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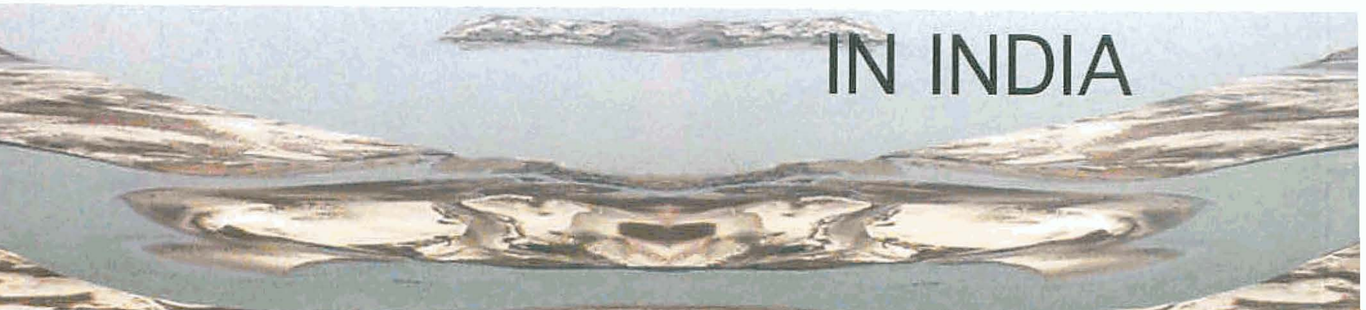
HANDBOOK OF Water Resources IN INDIA



Development, Management, and Strategies

Water Resources
Water Resources
Water Resources

edited by
John Briscoe and R. P. S. Malik

THE WORLD BANK

Water Resources
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Handbook of Water Resources in India

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Abbreviations

AIBP	Accelerated Irrigation Benefits Programme
BCM	billion cubic metres
CAS	Country Assistance Strategy (of the WB)
CEM	Country Economic Memorandum
CERC	Central Electricity Regulatory Commission
CPSP	Country Policy Support Program
CWC	Central Water Commission
EDI	Economic Development Institute (World Bank)
GDP	Gross Domestic Product
GOI	Government of India
GWP–TAC	Global Water Partnership—Technical Advisory Committee
IBRD	International Bank for Reconstruction and Development
ICB	International Competitive Bidding
ICID	International Commission on Irrigation and Drainage
IDA	International Development Association
IDWS	International Drinking Water and Sanitation
IFC	International Finance Corporation
IL&FS	Infrastructure Leasing and Financial Services Ltd.
INCH	Indian National Committee on Hydraulic Research
INCID	Indian National Committee on Irrigation and Drainage
INCOH	Indian National Committee on Hydrology
IRBM	Integrated River Basin Management
IWP	Indian Water Partnership

IWRA	Indian Water Resources Association
IWRM	Integrated Water Resource Management
Lpcd	litres per capita per day
m.ha.	million hectares
MIGA	Multilateral Investment Guarantee Agency
Mld	million litres per day
M&M	Medium and Major
MoWR	Ministry of Water Resources
NHPC	National Hydro Power Corporation
NWRC	National Water Resource Council
OECD	Organization for Economic Cooperation and Development
OED	Operations Evaluation Department
O&M	Operation and Maintenance
RBO	River Basin Organization
RGNDWM	Rajiv Gandhi National Drinking Water Mission
RIDF	Rural Infrastructure Development Fund
RWSS	Rural Water Supply and Sanitation
SERC	State Electricity Regulatory Commission
SPV	Special Purpose Vehicle
UWSS	Urban Water Supply and Sanitation
WAPCOS	Water and Power Consultancy Services
WR	Water Resource
WRCP	Water Resources Consolidation Project
WRMG	Water Resources Management Group
WS	Water Services
WUA	Water Users' Association

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Foreword

This *Handbook on Water Resources* written by many of India's leading 'water thinkers and water practitioners', presents a set of papers on major water policy issues in India. The original version of the chapters was commissioned by the World Bank as inputs to help define India's water challenges and the needed responses. The overall report, *India's Water Economy: Bracing for a Turbulent Future*, authored by John Briscoe and R.P.S. Malik, was published by Oxford University Press in 2006. The main conclusions of that report are presented in the first chapter of this handbook.

The chapters in this volume are the final products of an intense interactive process involving all authors. The overall process included a number of consultations. In a multi-stakeholder consultation in August 2004, the idea of the study and the titles of the commissioned papers were presented, and inputs on substance and process were made by individuals from the Union government, Planning Commission, state governments, the private sector, financial institutions, urban water supply utilities, NGOs, academics, professional associations, chambers of industry, bilateral and multilateral aid agencies, and UN agencies. The same individuals were invited to a final consultation on the draft report, held in New Delhi in October 2005. Drafts of the report were also discussed at seminars held by the Confederation of Indian Industries (CII), the Federation of Indian Chambers of Commerce and Industry (FICCI), the World Wildlife Fund (WWF), the International Water Management Institute (IWMI), and the Planning Commission of the Government of India.

In January of 2005 the Ministry of Water Resources hosted a major consultation on 'Challenges for Water Development and Management in India and Future Strategies', which was addressed by the ministers and secretaries of finance and water resources, the member for water and power of the Planning Commission, and the World Bank country director for India. The focus of the consultation was on the findings from the main papers presented in this volume, on the emerging themes from this study, the views of the Union and state governments, and the implications for World Bank involvement in water in India.

The overall report benefited greatly from the formal reviews and comments from external reviewers (Suresh Prabhu, Peter Rogers, Ramaswamy Iyer , George Verghese, Tushaar Shah, Maria Saleth, Vijay Vyas, Ramesh Bhatia, Ravinder Malik, and Nirmal Mohanty) and the World Bank staff (Sumir Lal, Sanjay Pahuja, Sunil Khosla, R.S. Pathak, Prabir Joardar, Grant Milne, Connie Bernard, Martien van Nieuwkop, Gajan Pathmanathan, Dina Umali-Deininger, Manuel Contijoch, Karin Kemper, Javier Zuleta, Srinivas Rajagopalan, Harshadeep Rao, Keith Pitman, and Alain Locussol). Not all reviewers agreed with all that is written in the report (nor did the authors agree with all that was suggested by the reviewers).

IWMI graciously helped with the production of the basin maps. Jacqueline Julian of the World Bank provided excellent assistance. Generous support was provided by the Bank Netherlands Water Partnership Program.

John Briscoe and R.P.S. Malik
January, 2007

1

India's Water Economy

An Overview

JOHN BRISCOE AND R.P.S. MALIK

India faces a turbulent water future. The current water development and management system is not sustainable: unless dramatic changes are made—and made soon. The way in which the government manages water, India will have neither the cash to maintain and build new infrastructure, nor the water required for the economy and for the people.

The associated overview report 'India's Water Economy—Bracing For a Turbulent Future' (Briscoe and Malik, 2006), on which this Chapter draws heavily, examines in detail the evolution of the management of India's waters, describes the achievements of the past, and the looming set of challenges. It suggests what changes should be considered and how to manage the transition from 'the ways of the past' to 'the ways of the future' in a principled but pragmatic manner. The set of twelve background documents by eminent Indian practitioners and policy analysts, which formed the basis of the overview document and are contained in the present value, addresses two basic questions:

- What are the major water development and management challenges facing India?
- What are the critical measures to be taken to address these?

India has a highly seasonal pattern of rainfall, with 50 per cent of precipitation falling in just fifteen days and over 90 per cent of river flows in just four months. Throughout history people have adapted to this variability by either living along river banks or by careful husbanding and management of water. Until the nineteenth century, most of this management was at the community level, relying on a plethora of imaginative and then-effective methods for harvesting rainwater in tanks and small underground storages.

Over the past 150 years India has made large investments in large-scale water infrastructure, much of which brings water to previously water-scarce areas. This has resulted in a dramatic economic shift, with once-arid areas becoming the centres of economic growth, while the historically well-watered areas have seen much slower progress. For the most part the results of this 'hydraulic infrastructure platform' have been spectacular both nationally (through the production of foodgrains and electricity, for example) and regionally (where such projects have generated large direct and equally large indirect economic benefits). The poor have benefited hugely from such investments. The incidence of poverty in irrigated districts is one-third of that in unirrigated districts.

There are regions of India that can benefit greatly from increased investment in water infrastructure, of all scales. India can still store only relatively small quantities of its fickle rainfall. Whereas arid-rich countries (such as the United States and Australia) have built over 5000 cubic metres of water storage per capita, and middle-income countries like South Africa, Mexico, Morocco, and China can store about 1000 cubic metres per capita, India's dams can store only 200 cubic metres per person. India can store only about 30 days of rainfall, compared to 900 days in major river basins in arid areas of developed countries. A compounding factor is that there is every indication that the need for storage will grow because global climate change is going to have major impacts in India—there is likely to be rapid glacial melting in coming decades in the western Himalayas, and increased variability of rainfall in large parts of the subcontinent.

A review of India's hydropower infrastructure reveals a similar picture—whereas industrialized countries harness over 80 per cent of their economically-viable hydropower potential, in India the figure is only 20 per cent, despite the fact that the Indian electricity system is in desperate need of peaking power and despite the fact that Himalayan hydropower sites are, from social and environmental perspectives, among the most benign in the world. Especially in the water-rich North East of the country, water can be transformed from a curse to a blessing only if major investments are made in water infrastructure (in conjunction with 'soft' adaptive measures for living more intelligently with floods). Recognizing this, the Prime Minister has recently called for the establishment of 'a Tennessee Valley Authority (TVA) for the Brahmaputra' which would combine major water infrastructure with modern management approaches to make water a stimulus for growth. In many parts of the country there are also substantial returns from investments in smaller-scale, community-level water storage infrastructure (such as tanks, check dams, and local water recharge systems). And there are massive needs for investment in water supply systems for growing cities and for under-served rural populations.

The problems of a developing India, however, are not limited to providing adequate quantities of water. Growing populations, cities, and industries are putting great stress on the aquatic environment. Many rivers—even very large ones—have turned into fetid sewers. India's cities and industries need to use water more effectively, and there will have to be massive investments in sewers and wastewater treatment plants.

Global experience shows that the returns to investments in water infrastructure and management follow the broad outlines shown in Figure 1.1. During the first development stage, the challenges were predominantly engineering in nature. In India Arthur Cotton and other pioneering engineers were worshipped as saints, and dams became 'the temples of modern India'. The very success of this enterprise, as in other societies and for other issues, carried the seeds of its own downfall. As an infrastructure platform was built, the 'Type 2' and 'Type 3' challenges of maintenance, operation, and management started to emerge. The uni-functional ('build') and uni-disciplinary ('engineering') bureaucracy adopted the command-and-control philosophy of the early decades of independence, seeing users as subjects rather than partners or clients. The Indian state water apparatus still shows little interest in the key issues of the management stage—participation, incentives, water entitlements, transparency, entry of the private sector, competition, accountability, financing, and environmental quality.

Evidence abounds of the inability of the state water machinery to address even the problems of the provision of public irrigation and water supply services. User charges are negligible, resulting in lack of accountability and insufficient generation of revenue even for operations and

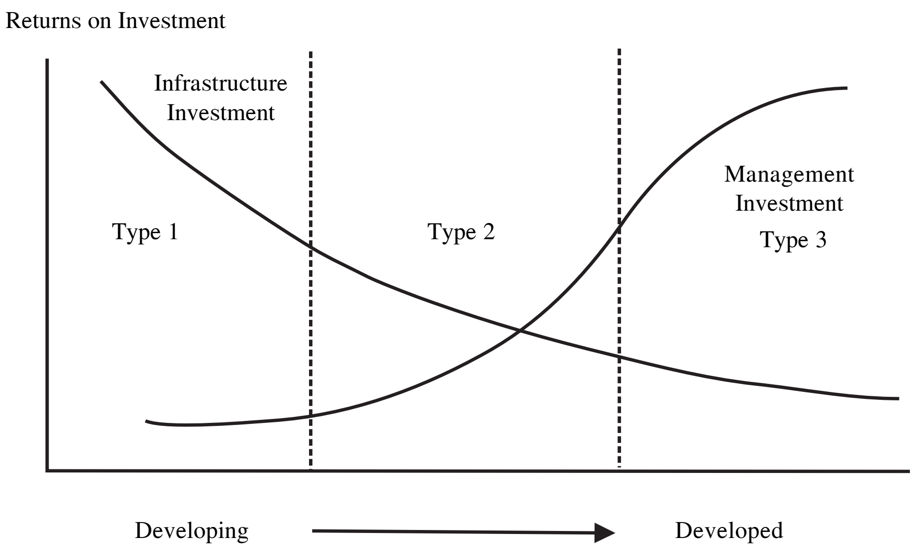

Figure 1.1: Rates of Return on Investment on Infrastructure and Management of Water Resources

Source: Briscoe, John and R.P.S. Malik (2006).

maintenance. The gap between tariff and value of irrigation and water supply services has fuelled endemic corruption. Staffing levels are ten times international norms, and most public funds are now spent feeding the administrative machinery, not maintaining the stock of infrastructure or providing services. There is an enormous backlog of deferred maintenance. The implicit philosophy has been aptly described as build-neglect-rebuild (Mohanty, 2005). This problem is serious in its own right, but it also means that public financing is not available for the vital tasks of providing new irrigation, water supply, and wastewater infrastructure to serve growing populations and the unserved poor. Most recent irrigation and water supply projects assisted by the World Bank, for example, have not financed new infrastructure, but the rehabilitation of poorly maintained systems.

The sector is facing a major financing gap. The real financial needs of the sector are growing to meet the costs of rehabilitating the existing stock of infrastructure and to build new infrastructure. These needs are amplified by the fact that large proportions of recurrent budgets are spent on personnel, not on real maintenance, and on electricity, irrigation, and water supply subsidies. On the 'supply side' there are ultimately only two sources of financing—tax revenues and user charges. The budgetary allocations to the water sector is falling, as are payments by users. The net result is a large and growing 'financial gap', which can only be met by a combination of methods which include greater allocations of budgetary resources, more efficient use of those resources, and greater contributions from water users.

This decline in the quality of public irrigation and water supply services would normally be expected to produce social unrest and political pressure. But to the (temporary) rescue of Indian society came a simple and remarkable transformational technology—the tubewell. With large areas of India having substantial and easily-accessible aquifers, people were able to ignore the inconvenience of poorly functioning public systems and become self-reliant using groundwater. In many ways this 'era of the individual coping strategies' has been remarkably successful.

- Irrigators have either drilled individual tubewells or relied on others' tubewells (giving rise to elaborate informal water markets). This has happened on a massive scale, with 20 million tubewells now installed, and groundwater now accounting for over 50 per cent of irrigated area.
- The urban middle class have learned to make do with irregular, unpredictable, and often polluted public water services. They have developed coping strategies which include investments in household storage, purchasing of bottled water for drinking, installation of household water purification systems, purchase of water from vendors, and, like their rural counterparts, private wells to tap the groundwater. Although the costs are high—six times higher than the average payment to the utility in Delhi, for example—this works for the middle class. Note that 80 per cent of domestic water supply in India now comes from groundwater.
- The situation of the poor in urban areas is far worse. They are powerless and therefore at the end of the line when the inevitable rationing takes place, and they cannot afford to make the same coping investments as the middle class. They depend heavily on water vendors, most of which are, again, supplied by groundwater, and provide water of very high cost.
- Industry, too, has coped by self-providing, mostly from groundwater. Where aquifers are either not available or exhausted, industries resort to very-high cost 'captive' alternatives (including reverse osmosis treatment of wastewater and desalination) to keep their factories running.

In many ways this private, self-provision strategy has been a success, and has underpinned spectacular gains in agricultural production and the rise of thousands of towns and cities. This has bred an attitude among many—political leaders, industrialists, irrigators, and the common people—that 'we have muddled through okay, and we will continue to muddle through'. This is a dangerous complacency, because it is based on three erroneous assumptions:

- that there is limitless groundwater;
- that the environmental debts (including vanishing wetlands and polluted rivers and aquifers) do not seriously constrain human activity; and
- that the financial liabilities inherent in these systems can continue growing indefinitely.

In already-large and rapidly growing segments of the economy and in many of the most productive regions of the Indian economy, this self-provision model is no longer sustainable. The National Commission on Water of 1999 has shown that overall water balances are precarious, that crisis situations already exist in a number of basins, and that by 2050 India's demands will exceed all available sources of supply. Already about 15 per cent of all aquifers are in critical condition, a number which will grow to 60 per cent in the next twenty-five years unless there is change. About 15 per cent of India's food is being produced using non-renewable, 'mined', groundwater. Since aquifer depletion is concentrated in many of the most populated and economically productive areas, the potential social and economic consequences of 'continued muddling through' are huge.

At the same time, Indian society is changing in many profound ways. Industries and cities (which both require water and produce wastes) are growing rapidly. Rural life is changing, with more than half of the people in rural Punjab and Haryana no longer engaged in agriculture. And agriculture itself is evolving. In a growing number of areas, high-value crops are now displacing low-value foodgrains, farmers are investing heavily in drip irrigation, and there are even travel agencies specializing in 'agro-tourism', so that farmers can see how their contemporaries manage with less water in Israel and other places. As incomes rise—100,000 people are joining the middle class every day—people are becoming more concerned with environmental quality. The net effect is that the demands for and on water resources are changing substantially, with the effects especially acute in the high-growth regions, most of which are water scarce.

Confronted with this reality of limited supplies and growing and changing demands, the need is obviously for a management framework which stimulates efficiency and which facilitates voluntary transfer of water as societal needs change. The traditional command-and-control and construction instruments of the Union and state water bureaucracies address neither of these imperatives. The economic and social costs of rigidity are large—a World Bank study of Tamil Nadu, for example, shows that if a flexible water allocation system were adopted, the state economy in 2020 would be 20 per cent larger than under the current, rigid, allocation procedures. A central element of a new approach must be that users have well-defined entitlements to water. The broader messages are that the ideas of the 1991 economic reforms must be drilled down from the regulatory and financial sectors into the real sectors (including the water sector) if India is to have sustainable economic growth, and that the role of the Indian water state must change from that of builder and controller to creator of an enabling environment, and facilitator of the actions of water users large and small.

An important manifestation of the breakdown of the current system is the growing incidence and severity of water conflicts—between states, between cities and farmers, between industry and villagers, between farmers and the environment, and within irrigated areas. The state has generally responded by proposing new supply schemes (a new dam, a desalination plant, or a rainwater harvesting scheme) which will 'solve the supply problem'. What is becoming increasingly apparent is that in the growing number of areas where water is already scarce, it is a zero sum game. These schemes increasingly solve one person's problem at the expense of someone 'downstream'. On the more thorny issues where tradeoffs cannot be avoided, the usual response of the state water apparatus has been to hope it rains and, failing that, to play for time. ('Passing it to the Supreme Court' has become a standard modus operandi for water matters where the administration cannot muster the necessary imagination or political will to act.) Where interstate Tribunal awards have been made, they have not helped much. They have taken years to complete, have not followed global good practice, and have stimulated states to focus their attention on 'getting more water next time', rather than on effective use of what they have. The results have been serious economic and fiscal damage. (For example, 18 per cent of Maharashtra's fiscal deficit is to pay for the construction of dams whose primary purpose was to lay claims for water from the Krishna in the next Tribunal Award.) In addition, there are no effective mechanisms for enforcing awards or preventing unilateral action or even exit by dissatisfied states. The lack of modern, fair, and enforceable interstate water compacts has also stymied sensible interstate 'win-win' water cooperation.

As in all other federal countries these issues are complex and political. India has some good models for proceeding—in its own treaties with Pakistan on the Indus and Bangladesh on the Ganga; and in the experience of other arid federal countries. Dealing with these issues is the single most important task facing the Union Ministry of Water Resources. Recent statements by national political leaders show growing awareness of the problem. The finance minister has warned about 'a growing set of little civil wars over water' and the minister of water resources notes wryly that he is really 'the minister of water conflicts'.

India needs a re-invigorated set of public water institutions, which are built on the following imperatives:

- focusing on developing a set of instruments (including water entitlements, contracts between providers and users, and pricing) and incentives which govern the use of water;
- stimulating competition in and for the market for irrigation and water and sanitation services;

- empowering users by giving them clear, enforceable water entitlements;
- ending the culture of secrecy and making transparency the rule;
- introducing incentive-based, participatory regulation of services and water resources;
- putting the sector on a sound financial footing;
- investing heavily in development of a new generation of multi-disciplinary water resource professionals;
- making the environment a high priority; and
- making local people the first beneficiaries of major water projects.

India is rapidly approaching the end of an era in which society could 'get by' despite the fact that government (a) has performed poorly where it has engaged (in service delivery) and (b) has abandoned major areas where government engagement is critical (such as groundwater management, conflict resolution, establishing and managing water entitlements, and the financing of public goods such as flood control and wastewater treatment).

There are two main corollaries to this diagnosis. First, that a major push is needed—by the government and the users working together—to bring abstractions from groundwater in line with recharge. While traditional technologies such as rainwater harvesting and tanks can play an important local role, they also create new and additional demands which often clash with existing uses, and they sustain the wishful thinking that supply-side options (both large and small scale) are what will 'solve the problem'. The simple fact is that in many parts of India demand will have to be brought down to match sustainable supply. Global experience shows that this difficult and essential task will require a partnership between users and government—to form empowered aquifer user associations; to formalize water entitlements which are consistent with the sustainable yield of the aquifer; to develop transparent information and decision support systems. So far the approach of the water apparatus has been to promulgate laws and policies, most of which are not implemented. Here an approach which begins with acknowledgement of and respect for the private interests of individual farmers will be far more successful than approaches which resort to command and control, or ones which are based on a communitarian ideal. The longer this adjustment takes place, the more costly and difficult it becomes.

Second, the end of the era of massive expansion in groundwater use is going to demand greater reliance on surface water supply systems. This is going to require recuperation of the large stock of dilapidated infrastructure and large-scale investment in public infrastructure of all scales (not only for provision and distribution of surface water supplies, but also for treatment of wastewater). And it is going to require a dramatic transformation in the way in which public water services are provided to farmers, households, and industries, in which the watchwords are water entitlements, financial sustainability, accountability, competition, regulation, and entry of alternatives to government provision, including cooperatives and the private sector.

India faces this challenge with many assets and some liabilities. The assets include citizens, communities, and a private sector who have shown immense ingenuity and creativity, attributes which are critical for the new era of water management. The major liability is a public water sector which rests on the laurels of an admirable past, but is not equipped to deal with the central tasks which only the government can deal with—developing an enabling legal and regulatory framework; putting into place entitlement and pricing practices which will provide incentives for efficient, sustainable, and flexible use of water; forming partnerships with communities for participatory management of rivers and aquifers; providing transparent information for use in managing and monitoring the resource and services; stimulating competition among providers through benchmarking and the entry of private sector and cooperative providers; regulating both the

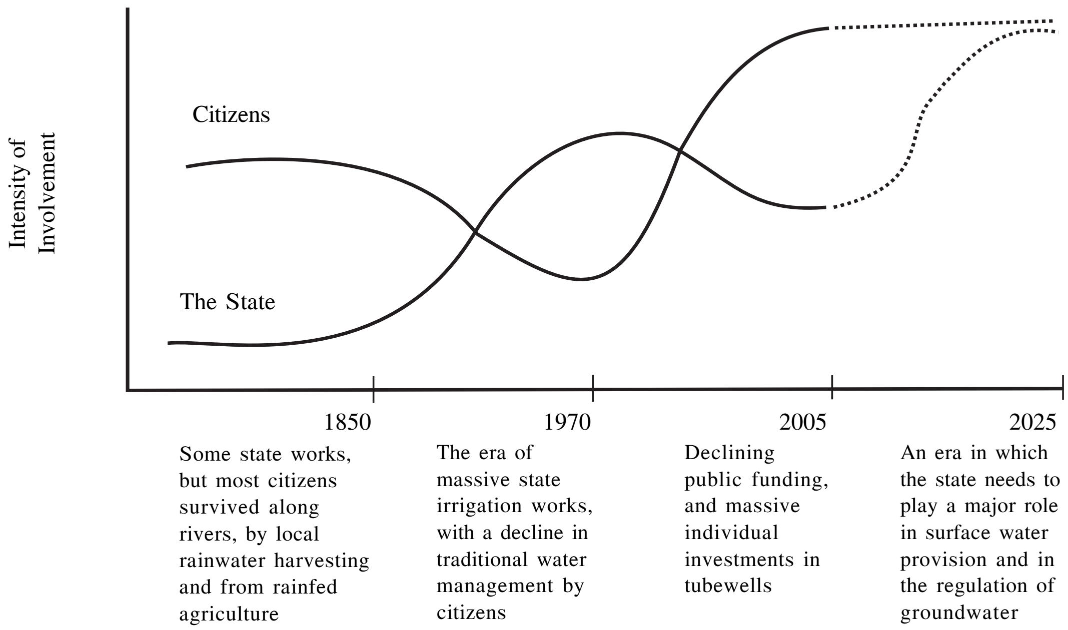

Figure 1.2: The Evolving Role of the Citizen and the State in Water Management

Source: Same as Figure 1.1.

resource and services; and financing true public goods, such as flood control and wastewater treatment. Figure 1.2 provides a schematic sense of the necessary 'next stage' in the evolution of water management in India.

