional systems, with comparable results in the field. Finally, the low cost system is designed to be incremental, allowing small farmers to start with a drum kit that irrigates 125 sq. meters at a cost of Rs. 800, and expanding the low cost drip system with profits derived from the crop.

Each low cost drip system is suitable for small-scale farmers cultivating sugar cane, cotton, vegetables and horticultural crops on small plots in semi-arid or hill areas. With drip irrigation, water sources previously considered too small for irrigation can now be utilized, and the same amount of water from a limited supply like a hand dug well in Rajasthan can be used to irrigate twice as much land as is possible under flooding in the dry season.

Systems and Elements: Bucket kits for home garden use, derived from the Chapin Bucket system, start at Rs.180 and consist of an ordinary 20-liter household bucket installed on a pole at shoulder height. The bucket is fitted with a 10-meter lateral line and is filled 2 to 4 times a day. The lateral line has 26 microtubes attached, each of which waters 4 vegetable plants, enough to provide vegetables for a family of 6.

Shiftable Drip System. Conventional drip systems require a plastic pipe (lateral line) for each row of plants. The shiftable drip system first developed in Nepal substitutes low cost labor for capital by making lateral lines shiftable, so that each line is capable of irrigating ten rows of plants instead of one[1]. An off the shelf plastic tank placed 2to 4 meters above the field with a simple cloth filter provides the pressure needed by the system. Water drips out of baffled holes or curled microtubes inserted into holes in the lateral line. This system works well for closely spaced low growing crops like many vegetables, in areas with low labor costs, and is around Rs.1,800 (US$50) for a 1200m^2 plot..

Non Shiftable Microtube Systems: **The Drum Kit** uses a 200 liter drum made of steel (Rs.400) or plastic (Rs.250) with a simple filter from which extend five 10m lateral lines, each fitted with 26 microtubes. The drum kit irrigates a 125m^2 plot and costs Rs.900. For an additional investment of Rs.400, it can be extended to cover 250m^2.

The Non-Shiftable Microtube System can be used on small or large plots, ranging from 1/16 of an acre to 2 acres. Microtubes are installed into holes in plastic lateral lines, with each microtube irrigating four plants. By extending microtubes out on both sides, each lateral line irrigates four rows of crops instead of one. The system is pressurized by a concrete tank with a low cost filter 4 meters above the field, or adapted to an existing electric or diesel pump using a bypass valve. At a cost of Rs.8,000 to Rs.10,000/acre (4000m^2) for crops with one meter spacing, the non shiftable microtube systems is approximately 1/3 the cost of comparable conventional drip systems.

Field tests comparing side by side 2000m^2 plots irrigated by flood and low cost stationary microtube drip were carried out in Rajasthan and Mahdya Pradesh on sugar cane and cotton respectively. In addition, side-by-side mulberry plots irrigated by flood, conventional drip, and low cost drip were evaluated in Karnataka. The tests confirmed previous studies in India that showed significant water saving and crop yield advantages for drip over flood irrigation. There were little or no significant differences between low cost drip and conventional drip systems. For example, cottonseed plots irrigated by low cost drip used 56% less water than flood irrigated cotton, and produced 34% more seed. Previous studies of cotton irrigated by flood and by conventional drip at Coimbatore found water savings ranging from 43% to 79%, with yield increases of 25% to 40%.

[1] Polak, Paul, Nanes, Bob, and Adhikari, Deepak. A Low Cost Drip System for Small Farmers in Developing Countries. Journal of the American Water Resources Association, Vol 33, #1, Feb/97.

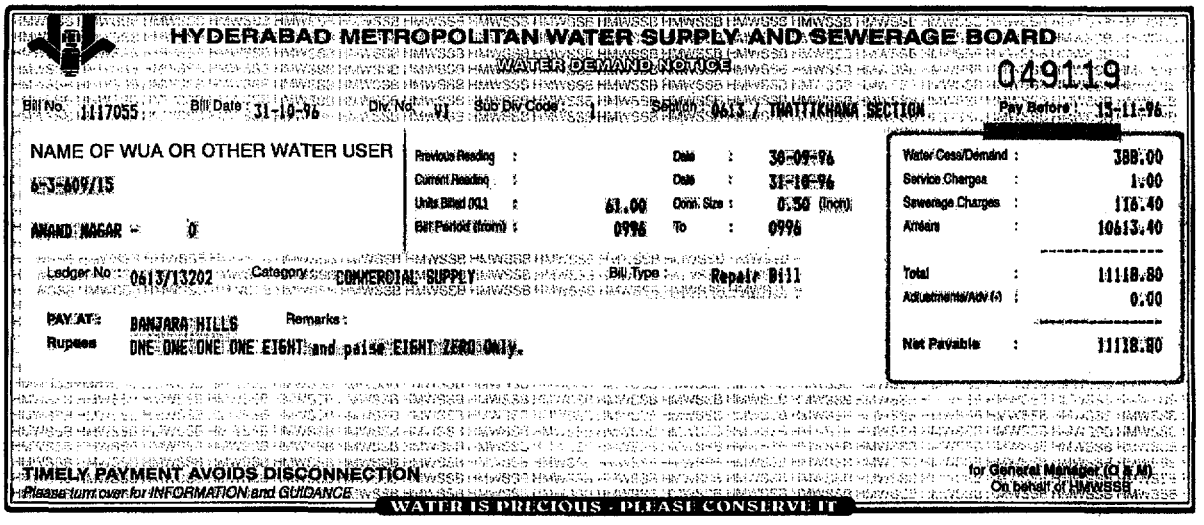
Grass Roots Private Sector Dissemination: IDE and its private sector partners have initiated private sector manufacture and distribution of low cost drip systems through a system of private sector manufacturers, distributors, and installers, stimulated by donor investment in increasing marketplace demand by small farmers through rural marketing and promotion initiatives. Three hundred initial low cost drip systems have now been sold and installed on farmer's fields. Similar efforts are being launched for low cost shiftable sprinkler systems, which are more applicable for grain crops.