In the eyes of many—including several of the very experienced Indians who wrote background papers for this report—the idea of such a modern, accountable 'Indian water system' is a fantasy, given the dismal performance of the Indian state on water matters in recent decades and the broader challenges of governance. Others point to 'the hollowing out of the Indian state... the growing middle-class exit from public services... and the inability to grapple with the many long-term challenges facing the country'. The glass is, of course, always half empty. But it is half full too. There are some important signs that the need for change is being understood, there are political leaders who are starting to grapple with these realities, and there are a few states which are taking the important first steps down this long and winding road.

India is fortunate, too, in that it is not the first country in the world to face this (daunting) set of challenges. The experiences of other countries suggest that there are a set of 'rules for reformers' in undertaking such a transition. These rules include:

- initiate reform where there is a powerful need and demonstrated demand for change;
- involve those affected, and address their concerns with effective, understandable information;
- if everything is a priority, nothing is a priority—develop a prioritized, sequenced list of reforms;
- pick the low-hanging fruit first—nothing succeeds like success;
- keep your eye on the ball—don't let the best become the enemy of the good;
- be aware that there are no silver bullets;

- don’t throw the baby out with the bath-water;
- treat reform as a dialectic, not mechanical, process;
- understand that all water is local and each place is different—one size will not fit all;
- be patient, persistent, and pragmatic; and
- ensure that reforms provide returns to politicians who are willing to make changes.

In a national workshop to discuss the Overview Report, the Ministry of Finance described what the Government of India (GOI) expects of the World Bank in the water sector. The World Bank is expected to finance projects which couple high-return investment with reform processes, and which bring knowledge about international good practice to bear on the water challenges facing India. With this guidance, what is it that the World Bank can do to be a better partner to India on water?

The World Bank’s India Country Assistance Strategy (CAS) of 2004 outlines the broad features of Bank involvement with India over the next four years. These include:

- lending which will simultaneously address investments, reforms, and knowledge transfer;
- a large increase—see Figure 1.3 in lending for water-related sectors (including water resources management, irrigation, hydro-power, and water supply and sanitation), with aggregate lending for these sectors set to rise from US¯200 million to US$ 800 million a year;
- a willingness to consider financing high-return infrastructure that can be built to reasonable social and environmental standards; and
- clear ‘guidelines’ for engagement with each water-related sector.

The CAS is a living document, with elaborations and adjustments emerging as needs and perceptions evolve. Consistent with the guidance from the ministry of finance, the Bank will focus

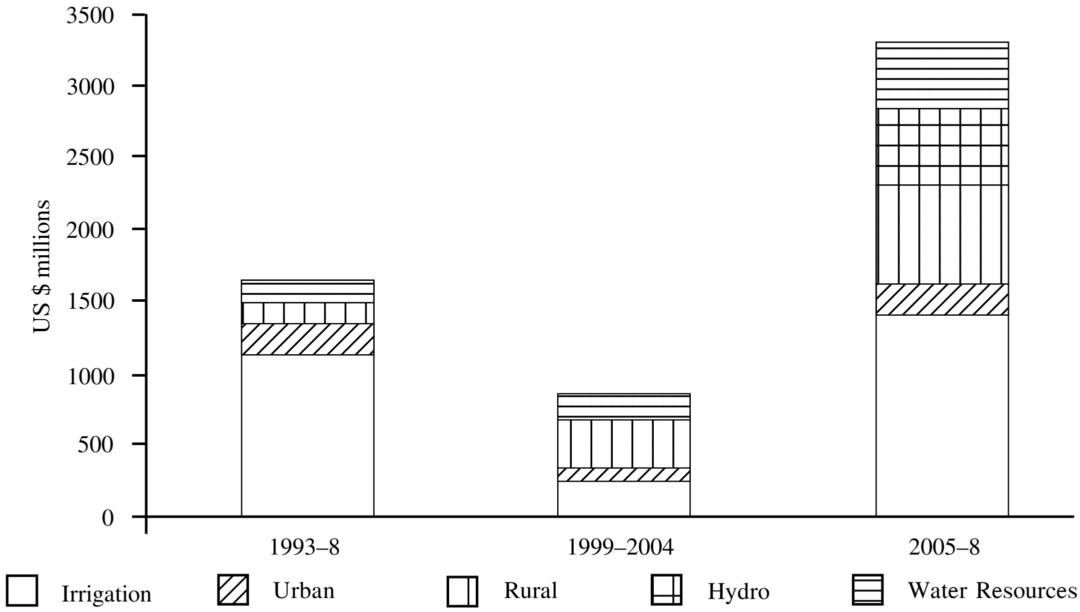

Figure 1.3: The Changing Composition and Level of World Bank Lending for Water

Source: Same as Figure 1.1.

more sharply on the institutional reform and global best practice content of Bank-financed activities. This will mean greater emphasis on 'instruments' that stimulate efficiency, accountability, and flexibility (such as water entitlements, information, regulation, competition, and pricing). It will also mean greater attention to the 'hidden groundwater economy'. It will mean more attention on building capacity in the public sector. It will mean being 'principled and pragmatic', following the 'rules for reformers' outlined earlier.

In its internal workings, the Bank will also give more explicit attention to ensuring better cross-sectoral collaboration within the Bank on water resources and to better integration of the Bank's lending and knowledge services—so that there is more explicit learning from projects, and that analytic work feeds back into the design of Bank-financed projects. And the Bank will recruit staff and consultants who have hands-on knowledge in translating reform principles into results on the ground.

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2

Government Policies and Programmes

ANIL D. MOHILE

History of Water Policies in India

The History of Water Development in India

India has a long history of water development. The uneven temporal distribution of rainfall has perhaps been the driving force for water development. Small storage reservoirs were reconstructed even before the Mauryan era. Larger 'run-of-the-river' type developments were undertaken during the Chola period. The Mughal era saw large-scale 'run-of-the-river' development through inundation canals. However, more systematic and large-scale water development, mostly for irrigation, was undertaken in the British period. In the 1850s an attempt was made to promote irrigation development through private companies. However these did not succeed.

In 1866 important changes were made in the principles and policy. It was decided that irrigation projects, in future, would be constructed by the states through their own agencies and financed from public loans. It was also decided that political boundaries (of states) would not be allowed to come in the way of implementing the best possible solutions.

The Government of India Act, 1935, transferred the subject of irrigation from the control of the centre to that of the states. The Government of India was no longer concerned with irrigation development except where disputes arose between neighbouring provinces.

After independence, in the era of planned development, particular emphasis was laid on water development for irrigation for increasing the food security. At present, a considerable storage development with a live storage of about 200 billion cubic metres, a gross irrigation of about 90 million hectares, and an installed hydropower capacity of about 30,000 megawatts has been created through water development.

The Evolution of Water Policies in India

In the early period, administrative policy documents indicate that the social aspects of water development were considered important. The commercial aspect became more important in the early British period. In this period, irrigation works were classified as commercial and non-commercial. For commercial works, it was necessary that a specified rate of return should be available by the tenth year after completion of the project.

There was no well-documented water policy before 1987. However some policy guidelines were available through documents like the report of the Second Irrigation Commission, the statements made in the Parliament with regard to the policies about flood control, and the various other official documents.

In the 1980s the National Water Resource Council (NWRC) under the chairmanship of the Prime Minister of India was constituted. The National Water Board supported it, at the official level. In both of these bodies, apart from the various ministries of the central government, all the state governments were also represented. The NWRC, in 1987, finalized the national water policy. This document represented the consensus in regard to the various policy issues after considering the opinions of the states. For arriving at such a consensus, this policy document is occasionally vague, and does not elaborate the various strategies which would have to be used. This umbrella policy was to be supported by the various state water policies, as also by the various detailed sectoral policy documents to be finalized through the National Water Board and the NWRC. Accordingly, policy documents like the irrigation management policy, policies regarding asset management, policies in regard to the operational and procedural change, etc. were finalized through the NWRC. Many states have also formulated their water policies.

In the year 2002, the revised national water policy document was finalized through the NWRC. The main changes in the 1987 policy were in regard to incorporation of the Integrated Water Resource Management (IWRM) principles, and a larger emphasis on river basin management. The environment-related concerns were also stated more elaborately.

The important milestones in the evolution of the Union government's water-related policies are listed below:

1866— The government is given the main role in irrigation development.

1935— Transferred 'irrigation' to the states.

1950— Beginning of planned development.

1972— Second irrigation commission report.

1980— *The Rashtriya Barh Ayog* (National Commission on Floods) submitted its report.

1986— Formulation of NWRC.

1987— National Water Policy (1987) finalized in the first meeting of NWRC.

1994— Modified draft of National Policy for Water Allocation amongst states, circulated to the states.

1998— Water sector review by GOI and World Bank.

1999— Second meeting of NWRC considered water allocation and river basin authorities.

1999— Report of the National Commission on Integrated Water Development.

2000— Water Vision by India Water Partnership.

2002— National Water Policy (2002).

2004— CPSP India studies by ICID–IAH.

The logical process of water policy reforms has been discussed further in the section 'A Critical Analysis of the National Water Policy'. It is difficult to follow this logical procedure in real life situations. As already discussed, both the National Water Policy (1987) and the National Water Policy (2002) were developed without explicitly following these procedures. Even then, while developing these policies, documents and master plans including the report of the National Commission for Integrated Water Resource Development, which brought out the current and future issues and indicated a general plan of development, were available.

At this stage, we need to mention two serious difficulties in implementing the policy provisions related to IWRM. They are:

Lack of Water Allocation Guidelines

The allocation of the waters of interstate river basins amongst states, at present, are either worked out through negotiated agreements amongst the states, or flow through the award of an interstate water dispute tribunal. Various alternate doctrines based on say the riparian principle, the chronology of use, the principle of causing no harm to the downstream entities, on the contribution of the state to the basin waters, as also those based on the principle of equitable distribution are available in the literature about international water law. These are cited during the process of negotiations or adjudication, with each party normally preferring the doctrine, which serves its interest. Apart from the doctrines, there are many other common contentious issues which are often discussed, but about each no agreed guidelines are available in India. Although all water dispute tribunals set up in India, so far, have favoured the doctrine of equity in use, thus setting up a strong precedent through the case law, no formalized guidelines exist in this regard. In this background, policy guidelines seem to be necessary.

The Union government, during the period 1995–2000 through the National Water Board and the NWRC, tried to evolve policy guidelines for 'allocation of the water of interstate rivers amongst the states'. Even after detailed discussions in the Board and considerable attention paid by the Council, the latter could not finalize the document, on account of the various objections by different states, either concerning the need for formulating such guidelines or concerning the details.

River Basin Authorities

The implementation of the principles of the IWRM makes it necessary to create basin authorities for managing interstate river basins. The 'management' needs to include activities such as integrated and holistic planning, implementation of projects, integrated operation of water systems, monitoring, etc. With the exception of the Brahmaputra Board, such basin authorities do not exist in India. There are a few basin authorities such as the Narmada Control Authority, the Upper Yamuna River Board, etc. which are involved only in the operation of the water systems and are not full-fledged basin authorities. The constitutional provisions under entry 56 of the Union list enable the Union government to create such an institution through a law of Parliament. The River Board Act (1956) provided a legislative framework for such institutions. However this Act seems to confer an advisory status on the River Board. This and other provisions of the Act have perhaps dissuaded the Union government from creating any institution under this Act. The Brahmaputra Board and the Betwa River Board were created through separate acts. While the former has comprehensive functions encompassing the whole range of basin management, the latter has a limited function relating to the construction of a project. While these boards could be created with full support of the states concerned, creating regular basin organizations and incorporating the principle of stakeholder participation through a consensus among the states appears very difficult.

In this background the Union government sought to provide, through the initial draft of the National Water Policy (2002), a legal support to the proposed river basin organizations. The National Commission for Integrated Water Resource Development had recommended the general structure of a river basin organization in which, apart from the concerned ministries and departments of the Union and the basin states, other stakeholders like water users were also members of the river basin organization. Many states had serious objection to providing a legal basis and delegating executive responsibility to the river basin organizations. Finally it was found that only an organization with an advisory role could become acceptable.

A Critical Analysis of the National Water Policy

The National Water Policy, 2002, does not list the basic or leading principles on which the policy is based.

Section 1 of the policy—'Need for the National water policy'—is a sort of a preamble to the policy and is therefore of some importance in regard to the leading principles. In the section, the need for an integrated water resource development and the importance of environment-related concerns are clearly mentioned. Thus commitment to the IWRM principles with the larger stress on environment issues is one of the basic principles of the policy.

This preamble also mentions the increasing demands for water for food, power generation, and so on. It recognizes that the increasing demand is both due to the growth of population and economic changes. The resultant scarcity of water and the consequent need for utmost efficiency in water utilization is specially mentioned.

Water quality-related concerns and the need to eliminate pollution of groundwater has similarly been mentioned. In this context, the importance of innovative techniques and better strategies resting on a strong science and technology base receives a mention. Earlier the World Bank and GOI report on inter-sectoral water allocation (World Bank, 1999) had mentioned the incomplete monitoring and enforcement, and inadequate regulation of groundwater extraction as some relevant issues. These have not been addressed.

While the need of a well-developed information system has been mentioned in section 2, the need for an open access to the information has not been mentioned.

Section 3, on water resources planning, is based on the principle that the maximum amount of the available water resources should be converted into utilizable resources. Thus this paragraph is based on an earlier thinking that any water which is not utilized represents the 'waste of resources'. The need to balance the use of water with its deliberate non-use in order to maintain environmental balance of the riverine, estuarine, and the coastal ecosystems is negated by the wording of this paragraph, although the ecology-related concerns are addressed elsewhere.

Section 4 deals with the institutional mechanism. The wording of this section indicates that this has been drafted in the background of a strong centrally planned economy where all water-related responsibilities are to be discharged by the governmental system. In this paragraph the need for a better institutional arrangement for operation and maintenance (O&M) (so that these activities are given equal or more importance than construction-related activities) is clearly brought out. Similarly, the need for an appropriate river basin organization for the planned development and management of river basins has been brought out. However, the possibility that in the future, the role of the government or the river basin institutes, in regard to the planning and management of the river basins, may shift from that of an implementer to that of a regulator seems to have been ignored.

Similarly, section 6 on project planning also presumes that the planning of individual water development projects would continue to be conducted by the government and that the economic criteria, as modified using the directions given in the section, would be the main deciding factor about the credibility of the development projects. The role of the private sector in planning and implementing such projects (within a broader policy framework laid down by the government), but driven not so much by the economic analysis but by the perceptions of the investor in regard to the financial profitability, has perhaps been ignored.

Section 11 deals with the financial sustainability. It mentions the principle that the water charges for various uses should be fixed in such a way that they cover at least the O&M charges, and a part of the capital costs (capital cost recovery). Thus again, water prices are considered totally as administered prices, negating the principle of using the market mechanisms to decide the price of water, even where the final decision is 'administrative'.

Section 13 is a small paragraph dealing with private sector participation. It states that private sector participation may help in introducing innovative ideas, generating financial resources, and introducing corporate management as well as accountability to users. It concludes that depending on the specific situation, private participation in building, owning, operating, leasing, and transferring of water facilities may be considered. It is at best a lukewarm response allowing a change to take place and falls short of even a controlled encouragement.

Thus, the policy-makers in regard to the Indian water policy seem to have been driven more by past experience and the current perception of the problems of the past in framing the policy. In the future situations, the role of the government in the water sector may be reduced to that of monitoring and analysing the situation and of regulating the development and management of water. The market forces would then decide the exact unfolding of the development and management scenarios including vital decisions in regard to financial sustainability and water pricing. The policy-makers, however, have either ignored or have not agreed to a possibility of such rapid changes. It is conceded that the policy-makers may have sound reasons for not agreeing to the likelihood of such rapid changes. However, if this is so, the rationale in this regard could have been articulated in the policy.

Water Sector Policies of the World Bank

The unified nature and indivisibility of the waters of the earth form the basis for coordinating water-related actions by different countries of the world in a single international agenda for water. This process started in the late twentieth century and is continuing. The main milestones of the process are mentioned below:

- The Delft Declaration (1991)—This identified the weaknesses of the institutional capacity as the main cause for unsustainable water services and supported capacity building and integrated planning.
- The Dublin Principles (1992)—This endorsed political commitments regarding the involvement of government and community towards institutional changes, the use of market economy, capacity building, etc.
- The UN Conference on Environment and Development (Earth Summit)(1992)—The agenda 21 gave priority to adjustment of decision-making systems and institutional arrangements at the country level to deal with the emerging environmental and other issues of the twenty-first century.
- Water Resources Management: A Policy Paper (1993)—This World Bank Policy Paper captured the Dublin principles and laid down the policy for the World Bank to promote and support national water sector policies.
- The Global Water Partnership–Technical Advisory Committee (GWP–TAC) 'Background Paper No. 4: Technical guidelines for integrated water resource management'—These define the process of Indian Water Resources Association (IWRA) and lays down the types of integration envisaged and the limitations of such integration.
- World Water Forum-I, Morocco (1997).
- Preparation of World Water Vision on water, food, and rural development (International Commission on Irrigation and Drainage (ICID) (2000)—This vision stressed the need for continued irrigation expansion, increasing storages, and additional irrigation water use even after management improvements.
- The preparation of integrated World Water Vision (World Water Council) (2000)—The consolidated vision presumed that there is no need for any significant addition towards agricultural water use.
- World Water Forum-II, The Hague (2000)—The sectoral visions for water use sectors and the consolidated vision were released.
- The International Conference on Fresh Water, Bonn (2001)—Brought out five thematic background papers.
- The Rio plus ten conference, Johannesburg (2002)—Reviewed Agenda 21 and laid down action plans for implementation of the agenda by the nations of the world.
- World Water Forum-III, Kyoto (2003)—Relooked at the World Water Vision. Needs of the developing countries with growing populations were recognized.

The evolving international agenda on water can be taken as the main driver for the World Bank to take action in assisting the various nations in evolving appropriate water policies on their own in such a way that these, in general, fit with the international water agenda.

The 1993 water strategy (World Bank 1993) was an important watershed. As a result of these, the focus of the World Bank's lending policies shifted from projects to sectoral needs. Pitman (2002b) points out that the level of World Bank lending to India in water portfolio, expanded at about 720 million a year and reached its peak in 1987. After the new policy the lending almost halved to about $ 330 million. The composition of the active portfolio changed significantly from the period 1979–87 to 1988–99, moving away from the irrigation focus to encompass broader water resource issues. Overall, irrigation projects were replaced by more water resource-oriented projects while water supply and sanitation portfolio remained fairly stable.

However, in spite of the changes, the performance analysis as presented by Pitman (2002a) does not indicate any marked improvement in the performance. The performance ratings have fallen. The hydro- and rural-water supply projects according to him have the poorest performance, irrigation, and drainage and urban water supply projects have a mixed performance, and only fisheries, aqua culture, and agricultural adjustments have performed satisfactorily. Institutional development, in general, has been unsatisfactory. In regard to time overruns some improvements are noticed beyond 1995. Even in regard to the compliance of operations water strategy, Pitman's data show only a marginal improvement from pre- to post-policy.

Comparison of National Water Policy with Suggestions of the World Bank

The World Bank (1999) in its inter-sectoral water allocation planning and management has recommended some core features for the state water policies and the national water policy. The position in this regard to the basic principles is indicated below:

- Comprehensive approach on water development on river basin basis—The IWRM principles including the river basin approach have been clearly mentioned in the 2002 policy (paragraph 3.3). The institutional mechanism necessary for the River Basin Organization (RBO) has also been mentioned (paragraph 4.2). However, in practice, no empowered basin-wise RBOs could be created due to political difficulties and lack of legislation. The state water plans and the state water policies as developed even under the water resource consolidation projects assisted by the World Bank have also not dealt comprehensively with the whole basin as a unit for planning and management. Preparing water plans, only for that part of a basin, which is in one state, is much different from preparing an integrated and comprehensive basin-wise plan.
- Treatment of surface or groundwater as a unitary resource—This principle is clearly mentioned in paragraph 1.2 of the 2002 water policy. However in the institutional mechanism the need for dealing with both surface and groundwater under the same umbrella has not been mentioned. A separate section (section 7) on groundwater development also allows an interpretation that the two sources are being considered as separate resources. Even in paragraph 1.2 of the policy, the mention of two definite figures for utilizable resourses from surface and groundwater overlooks the interaction between these.

Some of the main limitations of the present Indian water sector policies and programmes, as brought out in the World Bank–GOI work on intrasectoral water allocations (World Bank 1999) are indicated in Table 2.1.

Assessment of the Contributions of the World Bank in Formulation of the Union Water Policies

In 1991 the Bank was under increasing pressure for its alleged neglect of popular participation in irrigation and other water projects, and for its failure to see the impact of its water projects on other water uses and on the environment as a

TABLE 2.1: Comparison of Water Policies—1987 vs. 2002 (with Reference to the 1989 Review)

The 1987 policy and its limitations as brought out in World Bank (1999) review		Current position, as seen by the author, with reference to the 2002 policy
Provision	Main Limitations	
General remarks	Does not reflect new economic policies	The position continues. Private sector participation mentioned briefly.
	Pre-determined priorities inconsistent with social and economic values	The position continues. This study mentions the need to properly define priorities for domestic water.
Legislative and regulatory framework	Jurisdictional problems about river basins	The position continues. For international basins, India prefers bilateral action rather than basin-wise planning. For interstate river basins the need for RBOs is mentioned without bringing out the need for providing legislative support and executive responsibilities to RBOs. This study recommends legislative changes. Similarly, it recommends the finalization of a policy for allocation of waters of an interstate river to the states, and the possibility of constraining the allocations by uses. It also recommends a legislative back-up for these policies.
	Absence of the creation of water rights and uncertainties regarding water rights	The position continues in the 2002 policies. A clear statement in this regard needs to be included in the policy. The author of this paper recommends the recognition of water as a 'negative community' in which only usufruct rights can exist. The 'negative community' status of water indicates that it is a 'common' which is not owned by any one including the community. Thus, there would be no absolute property rights in regard to water. Any potential user, including the state, cannot use the water by causing harm to others or without an agreement or award conferring the rights to use the water. Further, the right can be exercised on the waters which are in the rightful possession of the user. It is also recommended that the 'state' grants the water rights to the users by creating water right regime. These water rights of users need to be subject to reviews.
Institutional mechanism concerning the Union institutions of the central government, civil societies, NGOs, communities, and industries	Incomplete monitoring and enforcement of legal provision of water pollution control; inadequate application of water qualities, classifications, regulations; limited effectiveness of River Board Act; lengthy procedures of conflict	The position continues except for the formulation of the central groundwater authorities, and the larger intervention of judiciary in regard to water quality regulations. RBOs with large stakeholder participation are recommended for better regulations. The 2002 policy (paragraph 4.1) mentioned the need for reorienting/reorganizing or creating institutions for multi-sectoral, multidisciplinary; and participatory work based on hydrologic units. However, no reform

(Contd ...)

Table 2.1 (Contd ...)

The 1987 policy and its limitations as brought out in World Bank (1999) review		Current position, as seen by the author, with reference to the 2002 policy
Provision	Main Limitations	
	resolutions through tribunals; non-involvement of all disciplines in the decision making of tribunals; fragmentation of water-related responsibilities and inadequate coordination has also been mentioned	programmes are underway; the present report recommends large institutional reforms for the Ministry of Water Resources (MOWR)/Central Water Commission (CWC) somewhat on the lines of the recommendations of the National Commission. Reforms for giving a legal back-up to the NWRC and for larger autonomy to the national committees have also been recommended in the present report.
	Limited sharing of information; neglecting their potential in water management consultancy and training; policies, regulations, etc., creating barriers in their functioning	This position continues. The 2002 policy does not deal with information sharing though information systems are discussed. Privatization is mentioned without emphasis. The participatory approach is discussed and is being promoted through programmes.
Intra-sectoral allocations and pricing	Water rates are too low and inadequate; charges are area based and not volumetric; no charges for use of groundwater; no disincentive for wasteful groundwater use; overwhelming tendency to subsidize rural water supply. Infrequent rate adjustment in urban water supply; lack of volumetric metering of domestic supplies; inadequate penalties for water pollution	The 2002 policy mentions (section 11) that water charges should cover O&M cost and a part of capital cost and that they should be linked to quality of service. Subsidies need to be targeted and transparent. However, no programmes to facilitate or force the states to take actions on these recommendations exist. If the water charges are linked to the quality of service, the user can challenge the recovery of the charge on the basis of deficient service. Since the line departments do not find this convenient, the states, in law, prefer to consider the water charge as a tax. The use of market mechanism, at least in guiding administrative decision about water pricing; is also not being implemented. The author of the present study recommends that water charge needs to be linked to the quality of service, and need to cover at least the full O&M costs, cross-subsidies need to be targeted and be made transparent, and market mechanism needs to guide the administered decisions on water prices.
Intra-sectoral allocations	Allocation decided administratively, on ad-hoc basis, and based largely on historical context and policy priorities; allocations as per relative value of water use are not made; no compensation to users in case of re-allocations	This position continues. The Dublin principles of allocating water to the most productive use have not been accepted. The author of the present study agrees with the non-acceptance, and recommends the establishment of a regime of water rights which could be subject to review, and re-allocations on the basis of improper use and changing ground situations.

(Contd ...)

Table 2.1 (Contd ...)

The 1987 policy and its limitations as brought out in World Bank (1999) review		Current position, as seen by the author, with reference to the 2002 policy
Provision	Main Limitations	
	Existing water markets are localized and fragmented	The 2002 policy does not change the situation. Although the water markets have the utility in deciding the value of water, they continue to be unauthorized.
	Trading in water rights, either amongst states or by individual users not provided for	The 2002 policy does not change the situation. No recommendations are made in the present study since, as per the author, water is a negative community, and the usufruct in water can therefore not be traded.

whole. Two irrigation projects stand out among those that call attention—Mahaweli Ganga in Sri Lanka and Narmada in India. Work then began on '*Water Resource Management. A World Bank Policy Paper*' which was published in 1993. The paper showed that the Bank, after years of finding irrigation too vast a subject for a policy paper, now found it too narrow. As a consequence, the World Bank's role in financing the water sector started to diminish. Again, after 2001, the World Bank policies in regard to the water sector seem to be changing and the important role of the water sector in reducing poverty is being increasingly recognized. Thus the policies of the Bank have been changing somewhat fast. In this situation if the policies of the Bank do affect the national policies through a flexible linkage, the consequent changes in the national water policies would exhibit both a delay (phase difference) and a dampening effect (reduction of amplitude). These processes would reduce the contribution of the Bank policies to the national policies. On the other hand, if the Bank policies are consistent, or if these change slowly, the effect on national policies would be more pronounced.

The water policies of the GOI have been evolved through a consultative process. The initial process of drafting takes place in the Central Water Commission (CWC), and the finalization of the documents is done through the National Water Board, in the NWRC. There is, of course, no consultation with any international body in this regard.

There is no direct evidence of the Union water policies being affected by the opinions of the World Bank or any other international body. Indirectly, the experience of working with such bodies would have helped in drafting the water policies. Some of the likely effects are listed below:

- The experience of the difficulties in regard to the rehabilitation and resettlement package in various World Bank-aided projects has been reflected in the concerns expressed in the Union policies about rehabilitation and resettlement. The detailed policies in regard to rehabilitation and resettlement have also been evolved taking such concerns into consideration.
- The insistence of the World Bank in properly considering the return flows from the irrigation projects (for example, irrigation in the Narmada Sagar project) has led to the recognition of the importance of return flows and conjunctive use of water.
- The importance attached by the World Bank and other international bodies to stakeholder management of irrigation has led to the incorporation of these ideas and ideas about water users associations in the Union policies. Both the umbrella national water policy and the detailed irrigation management policy reflect these concerns.

- The importance attached by the international funding agencies to the financial sustainability of water projects and to the consequent need of rationalizing the water tariffs have been reflected in the Union policies.
- The importance attached by the international bodies to public–private partnerships and to encouraging privatization in the water sector has been reflected in the Union policies. As discussed, the umbrella national water policy reflects this rather weakly, but the policy in regard to hydropower projects and the policy in regard to water supply do reflect these concerns more strongly.

In general, it could be said that the World Bank policies in the water sector have made a few significant contributions though indirectly to the Union water policies.

THE INDIAN WATER SECTOR: STATUS, PROSPECTS, AND ISSUES

An Introduction to the Indian Water Sector

- Based on physiography, the river systems of India can be classified into four groups, namely, (i) Himalayan rivers, (ii) Deccan rivers, (iii) coastal rivers, and (iv) rivers of the inland drainage basin. The main Himalayan river systems are those of the

TABLE 2.2: Utilizable Water, Requirements, and Return Flows

(Quantities in km^3)

Sr. No.	Particulars	Year 1997	Year 2010		Year 2025		Year 2050	
			Demand		Demand		Demand	
			Low	High	Low	High	Low	High
1	Utilizable water							
	i) Surface	690	690	690	690	690	690	690
	ii) Groundwater natural	396	396	396	396	396	396	396
	iii) Returns from irrigation	90	90	90	90	90	90	90
	Total	1175	1175	1175	1175	1175	1175	1175
2	Requirements							
	Surface	399	447	456	497	545	641	752
	Groundwater	230	247	252	287	298	332	428
	Total	629	694	710	784	843	973	1180
3	Additional returns							
	Surface	43	52	52	70	74	91	104
	Groundwater	53	54	58	37	51	32	65
	Total	96	106	110	107	125	123	169
4	Unutilized utilizable resource							
	Surface	334	295	284	263	219	140	42
	Groundwater	219	203	202	146	149	96	33
	Total	553	498	486	409	368	236	75

Source: GOI (1999a).

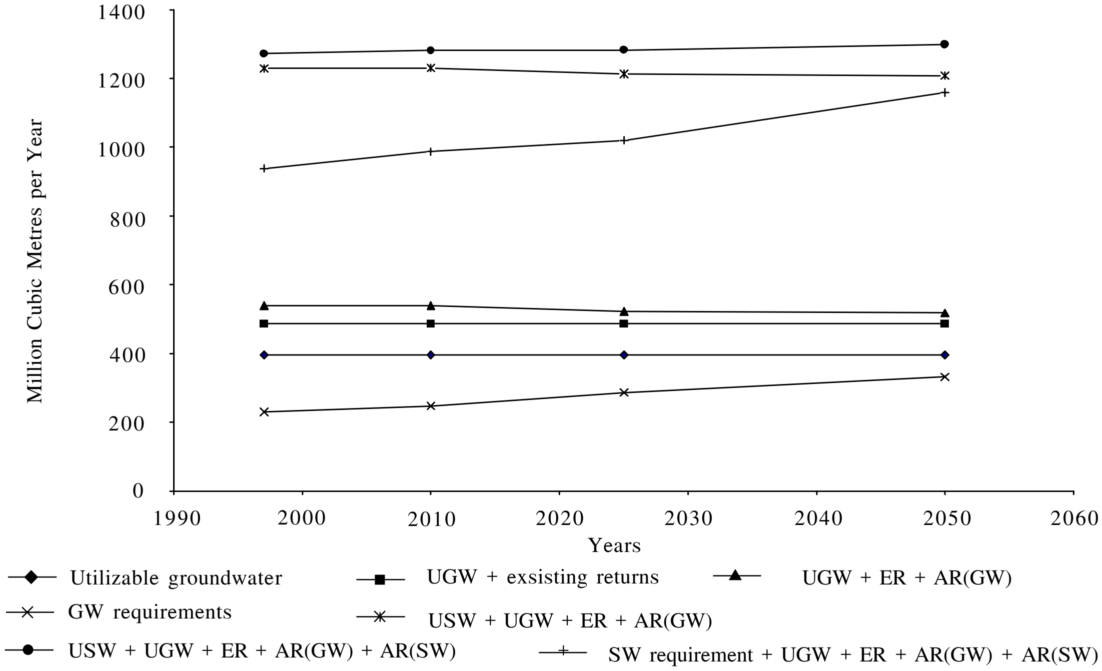

Figure 2.1: Utilizable Waters and Requirements (Low Demands)

Source: GOI (1999a)

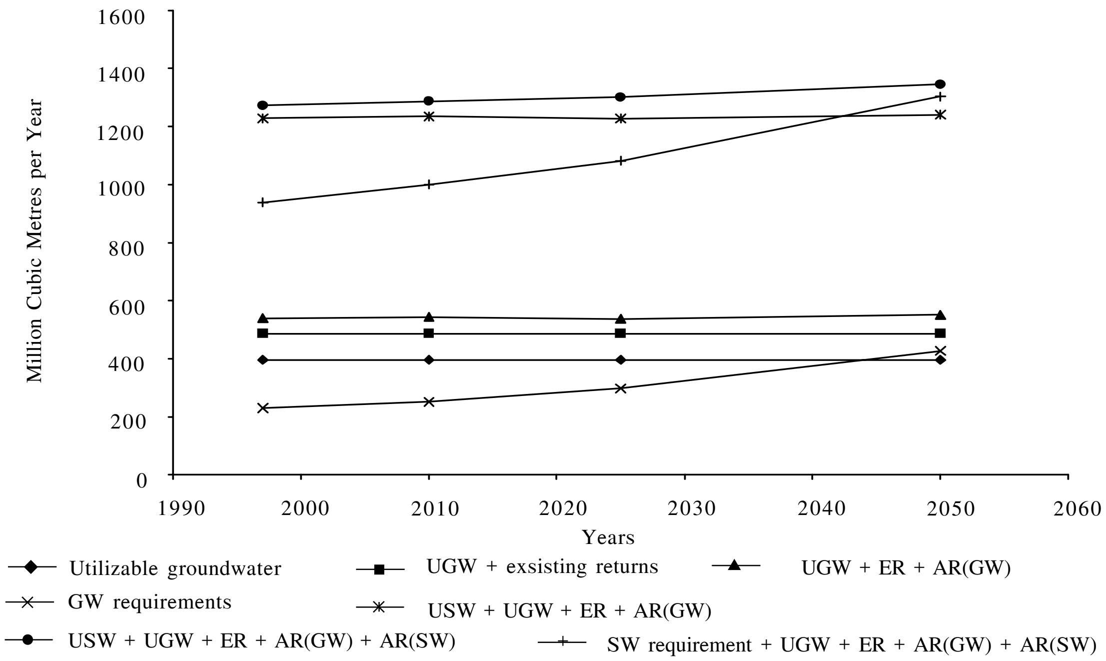

Figure 2.2: Utilizable Waters and Requirements (High Demands)

Source: Same as Figure 2.1.

Indus and the Ganga–Brahmaputra–Meghna systems. The Himalayan rivers receive very heavy rainfall in the monsoon months and the rivers swell, causing frequent floods. The flows in the summer months are due to melting of snow and glaciers and, therefore, these rivers have continuous flow throughout the year. The important river systems in the Deccan are the west-flowing rivers Narmada and Tapi and the east-flowing rivers Brahmani, Baitarni, Mahanadi, Godavari, Krishna, Pennar, and Cauvery. The Deccan rivers are rain-fed and some of them are non-perennial. There are numerous coastal rivers, which are comparatively small. Most of them are non-perennial. While only a handful of such rivers drain into the sea near the deltas of the east coast, there are as many as 600 such rivers on the west coast. The west coast rivers are short in length and have limited catchment areas. A few rivers in Rajasthan do not drain into the sea. They drain into salt lakes or get lost in sands with no outlet to the sea.

- The National Commission (1999) provided comprehensive water assessments. Their final abstracted assessment is given in Table 2.2. The salient information is shown in Figures 2.1 and 2.2. Figure 2.1 shows how, in the low demand scenario, the total utilizable flow would slowly and slightly increase due to increasing returns, and compares this with the requirements, for both the surface and groundwater. The reducing portion of the unutilized but utilizable resource is seen. Figure 2.2 shows the situation for the high demand scenario.
- The National Commission has not explicitly depicted the overall water balances for India, although the concept of water balance seems to have guided the commission. Based on the Commission's work and a few assumptions, the average annual water balance for India can be worked out as follows:

TABLE 2.3: Broad Indicative Water Balances

Item	Natural Condition	1997	2050 (High Demand)
INPUT			
Rainfall	4000	4000	4000
Trans-boundary flow (assumed)	300	300	300
Returns	0	186	259
Total input	4300	4486	4559
OUTPUT			
Evapotranspiration (natural)	2347	2347	2347
Withdrawal (anthropogenic)	0	629	1180
Flows to sea and trans-boundary flows	1953	1510	1032
Total output	4300	4486	4559
Anthropogenic evapotranspiration out of the withdrawals	0	443	921

Source: Same as Table 2.1.

The National Commission has presumed that the water resource of India comprising the natural run-off of the river basins as well as the flows in the aquifers is constant at around 1953 cubic km per year on the average. They have also assumed that the utilizable surface and groundwater flows would have a constant (natural) component of 996 km^3 per year along with slightly variable component due to returns. These concepts need a change in accordance with the recent concepts developed through ICID-Country Policy Support System (CPSP) programme mentioned separately. According to these, the precipitation could be considered as the main resource, and the evapotranspiration could be partially subject to water management interventions. Also the hydrologic processes leading to conversion of rainfall into run-off, evapotranspiration, etc. may themselves undergo a slight change due to changes in land use, cropping patterns, etc. Notwithstanding the needs for such refinements, it is clear from National Commission (1999) that the balances are precarious, and if things are not planned a demand–supply crisis, even at national level, can result. At basin or local levels, such near crisis situations, to some extent, already exist, and these will develop further.

The Water Vision 2005 prepared by the Indian Water Partnership (IWP 2000) concludes that if no new initiatives through policies and programmes are taken then, considering the emerging challenges in terms of growing population and the increasing urbanization and industrialization, the water scenario for 2025 would involve a serious threat to health and ecological security. Their prescription for averting the crisis includes:

- greater cost recovery;
- private sector participation;
- stricter enforcement of environmental laws and pollution control;
- larger investments;
- water conservation policies;
- conservation of rivers, lakes, and coast lines;
- changing agricultural practices to reduce non-point pollution;
- environmental safeguard in WRD projects;
- stakeholder participation and delegation of responsibilities;
- Integrated Water Resource Management (IWRM) with emphasis on micro water sheds; and
- public awareness.

They also estimated the investment needs for 2000–25 as shown in Table 2.4.

TABLE 2.4: Investment Needs of Water Sector, 2000–25

	Amount in Rs billion for 2000–25	Annual Investments in Rs billion (2000 prices)	Annual Investments in billion dollars (2000 prices, Rs 35 to a dollar)
Irrigation	1820	72.8	2.08
Water supply	1400	56	1.6
Sewage	1116	44.5	1.27
Sanitation	664	27	0.77
Total	5000	180.3	5.72

Note: Rupees billion equals rupees hundred crores.
Source: IWP (2000).

State Water Policies

By now, many states have formulated state water policies. However, these seem to echo, elaborate, or modify the National Water Policy. Converting the National Water Policy into a strategy relevant to the state, after considering the physical and geopolitical situation of the state, the economic development strategies relevant to the state, etc. has hardly been attempted.

The author is of the opinion that the state water policy could include:

- a preamble, which gives information about the water resources available to the state. This should consider the hydrology and the water rights of the state flowing out of agreements, awards, or otherwise, the water development possibilities, likely future issues in management and development, etc., and including differences within the parts of the state in regard to the water situation;
- a statement about the water vision of the state and the policy measures required to facilitate the achievement of the vision;
- an analysis of the National Water Policy, including issues more relevant, and not so relevant to the state, and bringing out issues where state policy has to be different from the National Water Policy;
- a detailed strategy relevant for the state; and
- a preliminary action plan, indicating the executive and legislative actions necessary and the time frame.

Water Use

The National Water Policy gives a general priority in regard to the various water uses. It is stated that these priorities can be changed. Domestic water supply has the highest priority, and this is followed by irrigation use. The overriding priority to be given to the domestic water supply has further been strengthened by recent judgements of the Supreme Court which stated that access to water is part of the fundamental right to life. However, drinking water is only a part of the domestic needs. The highest priority needs to be attached only to the core demand for water required for maintaining essential health and hygiene. But such ideas are yet to be incorporated in the policy.

The growing demands for urban and rural water supply require that the priority attached to water supply (or to its core demand, as suggested in this study) be put in practice. In closed or nearly closed basins, this would require either a readjustment in the water uses and water rights or high costs for saving water from existing uses. Thus, a water right regime, which allows a review and readjustment according to the ground situation, needs to be put in place through policy and legal changes. If costs are involved in allowing additional uses, the policy needs to indicate as to how these would be recovered. Market mechanism through a trade in water rights has also been advocated. However, as stated earlier, the author of this study does not favour this approach.

Issues Related to Water Supply and Sanitation

Should the norms for water supply be pegged at low level, in a pragmatic way, so as to provide immediate relief to the largest number of people within the limited availability of money; or should the norms meet the need for improving the lifestyle and to bridge the urban–rural divide? The author advocates a double norm, a tolerable minimum and a desirable one.

Water Auditing Systems

These need to be institutionalized. Private sector or NGOs could be associated for an external audit.

Use of Treated Water for Non-potable Uses

There could be much saving in water treatment cost, as also in gross raw water demands, if non-potable uses like use in toilets, gardens and parks, etc. are based on partially treated wastewater from potable uses (kitchens, bathrooms, etc.). However, this would require local treatment as also double piping system, with inherent health hazards.

Decentralization of Wastewater Treatment in Urban Areas

This has been much advocated. The treated wastewater from such local plants can be used locally. However, the problem of its transport to rivers, and river pollution, would continue to be an issue.

Rural Water Supplies to Area with Endemic Groundwater Problems

These can include water quality problems (blackness, fluorides, and arsenic) and the problems of over-exploitation and falling levels.

According to the author, in such problem pockets, the local solution may be inferior to a large-scale piped water supply scheme based on good quality surface waters, often based on storage. The present preferences (with exception to the Narmada water supply to rural areas) do not look to such solutions, which will provide improved quality, better inter-annual reliability, and economics of scale.

Issues in Inter-basin Transfers of Water to Non-basin States

These issues flow from the following questionable concepts:

- water is a ‘property’ of basin states, and can be given to non-basin states only by basin states; and
- definition of ‘surplus’ waters involves value judgements, and that only the donor

state can make such judgement. Even the donor state cannot make binding assessment, which could tie down the future generations to the present decision.

Both then are important but debatable points, which require a proper policy analysis. These issues cannot be brushed aside.

In the international context, the present conventions do favour the view mentioned above, though this is not stated explicitly. But even there, the definition of a 'basin' which is a 'unitary whole' is linked to the existence of a 'common terminus' beyond which the interests cease.

However, this 'terminus' beyond which the interest ceases could vary from case to case. For example, consider a basin in which two river systems share a common delta and in which the lower deltas do not have any environmental concerns or water utilization possibilities which are either hampered or facilitated by actions in the two systems on the upstream. In such cases one could argue that the 'termini' occur above the common delta and the two systems could be considered independently.

The situation would be reversed, if, due to the oceanic link, the interest does not cease, even at the geographic terminus. Consider a landlocked sea (such as the Aral Sea) or a nearly landlocked sea (such as the Mediterranean). In such cases the actions in one river basin may affect fish in the sea and thus affect future course of actions in other contributing basins. In such a case, the sea, and not the main river mouth, could be considered as the common terminus, and all rivers feeding the sea could become part of a larger basin.

In a semi-federal set-up, as is found in India, the position is much different. For example:

- The states themselves are the creation of the Union, which came first, and as per the Constitution, the Union can create a new state or change boundaries. In a true federation, sovereign states, by their own action, create the federation as a consequent entity.
- States are not sovereign.
- Whereas nation members of an international river basin have little or no interest in the development of other nations outside the basin, beyond general goodwill towards universal or regional well being, the states of India have a definite positive interest in the development of the nation, through the development of the non-basin states (within of course, the constraints imposed by their own developmental needs).

The issue concerning the definition of 'surplus' waters and the prerogative of 'donor states' to take decisions regarding these waters is an important procedural issue. Duly elected and constituted governments cannot avoid taking decisions about the scope available to the future generations, through implementation of developmental plans, through long-term agreements, treaties, etc. They need to operate within the concepts of 'sustainability' the definition of which normally includes the choices available to the future generations; but the state cannot be denied the right to take such decisions. Once this viewpoint is accepted the power of the Union to regulate the interstate river basins will make it the appropriate 'state' for this purpose.

Once conceptual issues are decided, the institutional and legal issues would have to be dealt with. The Indian constitution lays down the legislative and functional jurisdiction of the Union and the states through the lists in the seventh schedule. Entry 56 of the Union list states:

Regulation and development of interstate rivers and river valleys to the extent to which such regulation and development under the control of the Union, is declared by Parliament by law to be expedient in public interest.

Entry 17 of the state list reads:

Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage, and water power subject to the provisions of entry 56 of list 1.

Thus, the Union, through an Act of Parliament can empower an agency to lay down norms for planning inter-basin transfers from the waters of an interstate river, and the same or another agency, to detail proposals as per norms. Both the norms and proposal can be finalized through a quasi-judicial process in which these are published, objections are heard, and decisions given. This process can, if necessary, include a permanent water disputes tribunal.

Issues Related to R&D and HRD

The Delft declaration (1991) laid stress on water sector capacity building as a strategic element for the sustainable development of the water sector. It declares that capacity building is a long-term continuing process that has to permeate all activities of the sector and that it entails the application of a number of specific techniques to strengthen performance of the sector and sector supporting organizations. It further recognized that the strategies for capacity building in the water sector need to be country-specific, and tailor-made, based upon the water sector assessment of the country. The general approach to the strategy, mentioned in the declaration is:

- developing improved policy and legal framework as also institutional and human resource development (HRD);
- resource management including demand management and pollution management;
- external support agencies adopting capacity building as an essential element of their assistance;
- involving the private sector in managing water services; and
- involving local and foreign universities, organizations, etc. in capacity building.

In the context of this declaration the two small paragraphs in the National Water Policy about the role of science and technology appear rather weak and these have not been followed by any detailed strategy document. On the other hand, the National Commission (1999) laid a considerable stress on research and development both as a problem-solving tool and as an important element providing information and database in policy evolution in the water sector.

While analysing the research and development (R&D) process as a problem-solving tool it emphasized the need for conducting a diagnostic analysis of the problem to decide its likely causes. Depending on the cause, technological research, development activities, action research, HRD and training activities, and policy analysis are suggested as the likely paths to the solution.

While analysing the role of research development and training in policy evolution, the Commission indicated that the analysis of the performance of the water sector is the key to policy evolution. If the sector performance is not satisfactory then the documented pool of R&D experience should be able to indicate (provided there is enough R&D information), the directions of the desirable policy changes. If the R&D experience is insufficient to indicate such changes the first step should be improvement of R&D policies, HRD policies, and funds for these. However, if the water sector performance analysis cannot be conducted for want of information, the first task should be to improve the database.

While dealing with HRD the Commission did go into the training needs of the sector in the light of the likely changes in the responsibility for water sector functions by different types of organizations. In their analysis, policy formulation is, and would continue to be, the responsibility of central and state governments even while NGOs, water users, and professional societies would emerge as having important responsibilities in future. In regard to sectoral planning and reviews again, governments, professional groups, NGOs, and the private sector would share the responsibilities. In regard to consultancy and designs, the private sector would mainly be responsible while the government and the professional societies would have some responsibilities. All the four groups would share R&D responsibilities with the government having the major responsibility. In regard to HRD and training all the four groups would share the responsibility but the major responsibilities would be with the NGOs and professional societies.

In the light of this analysis, and in the context of the Delft declaration which underlined the responsibilities of external service agencies in capacity building, it is recommended that the World Bank involves itself in a large way in a massive capacity building exercise. In the hydrology project, there was an emphasis on training but it was mostly limited to government staff. Ways would have to found for the sectoral programmes of the World Bank to build capacities in government organizations, the Indian private sector, the Indian NGO sector, and in Indian professional societies. The private sector would need capacity building mainly in regard to consultancy, designs, financing, and management of large constructions. The NGOs need capacity building in regard to policy formulation, small constructions, and training of farmers including training of the trainers. The professional societies need capacities in regard to policy analysis and formulation, resource assessment, sectoral reviews, and training.

The National Commission has noted few other important weaknesses related to HRD. The approach of the government is normally hierarchical rather than functional and the lack of due importance to professional and functional aspects tends to blur responsibilities and inhibits specialization. Interdisciplinary teamwork, which is so essential in the water sector, is absent. The links between academic institutions and water sector personnel are poor with the result that the academicians are kept away from important practical issues and problems, and water managers are not exposed to the latest technologies. These weaknesses would have to be especially addressed.

Investment in Infrastructure

Water resources development in India is dominantly in the public sector. Only groundwater development either through open wells or from tubewells is predominantly done by individual farmers, or by industry. Some small lifts on surface water bodies are also sometimes owned and operated by farmers or by groups of water users.

Private, commercial investments for developing irrigation are unknown. Such investments in domestic or industrial water supply are at a very low level. In the hydropower sector, such investments are somewhat more common, but even here, these form a very small proportion of the total investments.

Rights and Entitlements Regarding Water Use

In India, all surface water is owned by the state. Some consider that the traditional ownership by the community was usurped by the state, particularly during the British period. The various Irrigation Acts indicate that water in all streams of significant size belong to the state.