Limitations and Future Outlook: Uniformity of flow from the microtubes is approximately 5% less than from emitters in conventional drip systems, and some low cost drip systems require more labor than conventional systems. Bucket kits and drum kits provide affordable entry points for small farmers to irrigate horticultural crops with drip irrigation, opening the option of using profits from initial crops to expand their low cost drip irrigation system. The combination of US$5 bucket kits with water and sanitation initiatives has strong potential for improving food security for poor families. The introduction of drip systems at one third the cost of conventional drip irrigation with comparable results in water saving and improved crop yield opens up the possibility of rapid increases in the adoption of drip irrigation in India. This in turn would generate significant improvements in irrigation productivity.

Source: Paul Polak and R K Sivanappan[1]. (India - WRM Sector Review, World Bank, 1998).

[1] President, IDE, and former Dean, Tamil Nadu Agricultural University respectively.

Box A4.2
Computerized Billing: An Opportunity for Improved Cost Recovery and Stakeholder Involvement


HYDERABAD METROPOLITAN WATER SUPPLY AND SEWERAGE BOARD
WATER DEMAND NOTICE
049119
Bill No. 1117055 Bill Date 31-10-96 Div. No. VI Sub Div Code 1 Section 0613 / THATTIKHANA SECTION Pay Before 15-11-96
NAME OF WUA OR OTHER WATER USER
6-3-609/15
ANAND NAGAR 0
Previous Reading : Date : 30-09-96
Current Reading : Date : 31-10-96
Units Billed (KL) : 61.00 Conn. Size : 0.50 (Inch)
Bill Period (from) : 0996 To : 0996
Ledger No : 0613/13202 Category : COMMERCIAL SUPPLY Bill Type : Repair Bill
PAY AT: BANJARA HILLS Remarks :
Rupees ONE ONE ONE ONE EIGHT and paise EIGHT ZERO ONLY.
Water Cess/Demand : 380.00
Service Charges : 1.00
Sewerage Charges : 116.40
Arrears : 10613.40
Total : 11118.80
Adjustments/Adv (-) : 0.00
Net Payable : 11118.80
TIMELY PAYMENT AVOIDS DISCONNECTION
Please turn over for INFORMATION and GUIDANCE
for General Manager (O & M)
On behalf of HMWSSB
WATER IS PRECIOUS - PLEASE CONSERVE IT

The Hyderabad Metropolitan Water Supply and Sewerage Board provides an Indian example of a computerized billing procedure in the water sector. With appropriate adaptations, computerized billing could have a variety of advantages in the irrigation sector. For all schemes, major, medium and minor--whether managed by the ID, WSA, WUAs or some other management scenario, itemized billing can be useful for accurate and accountable record keeping. This is a critical component for establishing and maintaining the financial sustainability of irrigation schemes. In India's irrigation sector, the billing would most appropriately be done at the level of the WUA (one bill per WUA, with the WUA responsible for collection between members and internal record keeping).

The bills can also be useful as a stakeholder participation and cost-management tool. By providing itemized information to customers (WUAs), with transparent information regarding the relative amounts and types of separate charges on the bill, the WUAs (and ID/WSA) will become aware of how their water is related to their and the service agency's individual costs. For example, by providing a WUA with the information regarding how much of its bill goes to covering O&M; fixed costs associated with management (staff costs, capital investment, facilities overhead, extension activities, etc.); WUA management; and actual water use, WUAs and their members will be able to see the relative costs associated with each activity. Without the linkage between the amount of water used, activities and their costs, the farmer has less incentive to conserve water, whether through better on-farm management, alternative cropping patterns, etc., and no information to get involved in cost management.

Itemized computer billing can provide an essential service to the irrigation sector, through improved record keeping, accounting, cost recovery, and most importantly, through the provision of transparent information to water users themselves--thereby providing the incentive for water conservation and service costs management.

Source: Based on Hyderabad MWSSB. (India - WRM Sector Review, World Bank, 1998).

Box A4.3
Improving Canal Management in India (and Elsewhere)

Knowing in *"real time"* what is happening and being able to make decisions and take action in a timely manner is an essential part of effective canal management. Most main and branch canals in India lack enough measuring structures, cross-regulators, and computation and communications facilities to allow operators to properly control water flows and levels and to deliver the intended water volumes to each distributory and minor, particularly with unsteady water flows[1]. Contrary to the common view that canal designs should be simplified, experience demonstrates that the operational procedures should be simplified, but not necessarily the design. Thus, developments in the Narmada (Gujarat) and Majalgaon (Maharashtra) projects are important steps towards enhanced water control and efficiency.