The state develops the water and provides for the use of the water by various water users. However, water users do not have any well-defined rights in the form of water licenses, etc. The allocation of the waters of a river or a river basin to the various parts of the state, whether in the basin in or outside, is left to the state. Similarly the allocation of the water to the various conflicting water uses is also left to the state, except that the guidelines in regard to the priority of uses are available.

India has a type of governance which tends towards a federation, and this poses a peculiar problem in regard to the allocation of the waters of an interstate basin. Interstate basins drain more than 90 per cent of the geographical area of India. As per the Constitution of India, the regulation of the water of an interstate basin is an area within the legislative and executive competence of the Union, provided the Parliament, through an enactment, indicates that such regulation (as specified) is in national interest. If there is no such enactment, which empowers the Union, the competence, both legislative and executive, is vested with the states. The Parliament has enacted very few Acts empowering the Union to take executive action about the regulation of interstate basins. Notable among the few Acts are the Brahmaputra Board Act and the Betwa River Board Act. Another important Act under this provision is the River Boards Act, 1956.

However, this Act has never been used in setting up any River Board.

When the states attempt to develop an interstate basin, interstate problems often crop up. Negotiations amongst states leading to interstate agreements are the favoured procedure for reaching an acceptable solution. This can be done either by the states or by the Union acting as an 'honest broker'. If this method does not work, a state can request the Union to resolve the dispute through adjudication by a water dispute tribunal.

Under a specific provision in the Constitution, the Interstate Water Dispute Act has been enacted. The tribunal award is not subject to an appeal, although the states can ask for clarification on the initial order before it becomes final.

Both the negotiated route and the adjudicated route have been used successfully in this regard. The otherwise favoured process of negotiations leading to an agreement has some pitfalls. At times, states that are co-sub-basin states reach an agreement, but some co-basin states, which are not members of the sub-basin, are not a party to the agreement. The legality of such agreements becomes questionable. For example, in the 1930s the states of the United Provinces and the Punjab entered into an agreement about the sharing of the Yamuna water up to a point. The downstream states in the sub-basins were not involved. In the 1990s the five co-sub-basin states of the Yamuna up to Delhi signed an agreement for sharing of the water without involving the downstream basin states. Similarly, in the 1970s, the co-sub-basin states without considering the rights and entitlements of the other downstream basin states shared the water of the Sone. The legality of such actions has not been tested.

Similarly, the legal position in regard to the states unilaterally getting out of such agreements is not known. According to the author, an important issue which needs consideration is the nature of the agreement. An agreement between states can be considered as a mere contract, or it can be considered as having some elements of a treaty.

The Constitution does not have any entry in the state or Union list relating to 'environment'. Using the residual power available to the Union in such cases, the Union government has enacted laws on environment which have relevance to water-related matters, for example, control and prevention of water pollution, forest conservation.

In the context of sharing water-related responsibilities between the Union and the states, the procedures adopted by other nations like the United states, Australia, etc. which have a federal set-up need to be studied to see if India can learn something from them.

In Australia, the states seem to have the full sovereign powers with regard to water, and the federal Commonwealth has no direct powers, even in the interstate basins. Interstate agreements require ratification by the legislatures of all the party states. However, the Commonwealth, which finances the states in a large way, seems to have a large leverage with the states. Thus, the Commonwealth has played a large role in the management of the Murray–Darling river basin. (Blomquist et al. 2005).

Water Pricing and Financing

The World Bank review of the irrigation sector (World Bank 1994) comments that 1993 strategy affirms the general desirability of basin water prices on the principle of marginal value pricing but at the same time recognizes the imperfections of the market and the need for more flexibility. The National Water Policy of India (2002b) lays down the principles for fixing the administered prices for water, without any mention of the principal of market forces based on demands and supplies or on the principle of marginal value pricing. The present report recommends that even though administered prices would have to be fixed, the likely economic prices based on the principle of the marginal value pricing or the water prices in the unorganized gray water market could guide the administered prices.

The national water policy favours full recovery of the O&M costs as also some recovery on account of the capital expenditure. However, this has not been possible even for the comparatively high-value uses such as domestic water supply.

For major and medium irrigation, the average price of water is around Rs 300 per hectare while, at current prices, the O&M costs would be of the order of Rs 800 per hectare. The capital cost is around Rs 100,000 per hectare, and thus the annual value of this could be of the order of Rs 10,000 per hectare. Thus, the gap is too wide to be bridged.

For domestic water supply, the price of the treated water is normally less than Re 1 per cubic metre. The breakeven cost for new facilities could be of the order of Rs 15 per cubic metre.

Water pricing, particularly in regard to irrigation, is a politically sensitive decision. The users, even though they are willing to pay much higher price in the unregulated gray water market, demand a much better quality of service and a much more cost-efficient management as a prerequisite for agreeing to increased prices when it concerns the public body. Thus, even though a number of committees and commissions have recommended an increase in water prices, the state governments, of late, are more prone to reducing or abolishing water prices for irrigation.

Another issue, related to water pricing is one about royalties. If water is considered to be the property of the state, the state would be entitled to charge a royalty, if it allows the user to develop the water. In India, such royalties are common in regard to mineral exploitation but, in general, no royalty is charged in respect of water. (However, some states levy water charges similar to royalty for withdrawal of water by the private sector for industrial use or hydropower generation.) The author is of the opinion that this position is due to a tacit acceptance that water is a 'negative community' in which an absolute ownership is not possible.

Lee (2000) in the ICID survey mentions four types of organizational arrangements generally prevalent in the world in regard to irrigation management. These four models are explained in Table 2.5 below:

In India the 'individual or independent entity' model is prevalent in private groundwater use as also sometimes in surface lifts and rarely in small surface schemes. Traditionally, this method was common, for example, in the zamindari canals of northern India or in the 'Kudimarammat'-type small tanks in Tamil Nadu, but these traditional systems have more or less vanished. Private

TABLE 2.5: Model for Irrigation Management Institutions

Model	Role of Users	Role of Irrigation, Drainage or Flood Control Agency	Role of the Government
Individual or independent entity	Operates on individual or group basis, managing the service for individual or group benefit and covering the cost internally	Users form the agency	Providing legal framework to allow this
Private service agency	Enters into contract with the agency and pays charges according to the contract	Supplies services to users as per the contract	Provides legal framework and procedures
Public or semi-public body	Pays charges to the agency	Supplies services according to conditions set by the government	Controls operations; subsidizes charges, if necessary
Government administered systems	Receives services from the agency and pays charges to the government	Supplies the services to the extent possible according to the budget set by the government	Collects charges and pools with other taxes; sets priorities; and provides budget to agency

Source: Lee (2000).

service agencies are hardly prevalent. Public or semi-public bodies in the form of various irrigation corporations are coming up mainly for construction. The role of such corporations in irrigation management is not clear as yet. Currently, most public irrigation systems are government administered. In these there is no direct link between water charges and O&M budgets. The charges are decided more as a political decision and water price is considered to be somewhat like a tax. Budget allocations are decided not by the system need alone but by the priorities of demands from various sectors. A shift from this model to the public or semi-public model would establish a direct link between water charges and budgets for services, and government subsidies could be only for transitional balancing. A suggestion made in the Irrigation Management Policy, in this regard, has not been acted upon.

As stated the reasonable water charges can be linked to various factors. CWC (GOI: 1999b) mentions the following main factors to be considered in deciding water prices:

- recovery of the cost of the supply of irrigation water;
- paying capacity of the farmers based on gross/net benefit accruing from the irrigated agriculture;
- water requirement of the crop;
- source of irrigation, its capacity, and assuredness of the supply of water;
- type of land irrigated; and
- combination of all or some of the factors stated above.

Let us now examine, through a preliminary analysis, the likely economic cost of water used in public irrigation systems in India. Surface medium and major schemes today have a capital cost of the order Rs 100,000 per irrigated hectare, and these get justified through an economic analysis, which currently requires that the annual benefits exceed, by at least 50 per cent, the annual costs at 10 per cent interest. Thus, irrigation on 1 hectare is shown to provide an annual additional net benefit of Rs 15,000 or so. There is some likelihood that while formulating the scheme, an over-estimation of benefits based on some optimism may have prevailed. Even after considering this, an additional net benefit of Rs 10,000 per hectare appears reasonable; and if this is so the farmers should have a paying capacity of Rs 1000 to Rs 2000 per hectare, provided proper quality of service is available.

Farmers, particularly in the alluvial plains with good quality groundwater, frequently use private groundwater structure, pumping groundwater through a static head of about 20 metre or so, using diesel engines if reliable electric supply is not available. Such a use involves a fuel cost of about Rs 1500 per hectare. This is willingly incurred in addition to the capital and other O&M costs.

There is a large unauthorized gray water market in which farmers sell surface or groundwater to each other for irrigation. The prices are reported to be larger than those mentioned in the earlier paragraphs.

Of course, one has to adjust the price for the quality of service in respect of reliability, equity, and timeliness. Water from self-owned tubewells or from the water market would be much more reliable and timely and the user would have much better management control, as compared to the water from the public canals.

Considering all these aspects together, a fair price of irrigation water, which the farmer can pay, could be around Rs 500 per hectare for the kharif season, about Rs 800 per hectare for the rabi season, and around Rs 1000 per hectare for the hot weather season, for the usual non-ponded crops. For perennials requiring waters in all the three seasons, the price could be around Rs 2400 per hectare. Considering that the requirement in each season, on field, would be around 40, 50, and 60 centimetres, the volumetric rate would work out about 12.5 paise, 16 paise, and 17 paise per m^3 (cubic metres), respectively. These water prices are at the current prices and represent the desirable short-term goal.

Table 2.4 of the CWC (GOI: 2002a) indicates the present all-India cropping pattern. This consists of rice (30 per cent), wheat (31.2 per cent), other cereals (4.6 per cent), gram and pulses (6.1 per cent), perennials like sugarcane and condiments (7.4 per cent), oil seeds (9.6 per cent), two seasonal cash crops like cotton and tobacco (4.7 per cent), etc. Although, seasonwise distribution is not readily available, kharif crops would be around 40 per cent, rabi crops would be another 47 per cent, and perennials would be 8 per cent, while two seasonal cash crops would be about 5 per cent. With the rates suggested above, the average rate for this cropping pattern would be around Rs 800 per hectare.

All this goes to show that a massive increase in water rates from the current averaged rate of about Rs 120 per hectare to about Rs 800 per hectare would be possible within the economic principles. This seems to be an appropriate lower level estimate of the economic cost for the public water, as loosely determined by the market forces.

Such increase in one step, or in a few years, may be politically difficult. Smaller increases (say, doubling of prices) may also have a considerable resistance, but is unlikely to achieve any significant improvement in water management, through the market mechanism.

Thus, unless such a massive increase is made, water price increase may not be an appropriate policy measure for improving the field-level water management efficiency through the elasticity of supplies and demands.

Accountable Institutions

At present, the roles of various institutions in the matter of the evolution of water policies by the Union government are as follows:

The National Water Resources Council

Approving water-related policies through the evolution of a consensus.

The National Water Board

Assists the National Water Resources Council.

The Ministry of Water Resources

Drafting the agenda of the National Water Resources Council. Giving effect to the decisions.

The Central Water Commission

Acting as the secretariat to the National Water Board. Preparing the basic documents and drafts about water policies. Advising and assisting the ministry.

The Central Ground Water Board

Its main function is to assess the groundwater through geo-hydrological surveys and studies, and through the drilling of exploratory tubewells to facilitate such studies. Banks variously use the groundwater assessment information created by the Central Ground Water Board in deciding the credibility of proposals for obtaining loans in regard to the construction of wells and tubewells.

The Central Ground Water Authority

It has legal powers to regulate the exploitation of groundwater in order to ensure that environmental damage due to overexploitation of groundwater is avoided. As stated already, the Union uses its ‘residual powers’ in regard to ‘environment’. The central groundwater agency thus has no general powers of regulating groundwater use.

The National Committees

These Committees participated in the delibrations on various specialized subjects such as hydrology, irrigation and drainage, hydraulic research, etc. for deciding research areas as also in evolving a consensus at the professional level, about the problems and possible solutions.

The Specialized National Institutes

Within the ministry of water resources these institutes carry out research on problem areas including issues like the role of forests in hydrology, the quantum of return flows from irrigation, etc. which have a bearing on policies.

Various River Basin Institutes

The ministry such as the Brahmaputra Board, the Betwa Board, the Upper Yamuna River Board, the Narmada Control Authority, etc. oversee the implementation of the various agreements, tribunal awards, etc.

Various Water Dispute Tribunals

To adjudicate on the water disputes in accordance with the terms of reference fixed by the government and to formulate the awards. The case law so evolved, and the spirit of the award itself, has important implications on future evolution of water policies.

Non-Governmental Organizations

The NGOs do act as watchdogs to pressurize the state governments and the central government in regard to various executive decisions and policy evolution. Although, at times, the involvement of the NGOs seems to delay or negate the process of water development, their involvement sometimes leads to better actions. Better policies in regard to rehabilitation and resettlement of reservoir-affected persons; better standards for drinking water quality, improved decisions about design of structures (for example, the Ottu weir on the Ghaggar River), etc. are some achievements of actions by the NGOs.

The Judiciary

The decisions of the water dispute tribunal cannot be revised through appeals to the courts. However, before a tribunal is set up, the aggrieved states can and do approach the judiciary for a remedy. For example, the states of Andhra Pradesh and Maharashtra approached the Supreme Court for restraining the state of Karnataka in regard to the construction of the Alamatti reservoir. NGOs or individuals can also approach the courts for giving suitable directions to the government. For example, individuals approached the Supreme Court for intervention regarding water quantity and water quality problems of the Yamuna at Delhi. Similarly, NGOs approached the Supreme Court for directions to discontinue the raising of the Narmada dam. The case law evolved through the process affects water policies.

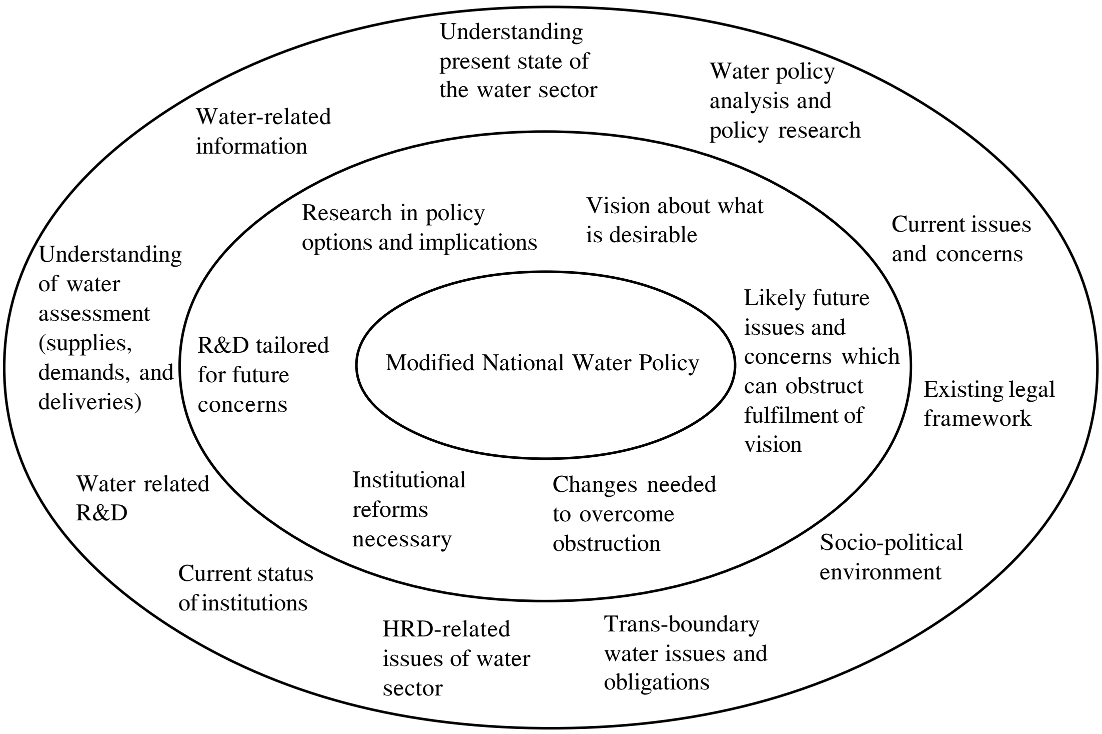

Figure 2.3: Water Policy—The Evolutionary Process

THE PROCESS AND EXPERIENCE OF WATER SECTOR REFORMS, WORLDWIDE

The Reform Process

The water policy reforms are required to be made in the background of the current situation of the water sector, the legal position, the aims and aspirations as reflected in a 'Water Vision', the demands, the engineering possibilities, etc. This is depicted in the Figure 2.3 given above:

A methodological review of water policies towards reforms would, therefore, have to be based on:

- understanding the current water situation of the country and the current issues, which need to be addressed;
- understanding the engineering and agronomic possibilities of land and water development, the economic possibilities of imports and exports of agricultural products and the scenarios of population growth;
- evolving a water vision for the future, indicating an optimistic scenario of water development which could serve as a rough target for the water policies; and
- understanding how any package of changes in the water policy would affect the present and future water situation.

Of the possible package of policy reforms, considering one or a combination of those reforms which could lead to a better future water situation, and which fits, more or less with a water vision developed through consensus, needs to be adopted.

Experience about Water Sector Policy Reforms in Other Countries

Appelgren in FAO (1995) discusses the factors leading to a water policy review and the approach in the review as followed by various countries. The steps taken by the countries in the water sector policy review are listed below in Table 2.6:

Thus in UK, France, Mexico, and Victoria (Australia) the water policy review leads to definite legislative actions in regard to the reforms. In the case of Chile, a draft legislation was prepared. In the case of Indonesia it has lead to the preparation

TABLE 2.6: Water Policy Review—Steps Taken in Different Countries

Justification for the Review	Initiatives Taken	Draft Policy Document/Public Consultation	Main Thrust of Policy Review/Reform	Final Documents and Actions
United Kingdom				
1985: Conflicting issues of financial management of public water authorities	1986: Government white paper on privatization	Consultation policy papers for Parliamentary review	Redraw boundary between the public and an integrated private sector; control of a privatized water industry	1988: Water Bill released; July 1989: Water Act enacted by Parliament
France				
Supply–demand imbalance worsened by drought	Creation of National Water Committee; regional seminars; National Water Seminar (March 1991)	Discussion of policy proposals at National Water Seminar	Manage water resources basin-wise through stakeholder; balance water resources development/ conservation	Law on waters enacted by Parliament in January 1992

(Contd ...)

Table 2.6 (Contd ...)

Justification for the Review	Initiatives Taken	Draft Policy Document/Public Consultation	Main Thrust of Policy Review/Reform	Final Documents and Actions
Chile				
Water resources deficiency; conflicts between the administration and the private sector	1990: Government initiates review of water policy; August 1991: National Seminar	Discussion of policy proposals at National Seminar	Balance public and private sector roles; enhance tenure security of water rights	Draft water resources legislation tabled in Congress (1992)
Mexico				
Growing regional imbalance	1989: Creation of the National Water Commission; review of water policies	Document outlining water policies and strategies released and disseminated by National Water Commission (December 1990)	Promote water use efficiency; improve quality of service; enhanced role of the private sector	Law on national waters enacted by Federal Congress in November 1992
Victoria (Australia)				
Inefficiencies in management	1980: Public Bodies Review Committee; 1988: Independent committee scrutinizes proposed water legislation	1981: Committee recommendations released; 1986: Discussion Papers and papers for new legislation released	Rationalization of water management bodies; restructuring of central water administration; legislative reorganization; corporatization of public sector agencies	Water (Central Management Restructuring) Act enacted in 1984; Water Act enacted in December 1989
Yemen				
Over-exploitation and fast degradation of groundwater resources	Inter-ministerial Advisory Committee and National Task Force	Inter-sectoral and inter-regional working groups	Conservation and sustainable utilization of water resources; environmental protection	(Action: Not clear)
Indonesia				
Deterioration of water resources infrastructure; regional supply–demand imbalance; water use changes	1987: Irrigation sector policy; 1991: Government's comprehensive water policy review; creation of private sector organizations for water resources management	1994: Draft water policy and policy action plan for Second 25-Year Plan	Decentralized water administration based on river basins; privatization and cost recovery; cross-sectional analysis	Water policy in Second 25-Year Plan and Sixth Development Plan; decentralized water administration

Source: FAO (1995).

of a 25-year plan and an immediate development plan. It has also led to decentralization of water administration. In the case of Yemen, a comprehensive report and policy study was ready but it is not clear if it has lead to any definite action.

In Egypt a water policy was prepared in 1933 and updated in 1974. After completion of the High Aswan Dam the policy was redrafted in 1975. The reduction of the flows of the Nile required updating of the water policy in 1990. It focused on better water management, forecasting, and disaster preparedness. Currently comprehensive models of the water systems have been undertaken to lead to a comprehensive long-term water policy. Appelgren reports how, in Lithunia, the various issues like unsafe groundwater, pollution from piggeries, financing of municipal wastewater treatment, inefficiencies in wastewater treatment, etc. were dealt with in the review of the water policies.

In Italy, as reported by Calizza in FAO (1995), the 1933 legislation was formulated in the context of a comparatively water-rich rural society. The decentralization of power, the growing water demands, and the increasing need for water pollution protection resulted in a situation where management through private institutions alone becomes infeasible. In the 1970s, new regulations for disposal of pollutants were released, but these regulations did not match the views of the water rights administration. A major review of the national water policy led to an enactment in 1989. This created river basin authorities as a focal point. The basin plan has the fundamental role of identifying interventions for proper management by public and private interests. This law also provides for the identification of an 'optimal unit' for which there would be a single 'sole manager', public or private, dealing with the distribution of drinking water and disposal of effluent.

Applegren also tabulates the factors, approaches, and facilitators for water policy review as follows:

For factors leading to water policy review, water scarcity or conflict is the factor most often cited (11 times), followed by government agenda (8 times), and the need for environmental protection (5 times). Within the approaches to the policy review, water legislation is cited the most, followed by the creation of a task force (9 times) and the initiation of a political process or public participation (8 times). The facilitators in changing the water policies mentions government agenda as the most cited (18 times), followed by the process of restructuring (5 times) and the political process (2 times).

TABLE 2.7: The Rationale, Drivers, and Facilitators for Water Policy Review

Country	Factors	Approach	Facilitators
Belize	EP, G, IR, LEG	NS, S, TF, WC	G
Canada	EP, WS	S, PP, TF	G, PP
Chile	ET, G, WS	LEG, PP	G
Egypt	G, WS	S, TF, WC	G
England and Wales	ET, IR	LEG, PP	G, PP
France	IR, WS	LEG, PP, RS	G
Indonesia	EP, WS	S, TF	G, RS
Iran	WS	S	G
Italy	EP, G, LEG, RS, WS	LEG, PP, RS	G, RS
Lake Victoria countries	IN	S	G
Lithuania	EP, IN, IR	LEG, PP, S	ET, G, RS
Mexico	G, WS	LEG, PP, RS, S	G
Nigeria	G, LEG	LEG, S, TF	G
Spain	G, WS	LEG, PP, RS	G, RS
Turkey	G, LEG, WS	S, TF	G
Vietnam	ET, IN, WS	S, TF	G, RS
Yemen	EP, WS	LEG, S, TF	G
Zimbabwe	EP, WS	LEG, NS, S, TF	G

Note: EP: environmental protection; ET: economy in transition; G: government agenda; IN: international issues; IR: institutional reform; LEG: water legislation; NS: national statement; PP: political process/public participation; RS: restructuring; S: study; TF: task force; WC: water commission; WS: water scarcity or conflict.
Source: Same as Figure 2.6.

Analysing the Indian Situation to Design Reforms

A recent exercise by ICID in the country policy support programme (ICID 2004), with which the author was associated, tried to follow this theoretical stepwise procedure, to a large extent. This became possible because the policy development was not done in a 'real life,' situation but in a 'quasi-real life' situation. The procedure was as follows:

- Two medium-size basins in India, namely, the Sabarmati and Brahmani, were chosen. China also conducted a similar exercise by choosing two basins one comparatively dry and one comparatively wet. The available water-related data was collated. A hydrologic cum water assessment model, capable of depicting future land use changes, human-induced changes in the water cycles, etc., and capable of modelling the whole of the land phase of the hydrologic cycle was developed.

  The basin water assessment was done sub-basin-wise in monthly time-steps by tracing the water balance of soil moisture, groundwater, and rivers. The main outputs of the model consisted of the overall water balance, river water balance, and groundwater balance on a monthly basis. Consumption was segregated according to the nature sector, the agriculture sector, and the domestic and industrial water sector. The monthly river flows and the monthly groundwater storages provided a means of verification of the model for the current or the past situation.
- The engineering agronomic and economic possibilities were studied using the available documents and through a consultative process with knowledgeable persons in all water-related disciplines within the basin.
- A large number of possible future scenarios for 2025 were tested on the model. The scenarios were slightly adjusted until the model outputs in the form of the residual flows, the composition of the natural and total inputs to surface and groundwater, the groundwater regimes, etc. were within tolerable or acceptable limits, if not the best.
- The bank of scenarios so created was then studied to shortlist those scenarios which appeared to fit with the vision of the state and the nation.
- The studies were discussed through national consultations, during the process of shortlisting the scenarios. The necessary policy changes, which can achieve the preferred scenarios, were worked out through such consultations.
- For extrapolating the water situation of the studied basins to other basins, water stress indicators were developed. These were different from those common in literature, namely, Alcamo et al. (2002) and Smakhtin et al. (2003). The indicators used in Country Policy Support Program (CPSP) were as follows:

TABLE 2.8: Water Stress Indicators

Indicator 1	Withdrawals from surface/total input to surface water	Represents quantitative stress on surface water
Indicator 2	Returns to surface/total input to surface water	Represents quality hazard to surface waters
Indicator 3	Withdrawals from groundwater/total input to groundwater	Represents quantitative stress on groundwater
Indicator 4	Returns to groundwater/total input to groundwater	Represents quality hazard to groundwater

Source: ICID (2004).

The other basins of India were classified by the level of indicators to compare with the Sabarmati and the Brahmani so as to understand the applicability of the results of these studies to other basins. Through the consultative process, national policy interventions as highlighted by the studies were documented.

- These proposed policy changes are likely to be discussed with the national governments and with the international funding agencies. Since this entire exercise was done outside the governmental framework, except for casual consultations, the finalization of the policy changes would require the involvement of the Union government. This would require their preliminary acceptance, followed by full-fledged discussions with the state governments in the National Water Board, and an approval by the NWRC. This process is yet to start.
- However, a number of these policy interventions are already being incorporated in this study.

The Reforms and Programme Initiatives Undertaken in India

Innovative Policy and Programme Initiatives

In the last few years there have been many innovative policy interventions and programmes in the water sector. Some of the important ones may be mentioned as follows:

In the Irrigation Sector

The accelerated irrigation benefit programme (AIBP) was taken up for early completion of ongoing projects, which were in an advanced stage of completion, by pumping in additional funds. Over the years, this programme has been modified and in the process the main objectives have become diluted. Delays have also been experienced in the process of transferring the funds from the finance department of the state to the project, depending on the 'ways and means' position of the state. This innovative programme has therefore been only a partial success. The programme perhaps needs to be revamped by specifying stricter criteria for the selection of the projects and by making it easier to operate in regard to direct availability of the funds to the project. There is enough scope for using banking institutions for regulating the flow of funds.

In the Hydropower Sector

The new policy for hydropower has been an important policy intervention. Again, this has been a partial success, and only a couple of hydropower projects in the private sector have materialized as a result of the policy. Most hydropower developments continue to be in the public sector, and the public sector corporations are implementing such projects on the basis of loans from Indian or international financing institutions. At present, most hydropower projects under implementation are of the 'run-of-the-river' type. For effectively meeting the peak demands, in the largely thermal-based grid, storage projects are essential. It appears that at present the policy does not adequately address the problems of political risks, delays in land acquisition and in the resettlement of people, and delays caused by consequent litigations in an adequate way. A further revision of the hydropower policy appears necessary.

In Regard to Domestic Water Supply

An important policy intervention consisted of specifying that in each irrigation project, a provision for water supply to the adjoining areas, to utilize about 10 per cent of the additional supplies, be made. This seems to have worked well and this provision is being generally adhered to. A post-evaluation, however, may be useful.

In Regard to Conjunctive Use of Surface and Groundwaters

The policy intervention requires that all irrigation projects provide for such a use. For facilitating this process, detailed guidelines on conjunctive use have been finalized (INCID and CWC) (INCID: 1994). The feasibility reports of all major and medium projects are supposed to provide for detailed conjunctive use plans. In the experience of the author, these plans are never adequately detailed, and often the costs and benefits of the conjunctive use are not included in the project.

The institutional modalities for implementing the plan and the necessary changes in the state policies also are left uncertain. This intervention can therefore be considered only as a partial success.

In Regard to Urban Water Supply and Sanitation

Reforms have been undertaken for encouraging decentralization by shifting responsibilities to the municipal governments, changing the role of the government from service providers to regulator, commercialization of existing units, financial reforms for providing market access to service providers, etc. The beginning has already been made in respect of private sector participation in urban water supply utilities, for example, in Chennai, Bangalore, Delhi, etc. However, the interfacing of the private sector participation proposals with the protection of water rights of the upstream and downstream users requires a very careful consideration. The experience regarding the use of the waters of the Sheonath river through private participation indicates that if these details are not considered, serious criticism about the sellout of natural waters can result.

In Regard to Rural Water Supply and Sanitation

Sectoral reforms have been started for empowerment of the community in decision-making. This would include decisions about the planning and implementation of schemes and, eventually, about the control and management. Partial capital cost sharing and full sharing of the O&M requirements is also provided for.

In Regard to Rural Water Supply for Problem Communities

The Rajiv Gandhi National Drinking Water Mission (RGNDWM) is an important programme intervention. This has been fairly successful, although supply to communities in areas with endemic groundwater quality problems has not been successful. Sub-missions have been constituted to deal with preventive and remedial measures to address problems like arsenic, brackishness, and iron.

THE RECOMMENDED LEGAL AND INSTITUTIONAL REFORMS IN INDIA

The Water Policy and the Laws Regarding Water

Water policies and the water laws interact and affect each other. At a higher level, it would be desirable that the water policies are evolved and the water law is changed as required by the desired policy. However, at the field level, more often than not the procedures of the land departments would be affected and constrained by the rules and regulations made under the law. This position is shown below in Figure 2.4.

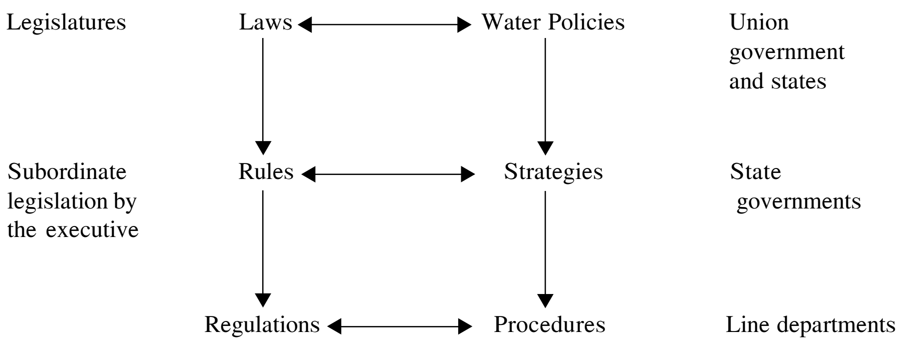

Figure 2.4: Interaction between the Legal and Policy System

The Constitutional and Legal Reforms

As discussed, water-related concerns in regard to the interstate basins could be dealt with effectively by the Union government if the Parliament empowers it to do so. However, in the absence of any such Act, the state governments can deal with water-related matters both in the interstate and intrastate basins. Much has been said about the need for constitutional reforms to bring water in the Union list or at least in the concurrent list. However, many (including the author) feel that the current provisions are sufficient and that the Parliament can pass suitable acts to enable the Union government to regulate the developments of the interstate basins and to oversee the management of waters of the basin. At present, the Union cannot easily obtain even the information about the utilization of waters from the states. Attempts for enacting a water-information Bill have also not succeeded. Even if the constitutional reforms are not considered necessary, much can be achieved through enactment by Parliament, as a process of legal reforms.

Box 2.1: The Constitutional Reforms

In the present provisions, water is not a 'state subject'. The legislative capability of the states, in regard to interstate rivers is limited by the enactment of the Union under entry 56. (About 90 per cent of the territory of India is drained through interstate river basins). According to the author, enactment by Union would be sufficient to correct the situation, and constitutional changes are not warranted. In any case, changes in the Constitution, about water-related provisions would be very difficult.

Some of the issues about which the Union government needs to derive powers from legislation could be stated as follows:

- powers to approve proposals of the states in regard to water developments in interstate basins;
- powers to collect information about water and its use for various purposes in different states;
- powers to monitor the management of waters of an interstate basin by the state;
- powers to set up basins authorities which can direct the states in regard to the management of the basins waters in accordance with existing awards or agreements, allocations, etc.;
- powers to approve the interstate agreements reached by the basins states, and to convert the agreements into legal instruments, which cannot be modified unilaterally;
- powers to set up independent inspecting and licensing bodies to inspect and certify the safety of dams; and
- powers to decide the availability of surplus water in river basins after consulting the co-basins states and to recommend inter-basin transfers of water to deficit basins.

In the views of the author, the present thinking that in India water is a 'state subject' is incorrect. The Constitution provides that the Union, in accordance with the law to be passed by the Parliament would have powers to regulate the waters of the interstate basins. The powers of the states are subject to the limitations created by the law of the Union. Considering this position, which is superior to the inclusion of water in the concurrent list, it is preferable for the Union to enact laws than to propose constitutional amendments. This would also be more pragmatic, since amending the Constitution for sensitive water-related issues would be difficult.

Reforming the National Water Resource Council

The NWRC, which is the highest political-level body to decide issues like the national water policy, the plans for inter-basin transfer of waters, etc. has no legal backing. (The Interstate Council, a somewhat similar high-powered advisory body, derives its powers from the Constitution.) Without such a legal backing, the decisions taken by the

NWRC may not be given much importance by the states even if they are a party to the decision. Again, the NWRC, as also the Interstate Council is supposed to take decisions on the basis of a consensus. In the rules of the Interstate Council, the consensus has been defined; but this is not the case in regard to the NWRC. Some reform in this direction may be necessary.

Restructuring of the Ministry of Water Resources and the Central Water Commission

The National Commission on Integrated Water Resources Development had recommended restructuring of the CWC to make it a more powerful and interdisciplinary body. They had recommended that the CWC should perform the functions of the Ministry of Water Resources somewhat on the lines of the Railway Board which functions as the Ministry of Railways. The restructured Commission was to have members dealing with water law, groundwater, etc. These recommendations have not been acted on. The restructured Commission was also to deal with all water-related issues including hydropower, rural and urban water supply, etc. The Ministry of Water Resources also wished to bring such water-related concerns under its charge. Although the command area development of the major and medium projects was transferred to the ministry from the Ministry of Agriculture, in general, such efforts have failed. Reforms in this direction appear necessary.

Reforming the National Committees

At present, the Ministry of Water Resources constitutes the national committees. Such committees are available in regard to irrigation and drainage (INCID, the Indian National Committee on Irrigation and Drainage), hydrology (INCOH, the Indian National Committee on Hydrology), hydraulic research (INCH, the Indian National Committee on Hydraulic Research), geotechinical engineering, dam safety, etc. These committees are mainly for coordinating the activities and programmes in the subject area between the state and central governments and their institutions, academic institutions, research laboratories, etc. Various state governments and the institutes of the states as also individual experts are represented on such committees.

The National Committee on irrigation and drainage desired to reform itself by becoming more democratic and allowing individual or institutional membership after prescribing some eligibility criteria and fees. Although this would have reduced the financial burden of the government, the government could not accept these proposals. Reforms in the direction of imparting full professional autonomy to such national committees even when the government financially supports them seem to be necessary. A wider membership base is also desirable.

Reforming the Process of Adjudication

The adjudication process takes a very long time. Sometimes (as in the case of the Godavari) the delay is caused by the party states trying for a settlement on their own. Sometimes (as in the case of the Ravi and the Beas) the delay could be due to other causes. However, in all cases, delays occur. Reforms to avoid such delays have been thought of, but have not been implemented as yet. A proposal for a standing water dispute tribunal, which can become an institution specializing in water law and which would avoid delays was considered by the National Water Board. This proposal also had a provision for arbitration or mediation as alternative conflict resolution, which could be tried before resorting to adjudication. However, this proposal was not favoured. Reforms, both for allowing alternative conflict resolution mechanisms, and for speedy adjudication, appear necessary. The author's suggestions in this regard are shown in Figure 2.5.

Increasing the Level of the Equilibrium of the Water Sector Management

It could be said that at present the Indian water sector is at a low level of equilibrium, in regard to

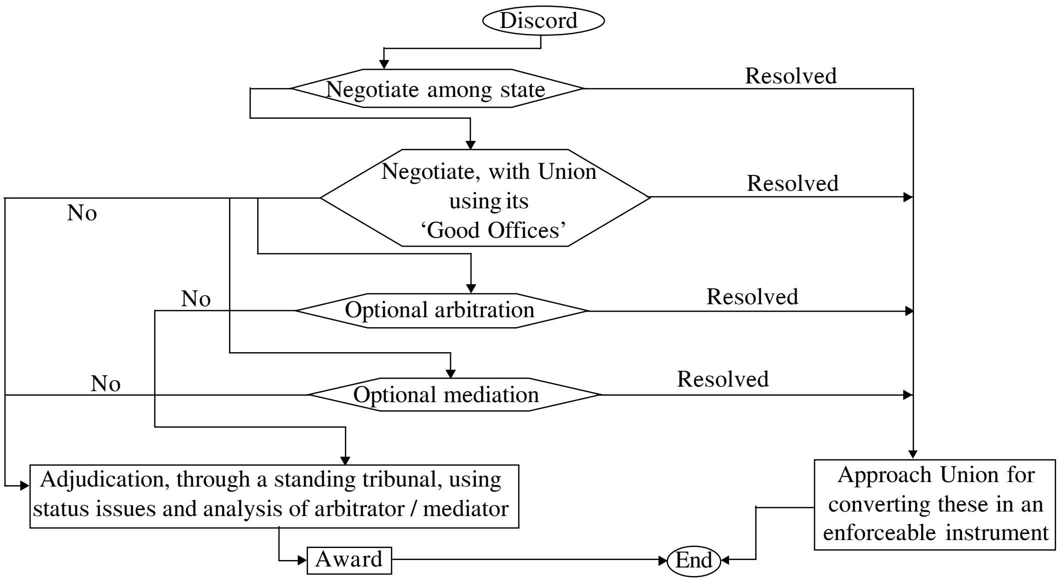

Figure 2.5: Management of Water-related Discords—Suggested Procedures

the investments, the services, and the recoveries. Larger investments, a better management of the sector, a higher quality of the service, and a higher cost recovery which makes the process financially sustainable could lead to a higher level of equilibrium being obtained. It could be argued that water policies could play an important role in making this change possible. We need to examine this hypothesis.

There is no doubt that both the irrigation water use and the water use for domestic supplies are, at present, in a financially unsustainable level.

In regard to irrigation, the present average yields are at about 2.5 tonnes per hectare. With better management, the yields for the cereal crops would go up to about four tonnes per hectare. In the best possible scenarios, the net sown area could reduce from the present level of about 140 million hectares (m. ha.) to about 120 m.ha. This may include a net irrigated area of about 80 m.ha. and a net rainfed area of about 40 m.ha. If we assume a cropping intensity of 150 per cent and 120 per cent on these two areas, respectively, and if we assume that about 30 per cent of the land is on non-cereal crops, the cereal crop production would be around 400 tonnes. This may be just sufficient, with dietary changes, By the year 2050, the rural population could be around 800 million, and around 500 million persons or about 125 million households may be deriving their main income from the land. Thus the net land per household would be only around one hectare. This would, at best be segregated as about 0.7 hectare in the irrigated area and about 0.3 hectare in the rainfed area. The total production of an irrigated cereal farm household would then be only 3.2 tonnes, and at the 2004 prices, the gross value of production at the farm gate, would be around Rs 20,000 or US$450. The net income from crops would be around US$250. Even after assuming a substantial additional income from other activities, the household income to be shared by four persons would be less than US$2 per day. Thus, unless a large-scale shift of population from agriculture to other sectors takes place, the so-called higher level equilibrium may not work out at all, at least for cereal farm households.

If large-scale crop diversification takes place, farm households producing cash crops on small irrigated farms may have substantially higher level of incomes. Large-scale crop diversification, coupled with cropping patterns designed to suit water availability, seems to be one way of attaining some semblance to a 'higher level of equilibrium'. The National Water Policy (2002) recommends water zoning and different patterns of development in each water zone. This policy directive needs to be expanded into a strategy of development based on water stress. The strategy perhaps could be as follows:

The Zone with Low Rainfall or Water Resource and with Low Population Density

This zone would mainly consist of western Rajasthan and Kutchch as also the cold desert and semi-arid areas in Jammu and Kashmir and Himachal Pradesh. In this zone irrigation of dry crops should be provided to the extent the water resource is available either locally or through water transfers. In general, irrigated dry crops should be preferred. Since the rainfall would not allow much useful water harvesting, rainfed agriculture can be kept to the required minimum.

The Zone having Low Water Resources and having a Considerable Population Density

This would consist mainly of Punjab, Haryana, western Uttar Pradesh, Gujarat, and the low rainfall area of the Deccan plateau covering parts of Madhya Pradesh, Maharashtra, Andhra Pradesh, Karnataka, and Tamil Nadu. In this zone, the main emphasis should be on improving the productivity of the rainfed agriculture by providing some supplemental irrigation water. Within this, the first priority would be for harvesting local water through agricultural and engineering majors for watershed management. Minor, medium, and major irrigation also needs to be provided if this can be done in a cost-effective way. The rehabilitation or modernization of existing irrigation facilities would be attractive from the economic efficiency point of view, but in view of the importance of equitable distribution and poverty alleviation, the existing rainfed areas may have to be tackled on larger priority. In case rainfed agriculture has to be continued, cash crops like fodder which do not require much water may be preferred. For irrigation, dry crops and, in particular, the wet season crops may be preferred. In irrigated crops also, the emphasis should be on high-value cereal crops and horticulture. Horticulture with drip irrigation on smallholdings would be an attractive option.

The Zone with Comparatively High Water Resources and Large Population Density

In this zone, the priority would have to be towards intensive irrigated agriculture through large-scale provision of irrigation. While crop diversification would be beneficial, large production of cereal crops including paddy and production of sugarcane could be encouraged. Conjunctive use of surface and groundwater is essential for allowing large irrigation intensities.

The Zone with Comparatively High Water Resources and Low Population Density

This Zone Would Consist Mainly of the Hilly Areas in the North East. In this zone, both the rainfed and irrigated agriculture, with comparatively larger land holdings can continue. Irrigation could be based mostly on the use of groundwater in order to avoid possible waterlogging problems. Crops like jute or varieties of paddy, which can stand occasional flooding, may be preferred in the wet season.

Water policies for the zones would have to be designed to meet the agricultural strategies as indicated above. For example, in the zone having low water resources and low population density, the irrigation water prices would have to be considerably subsidized. In the next zone with comparatively less water resources and high population densities, water prices for cereal crops and for high water consuming crops would have to be large enough so that farmers are encouraged to produce cash crops. Investment criteria in regard to watershed management and irrigation development may have to be relaxed to provide for increasing irrigation in this area, even at comparatively higher costs. In the zone of comparatively larger water resources and high population densities, a large number of surface irrigation works including storages need to be planned without considering the need for capital cost recovery. Water charges should, in general, meet the full O&M costs; however, since cereal crops are to be encouraged cross-subsidizing the water prices for such crops needs to be considered. In the zone having larger water resources and low population densities, the use of electricity for agriculture needs to be cross-subsidized to encourage the use of groundwater for irrigation. Surface water use for irrigation may be allowed in the wet season, but since alternative sources may be available large-scale storage development for irrigation need not be encouraged.

Suggestions Regarding Changes in National Water Policy

Let us now summarize the possible policy changes that need to be undertaken by the Union government.

Legal and Institutional Changes

These have been described in detail elsewhere. The suggestions are mainly for enactments, which facilitate and enable the Union government in discharging its regulatory responsibilities in regard to monitoring of the water sector and in regard to the development and management of interstate basins. As per the author, the legal and institutional changes hold the key to the reforms. Other important policy changes, which need to be considered, are given below.

Water as a Negative Community

The policy needs to clearly point out that water is a negative community in which no absolute ownership, either for the government or for any other entity, is possible. Only usufruct rights can exist in regard to water. This policy change is to be supported by a campaign for attitudinal changes. The existing irrigation Acts, etc. would also have to be modified to some extent for incorporating this principle. These ideas have already been elaborated in this study.

New Regime of Water Rights

The policy should require that the states share their water allocations and water rights with the water users by creating a new and just regime of water rights. These rights could be subject to modifications based on failure to use the right, and on the basis of changes in the ground situation.

Fresh Assessment of Water Situation and Development Strategies

Water policy evolution is required to be done on the basis of a detailed analysis of the future alternative possibilities of development and management, the analyses of issues and problems involved in each of the alternatives, and the analyses of policy interventions required to take the preferred course of action. There are two ways in which this can be done. The FAO prefers a detailed procedure based on preparation of various matrices. Although the approach appears interesting it has perhaps not been tried out. The World Bank in its water resources consolidation projects (WRCPs) required the concerned states of India to take up the preparation of a detailed state water plan before undertaking the evolution of water policies (World Bank: 1998b). The Union water policy or its 2002 revision was not based on either of these procedures explicitly. An outlying water plan was available in the form of the report of the National Commission (1999a). Although these inputs have been used in the policy evolution, it seems to have been done in an incomplete way. Important concerns coming out of the report have not been specifically addressed. It is important that this real-life assessment of the water situation and a nationwide study of demands, supplies, and alternative paths of development be undertaken once more before detailing water policies.

Food Security vis-a-vis International Trade in Food

As an integral part of the process mentioned above, the issue of food self-sufficiency or food security for the nation as a whole within the changing regime under the WTO, needs a detailed study. The desirability of virtual water trade, allowing large-scale imports of food, and its repercussions need to be studied. The possible use of water as a weapon, the possible accentuation of shortages in a long dry spell of a few years, the transportability of large food supplies, etc. need to be considered in the study. If a general self-sufficiency in food is desired, acceptable regulatory measures for international trade need to be designed. Integration of policies in regard to water, international trade, and food, is required.

Clarifying the Role of Private Sector

Similarly, the policy needs to be very clear and explicit about the role of private sector in water development. The present policy seems to allow private sector participation on a trial basis, but seems to presume that the government would be the main actor in regard to surface water development and management. This has already been discussed earlier. If this is the message to be sent out, it should be done in an explicit way and should be supported by a policy analysis. On the other hand, if the government's role in the water sector is to gradually change, this should be stated explicitly.

Perhaps the policy may mention that in the field of irrigation, the government would have to continue as the main actor in regard to development as also the management of the primary system. The management of the tertiary, and to some extent the secondary system could either be privatized or given to the cooperative sector. Privatization could be the main policy in regard to hydro power, and could be encouraged, through large pilots, for domestic water supply.

Shift in the Concept of Water Resources

On one hand, the nations of the world are sovereign nations which could be deciding the water policies entirely on their own, through a national process of evolution and adoption. On the other hand, the water resources of the earth represent a unified resource which manifest itself through the continuous movement of water in the global hydrology cycle as rainfall or snowfall, waters in the rivers and lakes, the fluvial part of the groundwater moving through the aquifers. Even if one is prepared to ignore the integration obtaining in the meteorological processes and the oceanic circulation of water, a river basin, up to its common terminus which normally is in the seas, (and beyond which the interests may cease) represents a unitary whole, within which, action at any place can affect the situation or the choices for action at another place.

This unity of water resources has been understood for a long time and its policy implications have also been deliberated upon. For example, Rogers (1992) clearly mentions that water is a unitary resource and all water whether it be rainfall, river water, or groundwater is part of the same resource and, therefore, the whole hydrologic balance is to be considered. The National Water Policy of India (2002b) also starts with a preamble, 'Water, as a resource is one and indivisible: rainfall, river waters, surface ponds and lakes and groundwater are all part of one system'.

The present policy is based on the concept that the run-off of basins consisting of the river flows and the flows in the aquifers is the main resource. The stress on water resources is increasing, and better techniques for local use of rainfall, as also for control of evaporation are becoming available. In this situation, the rainfall and trans-boundary waters need to be considered as the 'water resources'.

Maintenance of Proper Water Accounts

For every basin or sub-basin, proper water accounts need to be maintained. These would, in particular, account for both the withdrawals of waters and the return of water to the natural hydrologic system. The returned waters constitute both an important addition to the resources as also a threat to the quality. Similarly, the water accounts need to show separately the uses for the main use sectors, that is, the 'nature', the 'agriculture and food', and the 'domestic' and the 'industrial'. In all these sectors, the water use can be classified as 'beneficial' and 'non-beneficial'.

These need to be estimated separately. The non-beneficial use could be the main target for designing water-saving strategies.

Evaporation Management as a New Strategy

Within this new concept of water resources, evaporation is the only direct 'use' of water. The withdrawals are to be distinguished from the use of water.

Management of evapotranspiration, particularly in agriculture, through techniques like drip irrigation which does not wet the whole land surface, or mulching, or the use of plastics to prevent evapotranspiration, creation of micro-climates to reduce evapotranspiration, etc. are strategies which require a mention in the policies.