The Majalgaon Canal, supported by the World Bank, will have cross-regulators every 10 km, equipped with ultrasonic measuring devices linked via FM radio to a central computer, which will issue gate adjustment instructions to their operators in real time. The operating rule for the main and branch canals will be upstream-level dynamic control, with enough in-stream storage to respond immediately to changes in demand, and a reactive transit time of 4 hours over the whole 100-km main canal. Distributor and minor outlets have improved hydraulic designs, a downstream constant-level gate, and a Baffler distributor, allowing precise volumetric deliveries at the head of each one. (See Box A4.6). A critical remaining need for Majalgaon is for comparable advances in farmer organization. The impact of the new technology is still to be assessed but would likely be substantially below potential unless, in parallel, strong WUAs and farmer participation in management is achieved.

Out of India, Morocco's Canal de Rocade, serving the oasis of Marrakech, has been operated for decades under dynamic control, the most advanced stage of remote automated control. It has a combination of downstream and upstream constant level gates and constant upstream/downstream difference gates. China is studying the application of remote centralized control to the Hetao project in Inner Mongolia, serving 730,000 ha, including remote monitoring and decision support systems.

A common argument against remote centralized control is its cost. True, the cost of the automatic control structures, including civil works and mechanical equipment, in the High Level Pehur Canal in Pakistan is about twice the cost of manual gates. But it is only 8% of the total canal cost and 2.5% of the total project cost. Such increased cost can be economically justified by a 0.5% increase in agricultural production or by a 2% saving in foregone Tarbela Dam power, either of which should be easily attainable[2]. Therefore, automatic control structures should be considered whenever they are economically justified.

1 A related problem is the inadequate training in canal operations of many civil engineers who work in the irrigation departments.
2 This particular computation, as well as some of the examples in the text, were taken from H. Plusquellec, 1996.

Source: J. Olivares. World Bank. (India - WRM Sector Review, World Bank, 1998).

Box A4.4
A Company-Operated Canal in Chile

Canal operation by a private company in Chile has proved very successful. The problem was how to anticipate benefits on a canal (Canal Pencahue) which the Ministry of Public Works (MPW) is constructing. MPW wanted to start operating canal reaches as they were finished, but Government policy does not allow it to directly operate irrigation systems--besides, farmers objected to having to partake in financing the full cost of the irrigation bureaucracy. The logical alternative, transferring canal operation to a WUA, could not be carried out either, for such association could not be formed as the system had not been completed yet.

The solution was to hire a private consulting firm to operate the canal. (Of course, there was no such a thing as a "canal-operating company" in Chile--so MPW had to talk a consulting firm into becoming one). The firm keeps detailed cost accounts, and each farmer is charged for a part of the total cost proportional to the number of water rights they own (See Box A4.7), so transparency in cost accounting is ensured. The system proved so successful, and to the satisfaction of both the MPW and the water users, that a tender was called to award canal management for the second year. Three companies presented bids (in the event, it was awarded to the same company which had operated it the first year). Now farmers would like to continue hiring an external, commercial company to operate the Canal when this one is turned over to them upon completion.

Source: Project Documents. J. Olivares, World Bank. (India - WRM Sector Review, World Bank, 1998).

Box A4.5
Water Rights: Practical Instances and Experiences from India and Chile

In the Ganges and Mahanadhi delta regions of Orissa, West Bengal, Bihar, and Madhya Pradesh, there are evidences of the existence of officially granted non-transferable long-term water lease system with the express purpose of encouraging farmers to use surface water. In the case of a few South Indian irrigation systems, there are informal prioritized WRS where the rights are not for individuals but for different distributories and command segments. WRS are, therefore, neither new nor incompatible with Indian ethos and history. Informal WRS--both for individuals and groups--have been in existence since ancient times and continue even today, albeit in a much weaker form, in many tank and other surface irrigation systems throughout the country.

Apart from these fragmentary evidences suggesting the substantial institutional potential for creating WRS, there are two solid instances with the capability for being developed into a full-fledged WRS. These are the *Pani Panchayat* and *Shejpali* (water distribution roster) system, both in Maharashtra. The *Pani Panchayat* is a people-managed system in Pune District where individual water rights are determined based on need as determined by family size rather than by farm size. Usually, this water need is calculated at about half an acre (0.20 ha) worth of irrigation water.

Under the government-managed *Shejpali* system practiced in the canal commands of Western Maharashtra, the canal authorities issue "water passes" on the basis of applications from farmers. These passes with duration varying from a single irrigation to six years also have a priority ranking that varies directly with their duration. But for the non-transferability and quantitative specification of water rights, the water pass system resembles closely the water permit system being practiced in the Western US.

Chile and Mexico have recently gone through a process of establishing tradable water rights. In Chile, the 1980 Water Code dissociated water use rights from the originally intended purpose, and redefined them as a real right (a property right), which could be sold, bought, rented, leased, mortgaged or inherited as any other good in the economy. A National Registry for Water Utilization Rights was established, and water markets evolved. The main benefit has been the flexibility of the water "allocation" system along economic principles; anyone needing water can buy it in the market, at a price reflecting its scarcity value. A second benefit is that farmers now have an incentive for saving water, as they can sell or rent the ensuing surplus; agricultural use efficiency and production per unit of water have gone up. And third, the economic worth of water became separated from, and different from, the cost of capturing, conveying and delivering it (O&M). (See Box A4.7 for details on the Chilean system).

Source: Saleth (1996); Olivares (1997). World Bank. (India - WRM Sector Review, World Bank, 1998).