Water for Nature

The estimation of the water for natural needs includes the water use by the natural terrestrial ecosystem (different types of forests, grasslands, deserts, wetlands, etc.) as well as the aquatic (riverine, estuarial, deltaic, or coastal) ecosystems. The large and rather automatic use of rain waters, as a first charge, by the terrestrial ecosystems, often gets overlooked in the water accounts at present, since rain water is not considered as a water resource.

The need for maintaining a minimum flow in perennial streams for maintaining ecology and 'social consideration' is already mentioned in the National Water Policy (GOI: 2002b). However, the better-accepted concept of environmental flows which includes the flow required for maintaining the river morphology, and does not generally include the flow required by the riparian human habitations is not congruent with the concept of the minimum flows. It is desirable that the water policy speaks of the environmental flows.

As a result, it incorrectly appears as if the water requirements of nature sector (ecological or environmental requirements) are limited to a small quantity of 'minimum flows', which need to be augmented by cutting down on the anthropogenic uses. The policy needs to correct the situation, and indicate that the non-beneficial or the least beneficial use in the 'nature', 'food', or 'people' sectors needs to be targeted for water saving.

Watershed Management

It needs to be specified that any new downstream development, which is based on a larger use of the upstream waters, has to be planned after making reservation for likely future upstream water uses through watershed management and other measures of local water use. However, where the existing downstream developments, particularly the storage developments, are already water short, a policy to discourage further watershed development in their catchments may have to be followed.

Integrating Livelihoods in Land and Water Planning

The present policy already mentions the need for integrating land and water resources when dealing with irrigation. In India, as per the demographic projections, a large population would continue to live in the rural areas, in spite of a comparatively fast rate of urbanization. Projections indicate that by the year 2050, about half the population would be rural. Due to advances in information technology, as also due to better economic conditions, a larger proportion of the rural population would be in the services and manufacturing sectors as compared to the present. On the other hand, the urban population in the peri-urban area could have persons who derive the main income from agriculture. Even after considering these, a large proportion of the Indian population would have no other alternative than to derive their main income from land-based agriculture. There are many semi-arid regions, which have high rural population densities, and consequently small and unproductive rainfed land holdings. Even if food self-sufficiency or food security could be ensured, increasing rural incomes from agriculture on small land parcels may require irrigation as the only practicable strategy. Thus, for such overpopulated and water-deficient regions, irrigation may be required for the alleviation of poverty. This has to be brought out in the water policy. Poverty alleviation could be an important driver for increasing irrigation-water use, even if concerns about food security for the nation as a whole does not appear important in the future context.

Water Priorities by Uses

The present policy mentions that drinking water should have the highest priority. However, since the drinking requirements of humans and animals are very small, the actual drinking water is a small part of the domestic water needs. While operationalizing the policy, the whole of the domestic needs (which could be of the order of 200 litres per capita per day against the drinking needs of about 4 litres per capita per day) seem to receive the highest priority. This may not be appropriate. The policy needs to define a core demand of water for maintaining essential health and hygiene (may be around 50 litres per capita per day) and then assigned the highest priority to only these core demands.

Water Allocation by Uses

At present, waters of an interstate river are allocated to the states. While the states may plead for allocation for priority uses during the process, once the water is allocated to them they are normally free to use it for any purpose. The policy needs to provide for water allocation to states, which can be constrained for high priority uses.

Integrating Allocations with Water Quality

Irrigation often uses good quality waters even while the increasing domestic uses are being met with residual waters, which may not be of good quality. The policy needs to provide for the re-allocation of water by sources considering the quality aspect so that allocating the best-quality source for this purpose reflects the priority given to the domestic supplies. Similarly, the treated effluent from domestic supplies can be allocated for irrigation in exchange of the better-quality waters being used at present. Such a policy directive would also help in improving the riverine ecology.

Water Zoning and Designing Water Use Strategies, Zone-wise

As discussed earlier changing the present low-level equilibrium to a high-level one (or getting out of the vicious circle into the virtuous circle) is going to be difficult for the Indian cereal farmers. Even then, if agricultural policies are adjusted to water availability, much could be achieved. The National Water Policy (2002b) already provides for such an approach. The possible agricultural strategies and water use strategies have been discussed in this report. Further interdisciplinary thinking, and elaboration of these strategies in the water policy is required.

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3

Development and Management Policies

Perspective of the Planning Commission

A. SEKHAR

IRRIGATION

With a 24.2 per cent contribution to the gross domestic product (GDP) of India, agriculture provides livelihood support to about two-thirds of the country's population and provides employment to 56.7 per cent of the country's workforce. It also accounts for 14.7 per cent of the total export earnings and provides raw material to a large number of industries like textiles, silk, sugar, rice, flour mills, and milk products. Among the various inputs required for agriculture, namely, irrigation, seeds, pesticides, weedicides, fertilizers, credit, extension, and so on, irrigation is the most important. The right kind of irrigation has the potential to improve crop yields by three to four times and thus bring about a marked increase in farmers' income. For a tropical-climate country like India where rainfall is confined to from three to four monsoon months (within which also there is marked temporal and spatial variability), irrigation assumes still greater significance. Irrigation is the single-most important factor in drought-proofing because an area with 30 per cent irrigation is considered to be insulated against drought.

History of Irrigation in India

Irrigation in India has been practised from prehistoric times and appears to have been contemporary with agriculture itself. Numerous references are found in the Vedas and other ancient Indian literature to wells, tanks, canals, and dams, their importance to the community, their efficient maintenance and operation, and the duties of the state in these matters. Many of the tanks in central and southern India are many centuries old. While irrigation from shallow wells always has been, and still is, the result of individual private effort, the development of irrigation (mostly inundation) from surface flow has traditionally been the result of state enterprise. Archaeological investigations at the sites of the Indus Valley Civilization reveal evidence of stone-dams ('gabarbunds') and earthen embankments ('kachbunds'). In southern India, irrigation was in vogue in the Cauvery delta more or less in the same period as the Indus Valley Civilization. The Grand Anicut across the Cauvery was built in the second century AD. Besides river diversion works, thousands of minor irrigation tanks were constructed in the fifth century AD by the Cheras, the Cholas, and the Pandyas. The

Western Yamuna Canal was built in the fourteenth century AD, renovated by Mughals in the sixteenth century AD, and repaired in the nineteenth century by the British.

Irrigation development in the British period was financed by the revenue collected. Efforts to promote irrigation through private companies with a government guarantee of 5 per cent return on capital invested was unsuccessful. In 1866, important changes were made in the principles and policy governing the execution and financing of irrigation projects, keeping in view that large investments were required to expand irrigation and the poor response to privatization. It was decided that irrigation projects would be executed only by the state and would be financed from public loans. A number of projects like the Sirhind Canal (Punjab), the Lower Ganga Canal, the Agra Canal, the Betwa Canal (Uttar Pradesh), the Periyar system (Tamil Nadu), and the Mutha Canals (Maharashtra) were accordingly completed.

In 1901, the then GOI appointed the 'Indian Irrigation Commission' to report on irrigation as a protection against famine in India. Based on the Commission's recommendations, the Triple Canal Project (now in Pakistan), the Tribeni Canal (Bihar), the Godavari Canal, the Pravara Canal and the Nira Right Bank Canal (Maharashtra), the Sarda Canal (Uttar Pradesh), and the Mahanadi Canal (Madhya Pradesh) were completed.

A significant change in the policy governing the administration and financing of irrigation projects was brought about with the introduction of the Montague–Chelmsford Reforms in 1921. The provincial governments were authorized to raise loans themselves for financing of irrigation. The Krishnarajasagar (Karnataka), the Nizamsagar (Andhra Pradesh), the Mettur Dam (Tamil Nadu), the Bikaner Canal (Rajasthan), and the Sutlej Valley Canals and the Sukkur barrage (now in Pakistan) projects were taken up by the provinces after this authorization.

In 1935, the British Parliament passed the Government of India Act according to which the subject of irrigation was transferred from the control of the centre to the provincial or state governments. The centre was no longer concerned with the development of irrigation except where disputes arose among co-basin states. The constitution-makers, after independence, thought it prudent to continue this arrangement resulting in the centre losing all control over irrigation. Many of the malaise confronting the irrigation sector today can perhaps be traced back to this decision of 1935.

TABLE 3.1: Development of Irrigation in Pre-independence India

(m. ha.)

Years	Cultivated area	Total irrigated area
1896–1900	Not available	11.98
1901–5	72.71	13.15
1906–10	78.09	15.95
1911–15	82.79	18.01
1916–20	84.08	18.42
1921–5	82.55	18.62
1926–30	84.77	18.94
1931–5	85.02	18.94
1936–40	85.82	22.06
1941–5	87.24	22.60

Note: The percentage of cultivated area irrigated rose progressively from 18 per cent in 1901–5 to 24 per cent in 1941–5.

Source: Planning Commission, Government of India.

Constitutional Provisions

The Constitution of India was adopted by the Constituent Assembly on 29 November 1949. The framers of the Constitution had before them the precedent of the Government of India Act 1935 whose detailed provisions were found suitable for adoption in the interests of continuity and certainty. It is, therefore, not surprising that the subject of water has been kept in the domain of the states in the Constitution. Water finds mention in entry 17, list II of the Seventh Schedule of the Constitution (items which fall within the purview of the state legislature).

Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power, subject to the provisions of entry 56 of list I.

Entry 56, list I (Union List), however, gives powers to the central government in the regulation and development of interstate rivers.

Regulation and development of inter-state rivers and river valleys to the extent to which such regulation and development under the control of the Union is declared by law to be expedient in the public interest.

It would be seen that there is enough authority conferred on the central government by the Constitution in the regulation and development of interstate rivers. The central government has not so far exercised this authority although, in 1956, the River Boards Act was enacted for the regulation and development of interstate rivers and river valleys in consultation with the state governments concerned. No river board has so far been established under this Act although, through separate Acts passed by Parliament, the Brahmaputra Board (1980) and the Betwa River Board (1976) were set up.

The Sarkaria Commission on Centre–State Relations examined this question in 1983 and came to the conclusion that existing arrangements in the Constitution are the best possible method of distributing powers between the Union and the states with respect to a highly sensitive and difficult subject. The Commission therefore did not support the suggestion that 'water' should be included in either the 'Union List' or even the 'Concurrent List'.

The Constitution has also a specific Article (Article 262) dealing with adjudication of disputes relating to matters of interstate rivers or river valleys, which reads as follows.

Article 262:

(1) Parliament may by law provide for the adjudication on any dispute or complaint with respect to the use, distribution or control of the waters of, or in, any inter-state river or river valley.

(2) Notwithstanding anything in this Constitution, Parliament may by law provide that neither the Supreme Court nor any other Court shall exercise jurisdiction in respect of any such dispute or complaint as is referred to in clause (i).

The central government in 1956 enacted the interstate Water Disputes Act for setting up of tribunals to settle interstate water disputes. So far tribunals set up for the Krishna, the Godavari, and the Narmada have given their awards. Awards from the Ravi–Beas and the Cauvery Tribunals are awaited. In April 2004, a second Krishna Tribunal was set up. Recently the Act has been amended prescribing a time limit for tribunals to complete their tasks.

Unlike some other countries, India does not have a national water law or code. There are many laws at the state level and some at the central level relating to different aspects or uses of water or having a bearing on water, but there is no overarching umbrella legislation on water per se. There is a National Water Policy but it has no statutory backing or force. According to Ramaswamy R. Iyer there are divergent perceptions relating to water. Water is seen variously as a riparian right; as essential to life and therefore as a fundamental right or a human right; as an integral part of the ecological system and of planet Earth; as a sacred resource; as an 'economic good' or tradable commodity; as a 'common pool resource' or 'commons'; as private property; and so on. These divergent perceptions lead to divergent policy prescriptions, such as state control, community management, privatization, water markets, and so on. Unfortunately, the diverse water-related laws at the state and central levels add to the complexity and confusion. Similarly, no answers have so far been found to the problems created by the prevalence of ownership rights in relation to groundwater. The need to regulate the extraction of groundwater and the operation of groundwater markets with reference to the objectives of conserving and protecting the resource from depletion and pollution/contamination and ensuring equity and social justice is evident, but hardly any progress has been made in those directions.

The Planning Commission and Planned Development

Vide Government of India Resolution dated 15 March 1950, the Planning Commission was set up with the following terms of reference:

- assess the material, capital, and human (including technical personnel) resources of the country and investigate the possibilities of augmenting such of these resources as are found to be deficient in relation to the nation's requirements;
- formulate a Plan for the most effective and balanced utilization of the country's resources;
- on a determination of priorities, determine the stages in which the Plan should be carried out and propose the allocation of resources after the due completion of each stage;
- indicate the factors which are tending to retard economic development, and determine the conditions which, in view of the current social and political situation, should be established for the successful execution of the Plan;
- determine the nature of the machinery which will be necessary for securing the successful implementation of each stage of the Plan in all its aspects;
- appraise from time to time the progress achieved in the execution of each stage of the Plan and recommend the adjustments of policy and measures that such appraisal may show to be necessary; and
- make such interim or ancillary recommendations as appear to it to be appropriate either for facilitating the discharge of the duties assigned to it, or on a consideration of the prevailing economic conditions, current policies, and development programmes; or on an examination of such specific problems as may be referred to it for advice by the central or state government.

From 1951 onwards, planned development in slices of five years was taken up (with a few Plan holidays in between). So far nine Five-Year Plans have been completed and the Tenth Plan is in process. The period of each Plan is as follows:

TABLE 3.2: Periods of Five Year Plans

Plan Numbers	Period
First	1951–6
Second	1956–61
Third	1961–6
Annual Plans	1966–9
Fourth	1969–74
Fifth	1974–8
Annual Plans	1978–80
Sixth	1980–5
Seventh	1985–90
Annual Plans	1990–2
Eighth	1992–7
Ninth	1997–2002
Tenth	2002–7

Source: Same as Table 3.1.

Irrigation has formed an important component of each of the Plans. The important thrust areas identified by each Plan insofar as irrigation is concerned have been as follows:

First Plan

- double area under irrigation in next fifteen to twenty years;
- desirability of taking steps to charge betterment levy on all new projects (betterment levy is the government's share in the increase in the value of land that accrues as a result of provision of irrigation facilities);
- setting up non-lapsable irrigation development fund by each state to meet all expenditure on irrigation and power projects;
- stress on economic use of water;
- setting up of a body to advise on relative priority of different projects after they are

technically cleared in the Central Water Commission; and
- while large irrigation projects would be undertaken by state, village cooperatives or association of landholders to be encouraged to take up small irrigation works.

Second Plan

- Engineering Personnel Committee appointed to assess requirement of engineers for infrastructure development; and
- completion of canals hand in hand with dams for quick utilization of potential.

Third Plan

- special steps to be taken to bring about substantial improvement in financial return;
- revision of water rates; and
- although legislation for betterment levy was enacted by all states except Uttar Pradesh, West Bengal, Jammu and Kashmir, enforcement has lagged behind.

Fourth Plan

- stress on command area development to close gap between potential created and utilized;
- earmarking 10 per cent of aggregate central assistance for allocation to specific projects; and
- integrated river basin planning.

Fifth Plan

- programme for command area development launched; and
- classification of major, medium, and minor irrigation projects was changed from cost-based to area-based criterion (in 1959, the norms for major, medium, and minor projects cost were greater than Rs 50 million, between Rs 50 million and Rs 1 million, and less than Rs 1 million, respectively. This was changed to cultivable command area greater than 10,000 hectares, between 2000 and 10,000 hectares, and less than 2000 hectares).

Sixth Plan

- expeditious completion of ongoing projects;
- new projects in drought prone, tribal, and backward areas to remove regional imbalances;
- initiating investigation for a national plan for inter-basin transfer of waters; and
- focus on groundwater.

Seventh Plan

- irrigation development at 2.5 million hectares per year; and
- accelerate exploration and exploitation of groundwater especially in eastern and north-eastern regions.

Eighth Plan

- holistic approach in formulation of projects with stress on environmental issues;
- concern about large number of ongoing projects—need for prioritization;
- strengthening of data base, use of remote sensing;
- modernization of existing systems, improvement of minor irrigation tanks; and
- extend coverage of flood forecasting network.

Ninth Plan

- criticality of water in doubling agricultural production in next ten years realized;
- focus of improved water-use efficiency;
- bridging gap between potential created and utilized;
- promoting participatory irrigation management and conjunctive use; and
- accelerating groundwater development with proper regulatory mechanism.

Tenth Plan

- focus on completion of on-going projects;
- steps to avoid proliferation of projects;

- benchmarking of projects;
- lag between potential created and utilized;
- Participatory Irrigation Management;
- water logging, improvement of water-use efficiency;
- revision in water rates;
- groundwater legislation; and
- nodal ministry at the centre for water resources, that is, Ministry of Water Resources would be in charge of overall coordination of all programmes/schemes relating to water.

Development of Irrigation Potential

The ultimate irrigation potential of the country has been assessed as 139.88–58.46 m.ha. from major and medium irrigation and 81.42 m.ha. from surface minor irrigation and groundwater. Groundwater alone has a potential of 64 m.ha. Till the end of the Ninth Five-Year Plan (2002), a total potential of 93.98 m.ha. had been created—37.08 m.ha. from major and medium and 56.90 m.ha. from minor irrigation schemes. A potential of 44.95 m.ha. has been created from groundwater sources.

Table 3.3 gives plan-wise status of projects completed besides the 217 projects completed in pre-Plan period.

Plan-wise growth of irrigation potential is given in Table 3.4 below:

TABLE 3.3: Status of Projects Completed in Pre-plan Period

Plan	Major Projects Completed	Medium Projects Completed
First	5	34
Second	20	85
Third	11	61
Annual Plans (1966–9)	5	43
Fourth	15	62
Fifth	6	70
Annual Plans (1978–80)	2	18
Sixth	30	138
Seventh	14	137
Annual Plans (1990–2)	7	12
Eighth	9	48
Ninth	24	41
Total	148	749

Source: GoI (2002), Tenth Five Year Plan, Planning Commission.

TABLE 3.4: Plan-wise Growth of Irrigation Potential

(m.ha.)

Plan	Potential Created (Cumulative)		
	Major and Medium	Minor	Total
Pre-Plan	9.70	12.90	22.60
First	12.2	14.06	26.26
Second	14.38	14.75	29.08
Third	16.57	17.00	33.57
Annual Plans (1966–9)	18.10	19.00	37.10
Fourth	20.70	23.50	44.20
Fifth	24.72	27.30	52.02
Annual Plans (1978–80)	26.61	30.00	56.61
Sixth	27.70	37.52	65.22
Seventh	29.92	46.61	76.53
Annual Plans (1990–2)	30.74	50.35	81.09
Eighth	32.96	53.30	86.26
Ninth	37.08	56.90	93.98

Source: Same as Table 3.3.

The investments made so far in the irrigation sector till the end of the Ninth Plan are:

- major and medium—Rs 1008.6533 billion and
- minor—Rs 404.3567 billion.

The Plan-wise investments are as under:

For the Tenth Five-Year Plan, the approved outlays are:

TABLE 3.5: Plan-wise Investments in the Irrigation Sector

(Rs billion)

Plan	Major and Medium Irrigation	Minor Irrigation		
		Public	Institutional Finance	Total
First	3.7624	0.6562	–	0.6562
Second	3.8000	1.4223	0.1935	1.6158
Third	5.7600	3.2773	1.1537	4.4310
Annual Plans (1966–9)	4.2981	3.2619	2.3474	5.6093
Fourth	12.4230	5.1228	6.6106	11.7334
Fifth	25.1618	6.3083	7.7876	14.0958
Annual Plans (1978–80)	20.7858	5.0150	4.8040	9.8190
Sixth	73.6883	19.7926	14.3756	34.1682
Seventh	111.0729	31.1835	30.6095	61.7930
Annual Plans (1990–2)	54.5915	16.8048	13.4959	30.3007
Eighth	210.7187	64.0836	53.3100	117.3936
Ninth	482.5908	86.1507	26.5900	404.7407
Total	1008.6533	243.0790	161.2778	404.3567

Source: Same as Table 3.3.

- major and medium—Rs 712.1318 billion; and
- minor—Rs 144.0666 billion.

Accelerated Irrigation Benefits Programme (AIBP)

Concerned with the large number of ongoing projects (major and medium) remaining incomplete, the central government launched the AIBP in 1996–7 as a Central Loan Assistance Programme (CLA) to assist the states in completion of 'last mile' projects in about four seasons. The funding pattern approved was 2:1 (centre: state) for non-special category states and 3:1 for special category states (including Kalahandi, Bolangir, and Koraput districts (KBK) of Orissa). For special category states and KBK, even surface MI schemes could be included. A special dispensation was given only to KBK permitting inclusion of even new major/medium irrigation projects.

About 178 projects are in the programme of which 28 have been competed so far. Till the end of the Ninth Plan, the central government had released Rs 84.8 billion under the programme. In the Tenth Plan, against approved outlay of Rs 28 billion each in 2002–3 and 2003–4, the actual releases were Rs 30.61 billion and Rs 31.28 billion, respectively.

The ultimate irrigation potential of projects under AIBP is 16.09 m.ha. of which 6.55 m.ha. was created prior to the AIBP programme. Of the balance 9.54 m.ha., a potential of 2 m.ha. has been created till March 2003 under the programme.

The AIBP guidelines have been revised from time to time with approval of the competent authority. In 2002, a fast-track component was included where for projects which can be completed in two seasons, 100 per cent CLA was granted without any state share. In 2003–4, the guidelines were again revised (as given below) effective from 1 April 2004:

- completion of normal AIBP funding projects in six to eight seasons against four seasons;
- completion of fast-track projects in three seasons against two seasons;

- CLA to be converted to Normal Central Assistance pattern of 30 per cent grant, 70 per cent loan (or 90 per cent grant, 10 per cent loan in case of special category projects);
- the states have to sign a MOA for each project covering balance cost, balance potential, and completion schedule so that the programme does not remain open ended; and
- for reforming states (states which agree to increase water charges to cover O&M costs in a five-year period), better lending terms (4:1 or 1:0 for special category states) are offered. So far Gujarat, Maharashtra, Orissa, Madhya Pradesh, Rajasthan, and Jharkhand have agreed for reforms in the water sector. Maharashtra and Gujarat have reported full recovery of O&M charges through water rates.

Groundwater Legislation

Out of the total replenishable groundwater resources in the country of 433 billion cubic metres (BCM), the level of development is only 37 per cent. However, there are many pockets in states like Andhra Pradesh, Gujarat, Haryana, Maharashtra, Rajasthan, Punjab, and Tamil Nadu where the level of exploitation has either exceeded the replenishable quantum or has come in the critical zone (85 to 100 per cent of the replenishable quantum). Out of the 7910 blocks/talukas/ watersheds in the country 671 (8.2 per cent) are over-exploited and 424 (5.18 per cent) are dark/ critical. If the present trend continues, the number of such blocks will double every twelve and a half years.

The Ministry of Water Resources (MoWR) circulated a model Bill to regulate and control the development of groundwater in 1970 and again in 1992 and 1996. Goa, Tamil Nadu, Lakshwadeep, Kerala, and Andhra Pradesh have enacted some form of legislation while Maharashtra, West Bengal, Pondicherry, and Gujarat have passed a Bill.

Based on the advice of the Planning Commission, the MoWR is having a re-look at the Bill. The Planning Commission has opined that the focus of the Bill should be shifted from mere regulation to groundwater development and regulation wherein development aspects through compensatory rain water harvesting receives equal if not more attention along with regulation of groundwater extraction.

Command Area Development Programme (CADP)

Despite impressive strides in creation of irrigation potential, analyses made by different agencies in the early 1970s indicated that agricultural production showed stagnation at 1970 level. The productivity of irrigated land also left much to be desired. The Second Irrigation Commission (1972) and the Committee of Ministers (1973) looked into the associated problems. They reported that there was a wide gap between the potential created and that which was utilized on account of treating in isolation the activities of irrigated agriculture. Starting of an integrated and coordinated approach to irrigation water management through a Centrally Sponsored Command Area Development Programme in the country as a whole was considered necessary. The programme was accordingly launched during 1974–5 in the beginning of the Fifth Five-Year Plan.

The Planning Commission during the period 1973–1984 issued a series of circulars to the states on issues relating to command area development. The contents of these are briefly summarised below.

TABLE 3.6: Command Area Development: Excerpts from Circulars of Planning Commission

Circular Date	Subject and Brief Contents
26 September 1973	Definition of the terms ultimate irrigation potential, potential created, and potential utilized
8 March 1978	Expeditious construction of field channels by amending provisions of Irrigation Acts

(Contd ...)

Table 3.6 (Contd ...)

Circular Date	Subject and Brief Contents
10 October 1979	Construction and maintenance of water courses and field channels for utilization of irrigation potential-definition of water course and field channel
25 July 1984	Decision on construction at government cost system to serve 5 to 8 hectares blocks against existing 40 hectares

Source: Same as Table 3.1.

The CADP comprised the following components:

- field channels and field drains;
- land leveling and shaping;
- realignment of field boundaries, consolidation of holdings;
- enforcement of rotational water supply ('warabandi');
- adaptive trials, demonstrations, and training;
- sprinkler, drip, groundwater development; and
- incentives for farmers participation.

The CADP was taken up in 276 projects with a total cultivable command area of 26.78 m.ha. CAD works were completed by the end of the Ninth Plan in 15.75 m.ha with a central assistance of Rs 26 billion.

In January 2000, the Planning Commission wrote to the MoWR that the existing AIBP programme be used as a vehicle to usher in reforms in the water sector, namely, increase in water rates to cover O&M costs and commitment by states to adopt the turnover programme for Participatory Irrigation Management (PIM). The MoWR accepted these suggestions but informed that PIM could be linked to the restructured CADP under formulation for implementation from the Tenth Five-Year Plan.

The new programme called the Command Area Development and Water Management Programme approved for implementation from 2004–5 retains some components of the earlier programme like field channels, field, intermediate and link drains, and 'warabandi', reclamation of waterlogged areas, training, adaptive trials, demonstrations, and R&D and includes new components like correction of system deficiency, renovation and desilting of tanks in command area, motivational activities, and bio-drainage. A beneficiary contribution of 10 per cent has now been introduced in components like field channels. Introduction of legislation/administrative arrangements for PIM has been made obligatory for states seeking funds under the new programme. The ambit and scope of the programme has also been confined on the advice of the Planning Commission to about 100 on-going projects in an advanced stage of completion to avoid thin-spread of resources over many projects.

Participatory Irrigation Management (PIM)

Although the subject of PIM had been stressed ever since planned development commenced, it was only in 1997 after the Government of Andhra Pradesh enacted 'The Andhra Pradesh Farmers Management of Irrigation Systems Act' that PIM received focused attention. This Act served as a model for other states to follow suit. So far Madhya Pradesh, Rajasthan, Tamil Nadu, Goa, and Orissa have enacted similar Acts. Kerala, Uttar Pradesh, Karnataka, and Bihar have modified their Irrigation Acts with enabling provisions to facilitate introduction of PIM. Maharashtra, Gujarat, and Haryana are likely to enact legislation shortly. This is one of the thrust areas identified by the GOI in the Tenth Plan.

Despite these developments, in terms of actual area covered by PIM (8.68 m.ha) or number of association formed (41,247), the situation is not satisfactory considering that about 58 m.ha net area is under irrigation in the country. Even where associations have been formed, the functions of the collection of water charges has not yet been entrusted to them. Even in Andhra Pradesh where about 10,000 water users' associations (WUAs) have been formed, the responsibility for collection of water charges is on the revenue department. 50 per cent of the collected amount is passed on by the Collector to the WUAs and the remaining 50 per cent remitted to the state government. In Bihar, state government has entered into Memorandum of Understanding with WUAs whereby WUAs themselves collect water charges and 70 per cent of the collected amount is retained by them. However, even in such cases, the collection efficiency is only around 35 per cent whereas it was expected that WUAs would be able to collect charges from almost all their members.

The Planning Commission and the MoWR are persuading the remaining states to enact legislation.

Project Appraisal and Role of the Planning Commission

In the First Five-Year Plan, projects were selected for inclusion in the Plan on an adhoc basis. The Planning Commission in the Second Five-Year Plan realized the need for project evaluation and inter-se prioritization and constituted, in 1954, a committee under the deputy minister, irrigation and power with the chairman, CWPC; the chairman, CBIP; president, Institution of Engineers; representatives of the Finance Ministry and Planning Commission; retired experts and director, CWC as members. The Central Water Commission was entrusted with the task and technical examination of all schemes with a view to see that all necessary investigations are carried out, the estimates of expenditure are reasonably correct and the estimates of revenue are made on adequate data. After the technical scrutiny and acceptance by the Committee, projects were accorded investment clearance by the Planning Commission making them eligible for inclusion in the state plan. It may be worthwhile to mention here that there is no constitutional provision requiring the centre to techno-economically clear projects and the above arrangements could be considered as without any legal backing. However, it could perhaps be justified as 'socio-economic planning' as mentioned in the Concurrent List of the Constitution.

The above committee was reconstituted from time to time and was last reconstituted as an Advisory Committee on Irrigation, Flood Control, and Multipurpose Projects in September 1976 under the additional secretary, Department of Irrigation. In 1986, these arrangements were reviewed and it was decided to replace the committee constituted by the Planning Commission with a committee constituted by the Ministry of Water Resources. In November 1987, the Ministry of Water Resources reconstituted the committee under the chairmanship of secretary, MoWR, with representatives of the agriculture, environment & forests, welfare, power, and finance ministries, the Planning Commission, the Indian Council for Agricultural Research, the CWC, and the CEA as members.

At the time of Plan formulation, the Planning Commission also constitutes separate Working Groups for Major & Medium Irrigation, CAD, Floods & Minor Irrigation to review the performance of the sector and recommend targets and outlays for the Plan under consideration.

The Planning Commission and the CWC issues from time to time guidelines to the states on detailed project report preparation. The 1980 guidelines of the CWC in this regard are noteworthy.

With the enactment of the Forest (Conservation) Act in 1980 and the Environmental (Protection) Act in 1986, major and medium projects required the clearance of the Ministry of Environment and Forests (MoE&F) before the Planning Commission could accord investment clearance. In February 1992, the Planning Commission wrote to the states to set up multidisciplinary bodies to process irrigation projects with the assistance of the Central Design Organisation in the states.

The guidelines for submission of project reports have been revised from 1 July 2002 to bring in the concept of 'single window' clearance. Hitherto, state governments used to submit detailed project reports to the CWC and after getting it technically accepted by the Advisory Committee, approach the MoE&F for statutory clearances. Thereafter the Planning Commission was requested for investment clearance. In the 'single window' concept, state governments will approach the CWC with a preliminary report for 'in principle' clearance. Thereafter they will approach the MoE&F and other ministries for statutory and other clearances. The preparation of the detailed project report is then taken up. Thus after technical acceptance of the proposal by the Advisory Committee following an approval in the CWC, the Planning Commission can issue investment clearance immediately. This revised procedure is expected to address the situation where a large number of technically cleared projects are pending for approval due to want of statutory clearance.

In November 2000, the Planning Commission empowered state governments to themselves clear major and medium irrigation projects on intrastate rivers which do not have interstate ramifications.

Economic Criterion for Acceptance of Projects

Prior to independence, irrigation projects were mostly diversion structures meant for protective irrigation. The projects were selected on the financial return criterion which is calculated on the basis of capital invested, working expenses, water charges, and betterment levy realized. The criterion indicates a certain percentage return on the invested capital which varied from time to time (6 to 3.75 per cent).

After independence, with the taking up of storage projects the accent shifted to productive irrigation. It was felt that the development of irrigation was handicapped by the rigid application of the financial return criterion. The Planning Commission initiated studies in 1958 of some major projects which showed that large benefits accrued from irrigation projects in terms of double cropping, diversification of crops, larger income of farmers, increase in employment opportunities, growth in processing industries, etc. The total benefits to society at large were far more significant than the financial returns accruing to the government. It was, therefore, felt that the benefit–cost ratio should replace the financial return criterion. For the sake of simplicity, only the direct quantifiable benefits of increased crop production were considered. A benefit–cost ratio of 1.50 was considered as the minimum required for irrigation projects. (A lower benefit–cost ratio of 1.00 was later accepted for projects benefiting drought prone areas.)

The Research Programme Committee set up in 1964 by the Planning Commission under the chairmanship of D.R. Gadgil endorsed the above approach. The then Ministry of Irrigation in a communication to the states in January 1966 conveyed that a project should be considered worthwhile only if the benefit–cost ratio is not less than 1.5. The Irrigation Commission in its report of 1972 also opined that the economic criterion was more suitable than the financial return criterion.

With a view to review the existing criterion for working out the benefit–cost ratio, the Planning Commission constituted in December 1981 a committee under Nitin Desai. In its report in February 1983, the committee suggested a different methodology for project evaluation by considering opportunity cost, adjustment for social cost of agricultural inputs and outputs, consideration of non-agricultural benefits, distributional effects, employment generation, internal rate of return, etc. It is proposed to adopt this methodology in future for project appraisal.

In pursuance of the National Water Policy (2002), the Planning Commission in November 2003 further relaxed the benefit–cost ratio criterion from the requirement of 1.5 to 1.0 in the case of special category states (north eastern states, Jammu and Kashmir, Uttaranchal, Himachal Pradesh) and also for projects where 100 per cent of the beneficiaries belong to the scheduled caste/ scheduled tribe category or 75 per cent to the scheduled tribe category. This is a step towards distributional and regional development goals.

Water Pricing

Water is both an economic and social good. Water is used for irrigation as an economic good and its logical pricing is a key to improving water allocation and encouraging conservation. During pre-independence, irrigation projects were constructed and operated as financially viable ventures. After independence, they were viewed as instruments of development and social benefits. The present canal water rates in the states is still area based depending on crop and season. There is a vide variation in the rates even for the same crop among the states. The water charges are very low and have not been revised for many decades in many states. In some states, water is supplied free. Table 3.7 below brings this out clearly.

TABLE 3.7: Water Charges

(Rs/ha)

State	Kharif Rice	Rabi Wheat	Sugarcane
Andhra Pradesh	494	494	494
Assam	140.6	281.2	111
Bihar	175	150	370
Haryana	113.1	91.4	148.2
Himachal Pradesh	24.3	14.6	41.1
Madhya Pradesh	215	235	800
Maharashtra	320	320	4230
Orissa	100	85	250
Uttar Pradesh	287	287	474

Source: Same as Table 3.1.

From the figures of gross annual receipts and working expenses of major and medium projects for the period 1974–5 to 1986–7, the gross recoveries as a percentage of working expenses went down from 85 per cent in 1974–5 to about 42 per cent in 1986–7. The situation in minor irrigation is even worse going down from 10 per cent in 1975–6 to about 2 per cent in 1986–7. The revenue receipts have been low due to the following reasons:

- very low water tariffs and reluctance of state governments to review and increase the rates to keep pace with rising capital and O&M costs;
- inefficiency in revenue collection organizations—waiving off water charges during drought;
- high levels of working expenses, especially on establishment; and
- present method of charging for water on area crop basis instead of volumetric basis—lack of incentives to farmers for saving water.

The Irrigation Commission (1972) recommended that water rates should be 5 to 12 per cent of the total value of farm produce, the lower percentage being applicable to fodder and food crops and the higher for cash crops. Several finance commissions have been recommending rates linking them to annual O&M costs and some percentage of capital cost.

In October 1991, the Planning Commission appointed a committee on pricing of irrigation water (Vaidyanathan Committee) to go into the whole gamut of issues related to water tariff. The Committee in its report of September 1992 recommended a two-part tariff, in the first phase, comprising a fixed charge of Rs 50 applicable to the entire command area as a membership charge and a variable charge per hectare of irrigation to recover annual O&M cost and 1 per cent of the capital cost. The change was to be brought about in three phases, ultimately leading to rates on volumetric basis with improvement of existing systems, creation of autonomous, financially self-reliant entities at the system level with participatory management by the users. The Committee also suggested that while full volumetric charges would take time to implement, a beginning could be made by shifting from the present crop-specific, area-based rates to rates related to area irrigated in each season (irrespective of the crop grown) so that differences in irrigation requirements between seasons are captured. For domestic and industrial uses, the Committee recommended that the costs of supply of water should be fully recovered through appropriate volumetric rates and arrangements should be built into the supply contracts for ensuring full and prompt recovery of dues.

A Group of Officers was appointed by the Planning Commission to examine the Committee's recommendations. While generally endorsing the various suggestions of the Committee, the Group did not favour the fixed charge part of the water tariff. The Committee's report was circulated to all the states.

In August 2000, the Planning Commission compiled information from a few states on the revenue realization from water charges and establishment component in O&M allocation. The data collected was very discouraging. Data for a typical year 1997–8 is presented below.

TABLE 3.8: Revenue Realization from Water Charges and Establishment Component in O&M Expenses

State	Percentage of O&M Allocation Required for Establishment	Percentage of Revenue Realized against O&M
Andhra Pradesh	47.6	64.2
Assam	89.9	0.01
Gujarat	54.9	34.6
Haryana	82.9	34.7

Source: Same as Table 3.1.

Floods

Devastation by floods has become a recurrent annual feature in India especially in Assam, Arunachal Pradesh, north Bihar, coastal Orissa, eastern Uttar Pradesh, and north Bengal. Floods cause loss of life, enormous damage to property (public and private), and disruptions to infrastructure. An area of 7.56 m.ha. is affected annually of which 3.55 m.ha. is cropped area. Annually, 1.2 million houses are also damaged. The annual loss is estimated as Rs 13.47 billion. Total flood prone area in the country has been assessed as 40 m.ha. of which 15.29 m.ha. has been afforded reasonable degree of protection through construction of 33,630 km of embankments, 37,904 km of drainage channels, 2337 town protection works, and raising of 4705 villages above flood levels. Table 3.9 below gives the investments made in the flood sector over various Plans.

TABLE 3.9: Investments for Flood Protection in Various Plans

(Rs billion)

Plan	Investment
First	0.1321
Second	0.4806
Third	0.8209
Annual (1966–9)	0.4196
Fourth	1.6204
Fifth	2.9861
Annual (1978–80)	3.2996
Sixth	7.8685
Seventh	9.4158
Annual (1990–2)	4.6064
Eighth	16.9168
Ninth	24.5784
Total	73.1452

Note: The approved Tenth Plan outlay is Rs 46.2 billion.
Source: Same as Table 3.3.

Rashtriya Barh Ayog (National Flood Commission) was constituted in 1976 to review and evaluate the flood protection measures undertaken since 1954 and to evolve a comprehensive approach to the problem of floods. The Commission made 207 recommendations covering need for flood-plain zoning, prevention of unauthorized riverbed cultivation, proper reporting of flood damage data, launching of special flood-prone area programme, and preparation of an integrated master plan for river basins covering optimum utilization of land and water and flood control.

The CWC is maintaining a network of 134 flood forecasting stations in the country besides inflow forecast for 25 major reservoirs. On an average about 6000 forecasts are issued every year of which 98 per cent are within prescribed accuracy limit.

Flood problems in India have their origin in neighbouring countries like China, Nepal, and Bhutan as most of the flood-prone rivers are international rivers. Construction of storages in upper reaches is therefore the only long-term solution which can be put to multifarious uses including flood control.

National Water Policy

The NWRC was constituted in March 1983 under the chairmanship of the Prime Minister with the main mandate of laying down the National Water Policy. The Council adopted a National Water Policy in September 1987. This Policy was updated and revised in April 2002 and was also adopted by the Council. The Policy lays down the road map for water resources development in the country. The allocation priorities, namely, drinking water, irrigation, hydropower, ecology, agro industries, and navigation in that order have been laid down. The Policy covers project planning, groundwater development, drinking water, information system, institutional mechanism, irrigation, resettlement and rehabilitation, financial and physical sustainability, participatory approach, private sector participation, water quality, water zoning, conservation of water, flood control, land erosion by sea and rivers drought, monitoring, water sharing, performance improvement, maintenance and modernization, safety of structures, science and technology, and training. The state governments are expected to formulate similar state water policies. Some states like Uttar Pradesh and Karnataka have already done so.

National Commission for Integrated Water Resources Development

In September 1996, the Ministry of Water Resources constituted a high powered commission called the National Commission for Integrated Water Resources Development under Member, Planning Commission to prepare an integrated water plan for development of water resources for drinking, irrigation, industrial water supply, flood control, etc. In its report in September 1999, the Commission presented a comprehensive overview of the water sector in India and made several useful recommendations like prioritization of on-going projects and raising of water charges. The report has also focused on environmental issues like water quality and formation of river basin organization for integrated basin planning. The report serves as a good data base for the various facets of water resources development. Follow-up action on the various recommendations made in the report is being taken by the MoWR.

Water Supply and Sanitation

The National Water Supply and Sanitation Programme was launched in 1954 during the very First Five-Year Plan. Progressively larger allocations were made for these sectors in the succeeding five-year plans. The importance of providing safe water supply and sanitation as basic minimum need was reiterated in the Fifth Five-Year Plan. Rural water supply was included as a component in the Minimum Needs Programme. The Sixth Five-Year Plan was launched at a time of increasing national and international concern for safe drinking water supply and sanitation.

The drive received further impetus when the 1980s was designated as the ‘International Water Supply and Sanitation Decade’. Initial objectives were 100 per cent population coverage with safe drinking water supply facilities in urban and rural areas, 80 per cent sanitation coverage in urban areas, and 25 per cent in rural areas. Keeping in view the ground realities these targets were later scaled down. The World Summit for Children in 1990 set the goals of achieving safe drinking water and sanitation to all by the year 2000.

In 1977–8, the GOI launched a new centrally sponsored scheme for accelerated rural water supply. In 1986, the National Drinking Water Mission was launched as a part of the scheme. In October 1999, a separate department was created for rural drinking water and sanitation. In 1986, a new centrally sponsored rural sanitation programme was also launched. Due to resource constraints, urban water supply and sanitation were not given importance till the Eighth Plan when two centrally sponsored schemes were launched for urban water supply and low cost sanitation.

The total investment by states has grown from Rs 430 million in the First Plan (1.28 per cent of public sector outlay) to Rs 186,240 million (2.16 per cent of public sector outlay) in the Ninth Plan. Similarly in rural water supply and sanitation, the investments have grown from Rs 60 million (0.18 per cent of public sector outlay) to Rs 2,09,140 million in the Ninth Plan (2.43 per cent of public sector outlay). The most recent Plan outlays are shown in Table 3.10.

TABLE 3.10: Recent Plan Outlays for Water Supply and Sanitation

(Rs millions)

Plan	Rural Water Supply	Rural Sanitation	Urban Water Supply	Urban Sanitation
Eighth	51000	3800	3380	1500
Ninth	81500	5000	6440	2200
Tenth	132450	9550	9000	2000

Source: Same as Table 3.3.

Rural Water Supply and Sanitation

The country has 1,422,664 habitations of which 1,339,828 (94.2 per cent) have been fully covered under the rural water supply programme with the required norms of 40 litres per capita per day (lpcd). Another 75,632 (5.3 per cent) have been provided with 10 to 40 lpcd while 5759 (0.5 per cent) are yet to be covered. Full coverage was envisaged by 2004 but this may slip to 2006 or even 2007 as many of the uncovered habitations are in remote areas without access to any source.

Rural sanitation coverage is very low in India—only about 28 per cent. There is a direct relation- ship between water, sanitation, and health. Consumption of unsafe drinking water, lack of sanitation, and lack of personal and food hygiene have been the major causes of many diseases. Prevailing high infant mortality rate is also largely attributed to poor sanitation.

A baseline survey on knowledge, attitudes, and practices conducted in 1996–7 showed that 55 per cent of those with private toilets were self-motivated. Of the total respondents 51 per cent were willing to spend up to Rs 1000 to acquire sanitary toilets. Keeping the above in view, Total Sanitation Campaign on demand driven mode was launched in 1999. Emphasis was given to Women Sanitary Complexes, School Sanitation, and Sanitary Marts. The targets and achievements have been reported in Table 3.11.

TABLE 3.11: Total Sanitation Campaign: Target and Achievements

Rural Sanitation	Target	Achievement till June 2004
i) Individual household toilets	31.45 million	7.7 million
ii) Sanitary complex	24,150	2525
iii) School toilets	3,36,764	75,369
iv) ‘Balwadis’ (creche)	52,568	12,077
v) Rural sanitary mart	2666	2243

Source: Same as Table 3.1.

Urban Water Supply and Sanitation

The prevailing norms require that towns with piped water supply but without sewerage be provided with 70 lpcd, cities with piped water supply and sewerage system with 135 lpcd, and metros/mega cities with 150 lpcd. Although 89 per cent of urban population is covered by water supply, the supply is intermittent, water quality is poor in some areas where sewage contamination occurs, and water tariff is so low that even O&M charges are not covered. ‘Unaccounted for water’ is a major problem in most urban areas and losses up to 30 per cent due to leakage, pilferage, etc. are not uncommon. Under central funding 1037 towns have been sanctioned so far of which 298 have been completed. According to the Census of India 2001, out of a total of 53.69 million urban households, 38.86 million households had tap water sources (26.67 million within the premises, 8.08 million near the premises, and 2.09 million away from the premises) with the remaining procuring water from other sources like hand pump.

As compared to rural sanitation, the situation in regard to urban sanitation is far more satisfactory as 63 per cent of urban households have toilets. However, only about 30 per cent have sewerage connection and the rest adopt various other means of disposal like septic tanks. The practice of carrying of night soil on head is more an urban problem than a rural one. The central government has a scheme, 'Integrated Low Cost Sanitation', for towns having a population of less than 5 lakhs (1981 census). A survey by the National Sample Survey Organization (NSSO) in 1989 showed that 5.4 million dry toilets need conversion and 7.3 million new ones are to be constructed. The operation of this scheme, which is a mix of subsidy, loan, and beneficiary contribution, has been undertaken by HUDCO. So far HUDCO has completed 1.7 million conversions/new construction in 1532 towns.

River pollution can be directly linked to urban sewage treatment coverage. It is estimated that 22,900 mld of urban sewage is generated in the country of which 9000 mld is generated in 23 metro cities alone. Only 30 per cent of this is treated.

Another area of concern is urban solid waste management. About 81,000 tonnes of municipal solid waste is generated in urban areas every day. The concept of sanitary landfill does not exist. Most of the garbage is dumped in open landfills causing environmental problems and groundwater pollution. Conversion of municipal waste to energy has been tried only in a few places like Vijaywada, Hyderabad, Lucknow but with limited success. Initial screening of solid waste for biodegradable and recyclable material is a must before conversion to energy. Most municipalities do not have facilities for such screening.

Role of the World Bank in Irrigation Development and Water Supply Sanitation in India

The World Bank has been trying out different lending models in the irrigation sector in India. In the 1970s single project funding like Nagarjunasagar, Subarnarekha, Upper Krishna Stage I involving funding of some slice of the dam and canal systems was favoured. This was followed by composite project lending where a group of projects in a state were identified, for example, Gujarat Composite, Maharashtra Composite. During this period, some rehabilitation projects were also included like Dam Safety Assurance & Rehabilitation and National Water Management Project. All these projects were not in a real sense linked to any reforms like hiking of water charges, formation of water user associations, raising of power tariff, formation of river basin organizations, or restructuring of state irrigation departments.

In the 1990s the Bank moved away from funding of construction to making existing infrastructure work more efficiently. This approach is considered by the Bank to be in line with its objective of poverty alleviation. Water resources consolidation projects were taken up in Haryana, Tamil Nadu, and Orissa and water sector restructuring projects in Rajasthan and Uttar Pradesh. Projects in Madhya Pradesh and Maharashtra are in the pipeline. Engaging of stakeholders and seeking agreement from states for a package of reforms are the main features of this type of funding. In a few isolated cases, the Bank has continued lending for new constructions, for example, Andhra Pradesh Irrigation Project Phase III.

During the Ninth Five-Year Plan, the following assistance was received in the irrigation sector:

TABLE 3.12: World Bank Assistance to Irrigation Section in India during Ninth Plan Period

	Million US$
i) AP III	131.51
ii) APERP (Irrigation)	57.99
iii) Haryana WRC	131.69
iv) Upper Krishna II	3.46
v) Punjab Irrigation & Drainage	37.97
vi) Orissa WRCP	145.50
vii) Tamil Nadu WRCP	131.69
Total	639.81

Source: Same as Table 3.1.

At Rs 48 per US$, this works out in rupee equivalent to Rs 30,710.88 million or Rs 30.71 billion. The total expenditure on major and medium irrigation in the Ninth Plan was Rs 482.59 billion. Thus the World Bank assistance formed only 6.4 per cent of the total expenditure. It might have been of the same order in earlier Plans also.

In the rural water supply sector, the Kerala, Maharashtra, and Karnataka projects are ongoing. The 'Swajal' rural water supply and sanitation project was successfully completed in Uttar Pradesh and Uttaranchal. In the urban sector, the Mumbai Sewage Disposal Project and Chennai Water Supply and Sanitation Project II were completed with Bank assistance. Mumbai Sewage Disposal II and Chennai Water Supply & Sewage III are under consideration. It may be seen that unlike the irrigation sector, the intervention of the Bank in the water supply and sanitation sectors has not been very significant.