Box A4.6
Technical and Design Features That Would Enable A Water rights System: The Case of Majalgaon, Maharashtra

The WRS at the level of users and user groups is now increasingly being felt. Apart from its social and political acceptability, the WRS also requires certain basic technical and design conditions needed for quantitative measurement and delivery of irrigation water. The Majalgaon project in Maharashtra satisfies the basic technical conditions for establishing WRS, but social organization aspects are still largely lacking (see below).

The 148-km long Majalgaon Right Bank Canal, part of a major canal project on River Godavari, financed under Bank assisted Maharashtra Composite Irrigation Project III, assumes national importance because of the Pilot Project of Dynamic Regulation (PPDR). The PPDR is based on the application of modern dynamic water control using computer and communication technologies. Briefly, it consists of three components: (i) 10 cross-regulators fitted with remote transmisson units (RTUs) with measurement and FM transmission equipment and Avio gates for water diversion to branch canals; (ii) volume control structures (proportional flow dividers, baffle distributors, and self-regulated outlets) at each of about 18 distributaries and level control structures (5 duck-bill weirs) on the Ganga Masla Branch Canal; and (iii) the General Control Centre (GCC) with a sophisticated computer system that can operate, monitor, and measure water in the MRBC at each of the 10 RTUs through the FM tele-transmission network.

This technology makes it possible to follow a flexible, needs-based water release policy. Apart from the elimination of water loss, the design capability of the system for precise water measurement could make volumetric distribution a reality. The technical conditions can inculcate a quantitative perception of irrigation water among users. This provides the necessary condition for piloting and evaluating the institution of a WRS involving quantitative water rights for users in each outlet and distributary levels.

However, a remaining need would be to establish the social organization and institutional features required for WRS in India. Here Majalgaon is still lagging, with WUAs still not operationally effective. The next step for Majalgaon should be to bring community organization and implementation aspects to match the potential effectiveness of the technical innovations.

Source: Project Documents. World Bank. (India - WRM Sector Review, World Bank, 1998).

Box A4.7
Water Rights and Water Markets in Chile

In Chile, Water is a public resource, and everyone must ask for a license--called a *water utilization right*--to use it. Up to 1980, such water utilization rights were granted in strict relation to actual need and forever linked to the purpose for which they had been granted. Selling, renting, or otherwise transferring them was forbidden, except that sales/rentals of irrigated lands implied the ensuing transfer of the water rights attached to them.

This system protected agriculture from other sectors' demands, but made water allocation rigid--soon, it became a constraint to urban development, mining, industry, and hydropower generation. Cities enjoyed a relative best situation, for the Water Code allocated them first priority. Also, since most cities were expanding over irrigated lands, waters thus freed were administratively transferred to city utilities. Farmers, having a secure utilization right, had no incentive for increasing water conveyance and application efficiencies.

The 1980 Water Code dissociated water use rights from the originally intended purpose, and redefined them as a real right (a property right), which could be sold, bought, rented, leased, mortgaged or inherited. A National Registry for Water Use Rights was established, kept alongside the National Real Estate Registry. No particular regulation was issued for market transactions, for water rights were assimilated to the general *régime* of good/service transactions. As a result, localized water markets evolved within watercourses or, occasionally, within the same hydraulic system. There is a market-clearing price, and transactions are effected through personal contacts, local newspapers, and water "realtors"--usually, real estate realtors or produce wholesalers. The most common transactions are: sale of the right or part thereof (water rights are fully divisible--see example below); its rent or lease for a cropping season or a fixed time span; and spot sale of a volume of water (in volumetric systems only). The buyer must finance the changes in the watercourses to physically transfer the water. The introduction of saleable water rights was facilitated by the dual facts that water utilization rights had already been granted on most waters, and most watercourses were managed by users' associations. No issue regarding the initial allocation of water rights ever arose, because such rights, albeit with a different legal definition, already existed.

The main benefit has been the increased flexibility of the water "allocation" system along economic principles; anyone needing water can buy it in the market, at a price reflecting its scarcity value. Urban supply utilities are smoothly purchasing the additional water they need; hydropower and mining companies have become aggressive buyers. Second, farmers now have an incentive for saving water, as they can sell or rent the ensuing surplus. And third, the economic worth of water became separated from, and different from, O&M costs.

The main disadvantage, or risk, of the new system, is monopolization of water rights. A couple of power companies and a single individual have been accused of accumulating some 70% of all water use rights in Chile. The need for long-term planning obscures the issue, however, for power companies claim they need to secure the rights today to plan for future plants. But the three largest companies hold unused water rights six times as large as the ones they are using, and have three times as much under request or processing. A second risk is the collapse of whole irrigation commands once and when more than a certain percentage of all rights are sold to companies out of command--particularly to power companies, which have been buying water rights from farmers on a delayed-delivery basis, which they will call in on at a single moment.

Additional information can be found in Rios and Quiroz, "The Market for Water Rights in Chile",World Bank Technical Paper N° 285; Hearne and Easter, Water Allocation and Water Markets, An Analysis of Gains-from-Trade in Chile, Technical Paper N° 315; Le Moigne (ed), "Water Policy and Water Markets", Technical Paper N° 249, and Rosegrant, M. and R. Schleyer (1994), "Tradable Water Rights: Experiences in Reforming Water Allocation Policy", Arlington, Irrigation Support Project for Asia and the Near East.

The Infinite Divisibility of Water Rights - A Fragment of the List of Water Users i.e., WUA members) in "United Channels of Buin", A WUA 40 km South of Santiago, Chile

Water Course	Name of Water Use Right Holder	Number of Shares Owned	
		In minor	In canal
3.6	Dr. Siegbert Gerstle y otros		8.104
	Parcelacion San Jorge		9.896
3.7			2.620
3.71	D. Enzo Costa Casini	1.898	
3.72	D. Alejandro Ayres Mangas	2.553	
	Soc. Proteccion Mutua de EE. II.	0.158	4.609
3.8	Frutera Linderos		4.258
3.801	C y D Agrofruta Ltda.		2.138
3.81	Coop. Huertos Familiares		5.662

Source: J. Olivares, World Bank. (India - WRM Sector Review, World Bank, 1998).

Box A4.8
Tendering Out Research and Innovation in Chile

For many years, Chile has "allocated" public monies for research and innovation to prospective executing agencies through a tender system. Budget and other resources are transferred to several specialized government-owned Funds, such as FONTEC, for technological and productive development, FONDECYT, for science and technology, and FIA, for agricultural innovation. These Funds are managed by boards whose directors have strong administrative, academic, entrepreneurial, or technical credentials. Prospective executing agencies (public, private, academic, NGOs and other non-profit ones, farmer associations, and others) bid for funding through periodic general-purpose tenders ("concursos"), specific invitations to bid ("licitaciones"), and open window procedures--the better or more innovative technical proposals getting higher point grades in bid evaluation. The awards are sealed through a contract. Three examples, two of them involving World Bank-supported projects, are briefly described below.

Technology Validation Centers. Under the Medium and Minor Irrigation Projects Loan (PROMM), each individual project includes such a Center. Instead of "granting" their implementation and management to the national research institute (INIA), they are allocated through site-specific tenders to the best proposal irrespective of cost. Proposals are evaluated on scientific, technical and managerial grounds, including the quality of the personnel and the proposed dissemination/extension methodology. Some of them have gone to INIA, others to national or regional universities, others to NGOs. The procedure has been deemed successful.

Adaptive Research and Validation. The Coastal Rainfed Zones Project finances such research in eight micro-regions. Proposals for activities in one, several, or all of them were invited from all kinds of agencies, on a single tender, for the subject matters identified at appraisal. In view of its experience (see below), the tender design and management was sub-contracted by the Project executing agency to FIA. Several universities and public agencies bid for the contracts.

Innovation in Agriculture. FIA calls periodic tenders to fund proposals for innovation in agriculture, livestock, forestry, aquiculture, and agroindustry. (i) Most contracts are awarded through general tenders, in which unrestricted proposals are invited on a specific set of (say, ten) subject matters, such as floriculture, berries, mushrooms, and milking sheep. (ii) Other contracts are let through specific tenders to implement a pre-identified innovative activity, already prepared by FIA staff*. These are high-risk, high-payoff type of innovative activities, such as introduction of an exotic species, breed or variety, or adoption of a new technology, and may include a subsidy to take care of the "social" component of the risk. And (iii) since nobody can tell whether an innovative idea will pop up at times or on subject matters different from those covered in the tenders (two recent examples are introducing ostriches, and raising frogs), FIA keeps an open window where proposals are received at any time. Over the last three years, awardees have been split almost evenly among public agencies (including one municipal government and one farmers' association), universities, and private firms. The system has been most successful, and increasing government funds are being channeled through FIA.

* The same procedure is used for tendering highway construction; if the technical design is submitted by a prospective awardee; this one gets a 10-15% price advantage in bid evaluation.

Source: Project Documents, and J. Olivares (World Bank) (India - WRM Sector Review, World Bank, 1998).

Table A5.1: Cumulative Surface Groundwater Irrigation Potential Created and Utilized Over Plan Periods: 1951-95. (million hectares)

Plan Period	Major and Medium - Irrigation -		----- Minor Irrigation ------ Surface Water		Ground Water		- - Total - -		Grand Total	
	P[1]	U	P	U	P	U	P	U	P	U
Pre-plan (Up to 1951)	9.71	9.71	6.40	6.40	6.50	6.50	12.90	12.90	22.61	22.61
First Plan (1951-56)	12.19	10.99	6.43	6.43	7.63	7.63	14.06	14.06	26.25	25.05
Second Plan (1956-61)	14.33	13.05	6.45	6.45	8.28	8.28	14.73	14.73	29.07	27.78
Third Plan (1961-66)	16.57	15.18	6.48	6.48	10.52	10.52	17.00	17.00	33.57	32.18
Annual Plans (1966-69)	18.10	16.75	6.51	6.51	12.51	12.51	19.02	19.02	37.12	35.77
Fourth Plan (1969-74)	20.70	18.69	7.00	7.00	16.50	16.50	23.50	23.50	44.20	42.19
Fifth Plan (1974-78)	24.72	21.16	7.50	7.50	19.80	19.80	27.30	27.30	52.02	48.46
Annual Plans (1978-80)	26.61	22.65	8.00	8.00	22.00	22.00	30.00	30.00	56.61	52.65
Sixth Plan (1980-85)	27.70	23.57	9.70	9.01	27.82	26.24	37.52	35.25	65.22	58.82
Seventh Plan (1985-90)	29.92	25.47	10.99	9.97	35.62	33.15	46.61	43.12	76.53	68.59
Annual Plan (1990-92)	30.74	26.32	11.46	10.29	38.89	36.25	50.35	46.54	81.09	72.85
Annual Plan (1992-93)	31.13	26.62	11.62	10.41	40.26	37.49	51.88	47.90	83.01	74.52
Annual Plan (1993-94)	31.60	27.08	11.80	10.52	41.48	38.59	53.28	49.11	84.88	76.18
Annual Plan (1994-95)	31.89	27.51	N.A	N.A	N.A.	N.A	54.04	49.95	85.94	77.47
Annual Plan (1995-96)	32.30	27.57	N.A	N.A	N.A	N.A	55.53	51.40	87.83	79.26
Annual Plan (1996-97)	32.83	28.37	N.A	N.A	N.A	N.A	56.61	52.32	89.44	80.69

Source: CWC (1995:95).
Notes: [1]P = Potential Utilised, and U = Utilized.

Table A5.2: Relative Role of Irrigation Sources by States, 1990-91

Major States	Net Sown Area (mha)	Net Irrigated Area (mha)	Canals	Tanks	Wells	Others[1]	Cropping Intensity	Irrigation Intensity
Andhra Pradesh	11.02	4.31	43.41	22.49	30.27	3.83	119.69	124.72
Arunachal Pradesh	0.15	0.03				100.00	165.77	103.23
Assam	2.71	0.57				100.00	140.32	100.00
Bihar	7.70	3.35	32.57	3.44	45.38	18.61	136.13	125.25
Goa	0.13	0.02	25.00	0.00	75.00	0.00	115.27	155.00
Gujarat	9.29	2.49	18.93	1.16	79.78	0.12	111.54	116.49
Haryana	3.58	2.60	51.44	0.04	47.98	0.54	165.57	163.02
Himachal Pradesh	0.58	0.10	23.23	1.01	4.04	71.72	168.78	168.69
Jammu & Kashmir	0.73	0.30	93.62	0.67	0.34	5.37	145.83	146.31
Karnataka	10.38	2.11	40.80	11.36	33.74	14.10	113.27	122.95
Kerala	2.25	0.33	32.43	14.71	19.52	33.33	134.40	115.02
Madhya Pradesh	19.56	4.31	35.61	3.64	49.77	10.99	122.10	102.71
Maharashtra	17.94	2.04	22.25	15.23	55.60	6.93	121.88	122.25
Manipur	0.14	0.07				100.00	128.57	115.38
Meghalaya	0.20	0.05				100.00	120.30	102.17
Mizoram	0.07	0.01				100.00	113.85	100.00
Nagaland	0.19	0.06				100.00	110.53	101.69
Orissa	6.30	1.93	46.74	14.94	38.31	0.00	152.19	119.65
Punjab	4.22	3.91	39.05	0.00	57.11	3.84	177.86	180.43
Rajasthan	16.38	3.90	35.13	3.48	60.74	0.65	118.34	119.16
Sikkim	0.10	0.02				100.00		100.00
Tamil Nadu	5.58	2.37	32.41	22.38	44.63	0.59	118.87	121.96
Tripura	0.27	0.04	63.41	4.88	17.07	14.63	164.81	100.00
Uttar Pradesh	17.30	10.54	30.29	0.99	65.77	2.96	147.29	140.12
West Bengal	5.33	1.91	37.52	13.76	37.26	11.46	162.39	100.00
All India	*142.23*	*47.43*	*35.63*	*6.84*	*51.04*	*6.49*	*30.30*	*30.24*

Source: Directorate of Economics and Statistics, Ministry of Agriculture.
Notes: [1]Includes area being irrigated by streams, ponds, and other surface water bodies other than tanks.

Table A5.3 Part I.: Distribution of Area Under the Principal Crops Into Irrigated and Unirrigated Segments (mha)

	Irrigated Segment			Unirrigated Segment		
Crops	**71-72**	**81-82**	**91-92**	**71-72**	**81-82**	**91-92**
Food Crops	**26.53**	**34.47**	**42.9**	**52.38**	**51.13**	**43.01**
Paddy	14.66	16.93	19.66	23.13	23.87	22.34
Wheat	10.28	15.63	20.70	8.82	6.47	3.80
Jowar	0.67	0.71	0.82	15.83	16.09	12.18
Maize	0.92	1.20	1.31	4.60	4.70	4.69
Non-food Crops	**4.28**	**7.74**	**11.23**	**16.22**	**14.6**	**15.7**
Groundnut	0.59	0.96	1.63	7.41	6.24	6.87
R.seed & Mustard	0.41	1.71	3.34	1.29	1.93	2.46
Cotton	1.56	2.22	2.66	6.84	5.78	5.34
Sugarcane	1.72	2.85	3.60	0.68	0.65	0.50
Total	***30.81***	***42.21***	***53.72***	***68.60***	***65.73***	***58.18***

Source GOI (1972, 1984, and 1993) and CMIE (1996).

Table A5.3 Part II. Average Irrigated and Unirrigated Yield Levels of the Principal Crops (tons/ha)

	Irrigated Segment			Unirrigated Segment		
Crops	**71-72**	**81-82**	**91-92**	**71-72**	**81-82**	**91-92**
Food Crops						
Paddy	1.65	1.91	2.09	0.70	0.90	1.05
Wheat	2.40	2.77	3.18	1.04	1.54	1.83
Jowar	1.33	1.48	1.32	0.63	0.93	1.08
Maize	1.02	1.64	1.98	0.66	0.99	1.56
Non-food Crops						
Groundnut	1.46	1.59	1.83	0.81	0.90	0.96
R.seed & Mustard	0.54	0.75	0.99	0.24	0.32	0.48
Cotton	0.85	1.37	1.87	0.32	0.68	0.73
Sugarcane	41.41	58.37	63.84	37.47	41.33	46.87

Source: GOI (1972, 1984, and 1993) and CMIE (1996).

Table A5.4 Part I: Yield Level Comparisons: Indian Average Demonstration Yields (Qtl/ha)

Crop	Year				
	1970-71	1973-74	1977-88	1984-85	1987-88
Paddy					
National Average	16.84	17.26	19.76	20.63	14.00
National Demonstration	56.86	52.70	51.77	48.36	31.00
Jowar					
National Average	4.66	5.44	7.26	8.20	--
National Demonstration	35.96	32.17	42.95	40.36	--
Maize					
National Average	12.79	9.65	10.43	14.41	10.00
National Demonstration	37.89	34.84	34.30	34.96	31.00
Ragi					
National Average	8.72	8.78	10.95	--	--
National Demonstration	35.46	33.22	22.60	--	--
Wheat					
National Average	13.07	11.72	14.77	18.73	20.00
National Demonstration	40.80	37.30	30.88	35.54	36.00

Source: Agricultural Situation in India cited in GOI (1992).

Table A5.4 Part II: Yield Level Comparisons: Indian and International Yield Levels for Paddy and Wheat (Kgs/ha)

Crop	Country	1965	1970	1975	1980	1985	1990	1992
Paddy	India	1300	1660	1858	2010	2329	2628	2607
	Pakistan	1650	1830	2290	2418	2350	2315	2507
	Phillippines	1310	1780	1721	2338	2663	2808	2813
	Indonesia	1850	2040	2629	3301	3942	4302	4488
	China	n.a	n.a	3507	4200	5263	5716	5807
	Egypt	5033	5430	5480	5755	5948	7266	7659
	Italy	4020	4730	5806	5385	6052	6028	5623
	USA	2640	3640	4019	4191	6068	6200	6411
	World	n.a	2280	2521	2770	3272	3553	3571
Wheat	India	910	1210	1338	1436	1870	2121	2397
	Pakistan	860	1180	1320	1563	1612	1825	1991
	China	n.a	n.a	1367	1878	2937	3194	3295
	Egypt	2640	2770	2472	3225	3759	5194	5255
	Italy	2280	2230	2711	2687	2789	2924	3551
	USA	1790	2090	2057	2249	2519	2656	2650
	World	n.a	148	1550	1877	2193	2559	2562

Source: FAO Production Year Book, FAO, Rome (Various years) cited in FertilizerAssociation of India, Fertilizer Statistics 1992-93, New Delhi.

Table A5.5: Plan Expenditures on Irrigation: 1951-95.(Current teams) (billion Current Rs)

Plan Period	Major and Medium Irrigation	- Minor Irrigation - State	Institutional	Command Area Development	Total	Share of Irr. in Total Plan Expenditure
First Plan (1951-56)	3.76	0.66	*	-	4.42	22.55
Second Plan (1956-61)	3.80	1.42	0.19	-	5.42	11.59
Third Plan (1961-66)	5.76	3.28	1.15	-	10.19	11.88
Annual Plans (1966-69)	4.30	3.26	2.35	-	9.91	14.95
Fourth Plan (1969-74)	12.42	5.12	6.61	-	24.16	15.31
Fifth Plan (1974-78)	25.16	6.31	7.79	1.48	40.73	14.13
Annual Plans (1978-80)	20.79	5.02	4.80	2.15	32.76	14.28
Sixth Plan (1980-85)	73.69	19.79	14.38	7.43	115.29	10.55
Seventh Plan (1985-90)	111.07	31.18	30.61	14.48	187.34	8.56
Annual Plan (1990-91)	26.35	8.36	6.76	3.09	44.56	7.64
Annual Plan (1991-92)	28.24	8.44	6.74	2.83	46.25	7.14
Eighth Plan (1992-97)2	224.15	59.77	**	25.10	309.02	7.12
Annual Plan (1992-93)	30.47	9.95	8.12	3.23	51.77	7.11
Annual Plan (1993-94)	33.69	9.69	8.76	3.86	56.00	6.05
Annual Plan (1994-95)2	42.85	14.13	11.26	4.41	72.65	6.48

Source: CWC (1995).
Notes: (1) * = Negligible, and ** = Not Available
(2) Outlay

Table A5.6: Plan Expenditure on Irrigation in India: 1951-95. (billion constant (1980-81) Rs).

Plan Period	Major and Medium Irrigation	- Minor Irrigation - State	Institutional	Command Area Development	Total	Share of Irr. in Total Plan Expenditure
First Plan (1951-56)	21.55	3.76	*	0.00	25.31	22.54
Second Plan (1956-61)	19.51	7.30	0.99	0.00	27.80	11.59
Third Plan (1961-66)	23.67	13.48	4.74	0.00	41.88	11.88
Annual Plans (1966-69)	12.47	9.4	66.81	0.00	28.74	14.95
Fourth Plan(1969-74)	28.76	11.86	15.30	0.00	55.92	15.31
Fifth Plan(1974-78)	36.48	9.15	11.29	2.14	59.05	14.13
Annual Plans(1978-80)	26.53	6.40	6.13	2.75	41.81	14.28
Sixth Plan(1980-85)	64.01	17.19	12.49	6.46	100.15	10.55
Seventh Plan(1985-90)	70.03	19.66	19.30	9.13	118.12	8.56
Annual Plan(1990-91)	13.19	4.19	3.39	1.43	22.31	7.63
Annual Plan(1991-92)	12.44	3.72	2.97	1.47	20.59	7.12
Eighth Plan(1992-97)	91.51	24.40	**	10.25	126.16	7.22
Annual Plan(1992-93)	12.19	3.98	3.25	1.29	20.71	7.10
Annual Plan(1993-94)	12.44	3.58	3.23	1.42	20.68	6.05
Annual Plan(1994-95)	17.49	5.77	4.60	1.80	29.66	6.48

Source: CWC (1995)
Notes: (1) * = Negligible, and ** = Not Available,
(2) Outlay.

Table A5.7: Pattern of Ninth Plan Outlay by Investment Categories Across States. (Ninth Plan Proposal)

State	Total Outlay Proposed for IX Plan (billion Rs)	Percentage Share of Irrigation: New Projects	Special Repairs of Existing Irrigation Systems	Dam Safety Measures	Improved Water Management	Water Use Efficiency	Potential Targeted (000' ha)
Andhra Pradesh	49.72	90.21	1.81	1.53	2.82	3.64	827
Arunachal Pradesh	0.02	--	--	--	--	100.00	--
Assam	2.16	90.74	--	--	--	9.26	84
Bihar	6.13	38.99	13.54	1.14	29.04	17.29	563
Goa	0.03	--	--	--	--	100.00	43
Gujarat	4.22	24.88	8.77	7.82	29.38	29.15	771
Haryana	9.43	66.38	6.47	--	23.22	3.92	329
Himachal Pradesh	1.37	94.16	--	3.65	--	2.19	22
Jammu & Kashmir	0.81	86.42	--	--	9.88	3.70	41
Karnataka	35.55	93.90	1.15	1.01	1.52	2.42	742
Kerala	6.58	94.22	--	1.52	--	4.26	237
Madhya Pradesh	11.71	66.18	3.67	9.56	8.11	12.47	1375
Maharashtra	7.98	60.40	7.64	1.38	14.54	16.04	909
Manipur	0.16	81.25	--	--	--	18.75	47
Meghalaya	0.01	--	--	--	--	100.00	20
Mizoram	0.01	--	--	--	--	100.00	--
Nagaland	0.01	--	--	--	--	100.00	--
Orissa	11.20	63.13	3.75	11.43	12.23	9.46	1031
Punjab	4.70	42.55	15.11	0.00	39.36	2.98	125
Rajasthan	8.95	60.56	6.70	9.16	18.88	4.69	624
Sikkim	--	--	--	--	--	--	--
Tamil Nadu	3.28	28.35	14.02	27.44	14.33	15.85	27
Tripura	0.03	--	--	--	--	100.00	23
Uttar Pradesh	14.70	50.75	13.88	4.97	21.09	9.32	1218
West Bengal	6.09	63.05	6.73	0.33	25.78	4.11	458
Union Territories	--	--	--	--	--	--	--
Total	*184.85*	*74.38*	*4.76*	*3.60*	*10.49*	*6.77*	*9516*

Source: GOI (1996a).

Table A5.8: Financial Performance of Major and Medium Irrigation Schemes Across Major States, 1989-90. (billion Rs.)

State	Capital Outlay	Revenue Expenditures	Revenue Receipts	Depreciation	Financial Loss A	Financial Loss B
Andhra Pradesh	28.984	3.155	0.352	0.276	2.803	3.079
Bihar3	30.201	0.584	0.061	0.288	0.523	0.810
Gujarat	22.327	3.559	0.170	0.210	3.389	3.599
Himachal Pradesh	0.213	0.004	0.000	0.002	0.004	0.006
Haryana	8.635	1.161	0.136	0.084	1.025	1.110
Karnataka	20.892	1.536	0.161	0.198	1.375	1.573
Kerala	7.601	0.193	0.016	0.072	0.177	0.249
Madhya Pradesh	25.865	0.579	0.123	0.247	0.456	0.703
Maharashtra[3]	40.052	4.389	0.276	0.375	4.114	4.489
Orissa	15.952	0.161	0.046	0.153	0.116	0.268
Punjab	8.874	0.781	0.174	0.088	0.608	0.695
Rajasthan	15.517	1.299	0.160	0.149	1.139	1.288
Tamil Nadu	6.519	0.809	0.016	0.064	0.793	0.857
Uttar Pradesh	32.180	3.507	0.366	0.310	3.141	3.451
West Bengal	5.553	0.457	0.016	0.053	0.441	0.495
Total	*269.364*	*22.175*	*2.073*	*2.570*	*20.102*	*22.672*

Source: GOI (1992).

Notes: [1]Depreciation is allowed at the rate of one percent on mean capital outlay. For 1987-88, the depreciation has been calculated at the rate of one percent on capital outlay at the end of the year.
[2]'A' Relates to excess of expenditure over receipts and 'B' relates to excess of expenditure including depreciation over receipts.
[3]Figures are provisional.