Issues in Focus and Prospective Plans

As we survey the present water scenario in the country, the concerns that come into focus are:

- forcasts of water scarcity or water crisis and related problem of food security;
- problems of drought-prone areas, climate changes;
- recurring flood-related damages in north Bihar, West Bengal, Orissa, and eastern Uttar Pradesh;
- plethora of incomplete irrigation projects;
- low cropping intensity even in irrigated areas;
- interstate water sharing conflicts;
- international issues—Pakistan, Nepal, Bangladesh, Bhutan;
- interlinking of rivers;
- conflicts due to competing water demands (agriculture and drinking water, agriculture and power, rural and urban demands);
- depletion of groundwater aquifers, subsidized power for agriculture;
- pollution of rivers, urban sanitation, and solid waste management;
- low efficiency of water use in agriculture and water supply, low levels of tariff;
- organizational issues—subject of water dealt in too many departments, slow pace of formation of water user associations; and
- weak database on irrigation statistics.

Water Stress and Scarcity

The temporal and spatial variability of rainfall in India is a well-recognized fact. The average annual precipitation is 1170 mm but varies from 11,000 mm in the north eastern region to 100 mm in the western desert. Fifty per cent of the precipitation takes place in 15 days or so and less than 100 hours altogether in a year. In a monsoon-dependent rainfall environment, 90 to 95 per cent of the flows in rivers occur in the four months of June to September.

The per capita availability of water has been steadily declining since independence from 6008 m^3 to 1829 m^3 as of now. A water availability of less than 1700 m^3 per capita is termed as a water stress condition while less than 1000 m^3 is water scarce. Broadly, the breakdown of 1000 m^3 is 600 m^3 for food security, 200 m^3 for domestic and industrial needs, and 200 m^3 for ecology and minimum flows. While on an average, India is not water stressed, many basins like Pennar and Sabarmati are already water scarce. The abundant untapped flows of Brahmaputra and Ganga push up the average and create a false sense of complacency on the water front.

Considering the hydrological situation India is placed in, importance of storages to conserve monsoon run-off needs no emphasis. One of the main reasons for water problems in the country is the low per capita storage (only about 200 m^3) as compared to Russia (6103), Australia (4733), Brazil (3145), Turkey (1739), Mexico (1245), Spain (1410), China (1111), and South Africa (753). For water stress to be avoided, a minimum per capita storage of 750 to 1000 m^3 needs to be achieved. India has no option but to go ahead with its dam construction programme. So far 177 BCM storage has been created and another 77 BCM is from projects under construction. Planned projects will add another 132 BCM. All this totals up to not even 400 m^3. Supplemental measures like transbasin water diversion, water conservation, rainwater harvesting, etc. would need to be adopted to make up for the deficiency in storage. There is also concern about the indiscriminate mining of sand from river beds in some states leading to groundwater depletion.

Incomplete Irrigation Projects

The Planning Commission has recently completed an exercise to identify the numbers, balance–cost, and balance potential of on-going major and medium irrigation projects in the country. There are 388 such projects (169 major and 219 medium) with a balance–cost as on April 2004 of Rs 902 billion and a balance potential of 13.05 m.ha. Some of the reasons for this situation are:

- irrigation being a state subject, state governments had taken up a number of projects on the plea of removing regional imbalances;
- the outlay for irrigation in state plans has declined from 23.25 per cent in the Fifth Plan to 16.5 per cent in the Ninth Plan leading to thin spread of resources; and
- project completion got delayed due to land acquisition problems, contractual problems, rehabilitation issues.

State governments are being advised not to take up new projects in the Tenth Plan but concentrate on completion of on-going projects first. In fact, the Planning Commission itself considered a 'plan holiday' for new investments to discourage new projects. They have also been advised to target central assistance under the Accelerated Irrigation Benefits Programme to the old projects. One of the thrust areas in the National Common Minimum Programme is to increase public investment in irrigation.

Sometime back, in early 1990s, a proposal called 'National Projects' was mooted by the Ministry of Water Resources. Large projects (some interstate) like the Indira Gandhi Canal, Sardar Sarovar, Indira Sagar, Teesta Canal, which were progressing slowly and were beyond the resource capability of the states were proposed to be fully funded by the central government for their early completion. However, the Planning Commission was not in favour of this. It appears that this proposal needs a re-look if large projects are to be expeditiously completed.

Interstate Water Conflicts

Interstate conflicts over water sharing has been the bane of water resources development in the country. Tribunals have been constituted in the past for Narmada, Godavari, and Krishna. Tribunals for Cauvery, Ravi–Beas, and Krishna (second tribunal) are presently engaged in adjudication. Although time limits have now been prescribed for tribunals, the adjudication process is still a long drawn affair. Tribunal decisions are interpreted differently by co-basin states and this again leads to disputes in operation of the award. Setting up of a new tribunal takes time due to administrative and logistic problems. Mechanisms set up to implement the award at bureaucratic/political level face difficulties in reaching a consensus decision. Constitution of a standing tribunal to adjudicate both on a water dispute as also interpretation of tribunal awards and interstate agreements perhaps could be a solution and merits serious consideration.

River Basin Organizations (RBOs)

The National Water Policy advocates establishment of RBOs with multidisciplinary units for the planned development and management of a river basin. For interstate rivers, state governments have been wary of agreeing to setting up of RBOs. For intrastate rivers like in Tamil Nadu under the Consolidation Project, the World Bank has been able to facilitate a first few steps which aim at getting a few RBOs set. For Cauvery and Krishna, the tribunals set up are likely to recommend setting up of a Valley Authority for smooth implementation of the awards. The main issue is not organizations but instruments—what are rights and responsibilities? Integrated Water Resources Development and Management with a river basin as a unit can only be achieved through an RBO. The central government must do everything that is possible to persuade the states in this direction.

Water Pricing

Supply of low-cost water to agriculture and drinking water sectors is a hidden subsidy to these sectors. This is leading to inadequate funds for maintenance and lack of funds for augmentation of infrastructure. Politically, state governments find it difficult to revise water charges. Similar to the electricity side, where state electricity regulatory commissions have been set up, there is need for a water tariff regulator in each state to periodically revise both irrigation and drinking water charges. The regulator will keep all factors in view like cost of supply, cost of maintenance, farmers' income, etc. in making recommendation. The CWC is working on a model for such a regulator. The Planning Commission will also pursue this with the states. The Government of Maharashtra has taken the lead on this.

Groundwater Issues

The time has come for quick reforms in regard to groundwater through a combination of legislative measures, appropriate power tariff, rainwater harvesting and prevention of pollution of groundwater sources. Cheap or free power to the agriculture sector is the single most contributory factor to the groundwater situation in the country. In other countries pricing alone has not solved the problem. There is no easy solution. It requires pricing but also the formation of aquifer associations, and clarity on and limits to groundwater rights. The Central Ground Water Board has prepared an outline master plan for rainwater recharge at a cost of Rs 245 billion for the whole country. This is yet to be fully evaluated. The master plan has not been taken up for implementation due to paucity of funds. Some recharge schemes have been announced in the budget of the year 2004–5.

Public Private Partnership

Private sector participation in surface irrigation (groundwater irrigation is almost all private) has been conspicuous by its total absence. The reasons for this are not surprising. It costs Rs 100,000 to develop 1 hectare of new potential in major and medium irrigation projects. Even at 10 per cent interest on capital, the annual interest charges work out to Rs 10,000 per hectare. Compared to this, the water charges are only a few hundred rupees per hectare. A promoter will thus not be able to meet even the interest liability with the water charges he recovers. Other countries have gone for 'reverse concessions', in which private operators are chosen on the basis of the operator who requires the smallest subsidy.

In 1995, the Ministry of Water Resources appointed a high level committee on private sector participation in irrigation and multipurpose projects under the chairmanship of the union minister of state for water resources to examine the feasibility of private sector participation in irrigation development. The committee recommended introduction of the concept on a pilot basis. The Planning Commission constituted a separate working group for the Tenth Plan on Private Sector and Beneficiaries Participation. The working group also felt that the concept needed to be tried out on a pilot basis.

It appears that presently only some aspects of irrigation can be privatized, namely:

- development of pisciculture in reservoirs;
- maintenance of recreation parks at dam sites;
- advertising hoardings on canal bank roads;
- development of plantations along canal banks; and
- development of canal head hydropower.

In the water and sanitation sectors, there are apprehensions about large-scale privatization of urban water supply. These relate to possible steep hike in water tariff or non-availability of water for the urban poor residing in slums as evident from the Cochabamba experience in Bolivia. Billing for water or maintenance of pay-and-use toilets are perhaps some of the areas that can be privatized. There is, in fact, a massive private industry—tanker trucks—and another large private industry of sinking boreholes, and providing in-house storage—to make up for the deficiencies in supply.

Irrigation Water Use Efficiency

At the planning stage, irrigation efficiency (at the field level—the basin level is different, of course, and often much higher since one person's losses are another's recharge!) is assumed as 55 to 60 per cent but in actual practice, the efficiencies obtaining on the ground are around 30 per cent or even lower. Unfortunately no scientific study of overall irrigation efficiency in large systems is available. The Planning Commission commissioned Water and Power Consultancy Services (WAPCOS) for two studies—the Upper Ganga Canal in Uttar Pradesh and the Western Yamuna Canal in Haryana. The results show overall efficiency in the order of 45 to 48 per cent which seems to be on the high side. A recent basin-wise study based on potential evapotranspiration and withdrawals for irrigation shows efficiency in the range of 26 to 27 per cent (Krishna, Godavari, Mahanadi, Cauvery) and 43 to 47 per cent (Indus, Ganga) with overall 37.7 per cent for the country as a whole.

Irrigation efficiencies are low in the country due to a combination of factors—low water tariff, poor state of canal system due to lack of maintenance, absence of rotational supply, and 'use it or lose it' implicit right, etc. About 20 to 25 m.ha. area of irrigation network needs modernization as the canal systems are dilapidated due to neglect in maintenance. There are no incentives to state governments for improving water use efficiency.

The Ministry of Water Resources is planning to take up efficiency studies in some select sub-basins/basins. The Planning Commission could also consider incentives to states which improve water-use efficiency. Needless to emphasize, water-use efficiency has to be viewed along with farmer turnover of irrigation systems, systems rehabilitation, and rotational supply of water. Volumetric supply, though desirable, will still take some more time to implement as canal systems do not have requisite measuring devices to implement this. Greenfield projects offer a great opportunity to implement more advanced delivery of water.

The concept of benchmarking of irrigation systems is fast gaining acceptability. Assessing and monitoring of irrigation efficiency is one of the objectives of benchmarking. Recently INCID has brought out guidelines for benchmarking irrigation potential developed is another indicator of system performance. The Bank played a major role in this.

Dam Safety

There are 4050 dams in the country. Another 475 are under construction. About 340 dams are more than 50 years old. Another 400 are 40 years old while 2000 dams are about 30 years old. Safety concerns for some of the old dams have arisen which are showing signs of distress. About 50 dams in Madhya Pradesh, Orissa, Rajasthan, and Tamil Nadu were rehabilitated under the Dam Safety Assurance and Rehabilitation Programme aided by the World Bank. 188 distressed dams have been identified for rehabilitation.

Drinking Water Supply and Sanitation

Rural drinking water supply is beset with the twin problems of slippage of habitations from fully covered to partially covered and from partially covered to not covered and water quality problems. (If a per capita supply of 40 lpcd is ensured, the habitation is fully covered. If the supply is between 10 lpcd and 40 lpcd, it is partially covered and below 10 lpcd is not covered.) Out of the 1,422,664 habitations in the country, 216,968 are quality affected by fluoride (31,306), arsenic (5029), salinity (23,495), iron (118,008), nitrate (13,958), others (25,091). Some of the water quality problems are geogenic (fluroride, arsenic, iron) and others are anthropogenic (fertilizer, sewage). There are 350,000 handpumps in the country and 116,000 mini water supply schemes. The ultimate solution is to convert substantially the hand pumps to surface water supply schemes. In urban areas, the problems are intermittent and low supply, pollution of water lines by sewer lines, uneven distribution of supplies, low water tariff and lack of funds for augmentation.

The problem of manual scavenging of night soil is a malaise of urban areas and is planned to be rooted out by the end of the Tenth Plan. The Planning Commission has prepared an Action Plan for this covering identification of manual scavengers, modification in guidelines for the HUDCO scheme to make it more flexible, involvement of NGOs and taking required legal steps. Rural sanitation improvement is linked to constraint on funds and information and education among rural masses.

Organizational Issues

The subject of water is being dealt at the centre by many ministries/department as mentioned below:

TABLE 3.13: Administrative Fragmentation of Water Supply

Water Sector	Ministry/Department
Irrigation, Flood control, CAD, minor irrigation,	Ministry of Water Resources
Watershed programmes	Department of Agriculture Department of Land Resources Planning Commission
Investment clearance for irrigation projects, allocation of funds	Planning Commission
Hydropower	Ministry of Power
Drinking water and sanitation	Department of Drinking Water Supply Department of Urban Development
Navigation	Ministry of Shipping
Desalination technology	Department of Atomic Energy Department of Science and Technology
River conservation	Ministry of Environment and Forests

Source: Same as Table 3.1.

The Tenth Plan document advocates that MoWR be the nodal ministry of water. The Planning Commission and the MoWR are working together to operationalize this recommendation. There is also a proposal to set up a National Water Mission for inter-ministerial coordination.

Irrigation Statistics

While state irrigation departments report gross area irrigated each year, the land use statistics of the Union Department of Agriculture gives data on net irrigated area source-wise. The data of the irrigation department which appears in the Annual Plan documents of states is quoted by the MoWR and the Planning Commission. When data on net irrigated area is converted to gross by adopting an average irrigation intensity of 135 per cent, a large gap becomes evident between the two sets of data. The MoWR, the Planning Commission, and the Department of Agriculture need to identify sources of error and report consistent figures.

World Bank Funding—Some Suggestions

As far as the Bank is concerned, the switching from project to sector loans to states for water resources consolidation projects with stress on water resources management and focus on institutional development and reform has given the Bank greater leverage than before. This policy addresses only one area of concern in the water sector, that is, need for system rehabilitation. The other potential areas in water that the Bank could consider or expand their lending are listed below.

- medium irrigation projects especially ‘last mile’ projects on the lines of the medium line of credit earlier pursued for Orissa, Madhya Pradesh, and Gujarat;
- dam safety rehabilitation project—second phase;
- rehabilitation of tanks in Andhra Pradesh, Madhya Pradesh, Orissa, Maharashtra, West Bengal on the lines of the Karnataka project. A national water resources

development project to cover all tanks in the country is proposed to be launched;

- artificial recharge and rainwater harvesting. The CGWB has prepared a Rs 245 billion master plan for the country and components of this could be picked up in slices;
- rural water supply and sanitation to meet the resource gap in achieving the Millennium Development Goal targets;
- flood protection works—embankments, anti-erosion works in Assam, Bihar, Orissa, West Bengal, and Uttar Pradesh; and
- coastal protection—National Master Plan under compilation in the CWC based on proposals received from states.

4

World Bank Policies and Lending Assistance

R.P.S. MALIK

Water resource development and management are critical to the World Bank's strategic objectives of sustainable growth and poverty reduction. Lending for water constitutes one of the most important components of World Bank lending. Lending for projects with significant water components have constituted about 12 per cent of the World Bank annual lending portfolio in the recent past, though there have often been marked variations in this lending proportion from year to year. The Bank has been lending not only for development of water resources but has been laying an overwhelming emphasis on more efficient service delivery and management of water. The World Bank lending has played a key role in developing countries and lending water has contributed significantly to economic growth, poverty reduction, and improved living conditions of the population in these countries. With growing water scarcity in a large number of countries, the demand for World Bank engagement in providing financial and technical assistance, in framing of laws and regulations governing water extraction and use, and in developing institutional frameworks for managing water resources, etc. is growing.

The development and efficient use of water resources have emerged as one of the most critical and challenging issues facing India. The country spends huge amounts of public and private money on the water sector and receives substantial funds for the sector from bilateral and multilateral development agencies. The World Bank has been one of the important external partners in this endeavour, though compared to total overall water sector investment in India, the share of the Bank's resources is small—less than 10 per cent. In fact India, China, and Brazil are the three largest World Bank borrowers for development and management of water resources. India's association with World Bank water sector lending dates back to 1954 when India received its first World Bank lending for the Damodar Valley Project. The World Bank also played a key role in India's signing of the Indus water treaty with Pakistan.

The present paper briefly reviews the evolution of World Bank water policies over the years. It then analyses the progression of these polices and approaches to water lending in India and presents a brief review of how effective World Bank lending for water in India has been. Using the Water Resources Data Base, the paper then analyses the magnitude and compass of lending for the water sector in different regions of the world during the period 1993–2004 and analyses the pattern and nature of lending for water in India in the broader global context of lending for water. The paper also gives in brief the expected shifts in World Bank lending for water in India as contained in the just approved Country Assistance Strategy (CAS) for India for the period 2005–8.

The paper draws mainly on material from several World Bank documents. A number of evaluation studies carried out from time to time by the Operations Evaluation Department (OED) of the World Bank provided most of the material for the present study.

Evolution of the World Bank's Lending Policies in the Water Sector

The World Bank's huge investments in water resources has played a major role in the Bank's efforts to help countries reduce poverty and upgrade living conditions of their population. In this section we briefly give an overview of how policies, procedures, and programmemes associated with the World Bank water-lending sector have evolved over time. Although the Bank has been providing water sector lending from the early years of its inception, the associated operational policies governing water lending have evolved over time, the Bank did not have a formal water policy document until early 1990s. The first formal water strategy by the Bank was formulated in 1993. The issuance of water strategy embodied in the 1993 Water Resources Management Policy Paper (World Bank 1993) formed a significant consolidation of various policies, procedures, and experiences and an important turning point in the Bank's approach towards water-lending sector. For the discussion on the evolution of water policy, we therefore demarcate two distinct policy phases—prior to and after issuance of 1993 policy document.

Bank Policies in Water Sector Prior to 1993 Policy Paper

We briefly discuss separately the policies for irrigation and water supply and sanitation in this phase.

Irrigation Sector[1]

Lending for irrigation accounted for 7 per cent of the total Bank lending during the period 1950–93. During this period the Bank supported 614 projects with irrigation components. In absolute terms the lending for irrigation during this period amounted to US$31 million at constant prices. As already mentioned, while the Bank did not have a formal irrigation policy document prior to the issuance of 1993 Policy Paper, the lendings during the pre-1993 period can be divided into three policy periods marked successively by an emphasis first on infrastructure (1948–71), then on agricultural expansion (1972–81), and finally on consolidation (1982–94) (World Bank 1994).

During the 1950s, most of the irrigation lending was made primarily for the construction of dams and the main distributary canals. Realizing that investments in canals and dams alone were not enough to derive the full benefits of irrigation, in the early 1960s the irrigation lending expanded to include complementary investments needed to make the investments in canals and dams more effective. The lending was thus extended to include such activities as on-farm works, input supplies, extension, roads, processing and marketing, research, credit, and training. Lending for irrigation continued to expand during this period but not nearly as rapidly as for agriculture as a whole. As a result irrigation's share of agriculture lending fell from 77 per cent in the financial year (FY) 1948–63 to 44 per cent in FY 1964–68 and to 34 per cent in FY 1969–71. The 'hardware' element in agricultural lending was declining and non-hardware projects were gaining share at irrigation's expense, and non-hardware was becoming a larger share of the irrigation projects themselves.

A notable feature of the lending even during this early period was that the Bank imbedded in the loan agreements water-charge policy which usually provided for recovery of O&M costs and at least partial recovery of investment costs (Waponhans 1969). During the earlier years the Bank also refused

[1] This section draws on World Bank (1994) besides other documents.

to lend for rehabilitation of irrigation projects. Rehabilitation was considered as something that borrowers should do with their own resources and rehabilitation was not seen truly an investment; to lend for rehabilitation would simply encourage poor maintenance. This policy, however, changed at some point in the late 1960s. That change proved important for Bank irrigation lending. It was recognized that it was arbitrary to separate rehabilitation from up-grading of existing facilities and from extending them.

In the second phase, 1972–81, the Bank issued several directives, which established the policy-making context. A number of these directives did not specifically aim at irrigation but applied in general to a number of projects. These included such policy directions as those relating to dam safety, precluding from proceeding on projects that might cause damage to riparian on international waters, involuntary resettlement, tribal people, involvement of beneficiaries and government agencies in identification and design of projects, etc. Based on these policy directives, twelve rural sub-sectors such as rural development, land reform, agricultural credit, and so on. were covered by policy papers during this period. The irrigation sector was however left out. It was argued that irrigation is the most variegated and site-specific sector of the Bank lending and there were few generalizations that applied to irrigation as a whole. Irrigation therefore needed a less formal approach to lending. The importance of drainage and greater cost recovery, however, continued to be stressed (Duane 1975).

During this period the Bank also continued to stress the recovery of O&M costs to promote adequate O&M. It also recognized cost recovery through mechanism other than water charges, such as land betterment levies and market taxes.

During the time of the consolidation phase of 1982–94, the Bank's irrigation lending had started to decline but not as a result of policy directives. As enthusiasm for rural development waned, the problem of acute food scarcity declined and marginal returns from irrigation declined due to fall in food prices, world investment in irrigation also slowed down. In Bank lending, the indistinct line between irrigation and other types of rural projects that was common in the 1971–81 period became sharper. Irrigation projects became easier to identify again with fewer tenuously related components in irrigation projects and fewer irrigation components hidden in the 'integrated' rural projects. Projects were more apt to cover the entire sector too and less to be limited to specific works at a specific site.

During this period several new policy directives were issued, of which a few were to ward off external criticisms aimed towards the Bank. Further, in addition to the earlier themes of cost recovery and drainage issues in the irrigation projects, new emphasis was added on better technical preparation of the projects and water management. Several new studies were undertaken on policies governing groundwater, institutions, management, world water demand, and cost recovery issues. The OED's first irrigation sector study (World Bank 1981b) highlighted the absence of uniformity in Bank irrigation cost recovery practice. An agriculture study 'Irrigation Water Charges and Cost Recovery Policies: A Policy Perspective' (1983) showed that project experience 'generally showed no association between water charges and water use'. It concluded that 'other factors are much more important in determining farmer's water management techniques at the field level. In short there was no empirical support for the theoretically correct argument that raising water charges to the long run marginal value of the water improves water-use efficiency. The working paper concluded '(i) in general the principles (of general policy) are sound and should continue to guide the Bank's efforts in this area; (ii) the evidence on implementation suggests, however, that more emphasis should be given to linking cost recovery with the operation and maintenance of irrigation systems'. It was subsequently decided that the 'Bank will lend for irrigation development only to those countries prepared to mobilize funds and make them available for the purpose of financing irrigation (including O&M costs)'.

The 1983 agriculture paper, however, failed to recognize that there are alternatives to assigning irrigation O&M to the government irrigation department, a public sector monopolist. It neglected to consider that O&M could be done by irrigators themselves or by other private parties. In retrospect, it is clear that these oversights were what led to the recommendation for water charges for the purpose of improving O&M, even while recognizing the absence of a connection between water charges and O&M.

Water Supply and Sanitation Sector[2]

The Bank commenced the financing of urban water supply and sanitation projects following the establishment of the International Development Association (IDA) in 1960. The first Bank lending operation in the water supply and sanitation sector was in 1961. By 1969, nineteen lending operations were already underway. Bank lending was from then on closely associated with two key UN targeting operations, namely, the UN Development Decade (1970–80) and the International Drinking Water and Sanitation (IDWS) Decade (1980–90). Both aimed to substantially increase water supplies and sanitation facilities worldwide. The UN Development Decade saw the launching of 109 projects, and a further 140 projects were initiated during the IDWS Decade.

Not all lending for water supply and sanitation during this period was addressed through freestanding projects in the sector. Urban development projects typically did provide funding for water supply and sanitation components to municipalities and specialized development agencies, while some agricultural projects financed rural drinking water supplies.

Operational Manual Statement (OMS) 3.72 issued in September 1978 set out the Bank's policy and general strategy for lending in this sector. Principal lending objectives were defined as:

- to achieve least-cost solutions to the governments' infrastructure needs, particularly to avoid costly investment mistakes in this heavily capital-intensive sector;
- institution-building, including ability to plan and implement national or regional programmes, mobilizing through adequate pricing policies the funds necessary for sector development, and staff training;
- acting as a catalyst for attracting increasing amounts of finance from other domestic and foreign sources to eventually contribute to financial viability; and
- providing access to water supply and sanitation to a larger proportion of the population, particularly lower income groups, with emphasis on the provision of a basic minimum supply of convenient, safe water, and adequate sanitation for all people in a community.

[2] This section draws on World Bank (1992).

Box 4.1 below contains a suggested definition of a typical Bank-financed water supply and sanitation project. It is based on the foregoing policies and strategies, and after reviewing staff appraisal reports. On that basis, the Bank lending in the sector did bear relevance to themes such as public sector management, environment, and poverty alleviation which were later included in the list of programmes of special operational emphasis; but these themes, especially the focus on poverty and the environment, had not acquired the prominence that they are supposed to have now in the design and execution of projects.

Hydropower

The Bank policy on power (including hydropower) required that any power project proposed for financing must be shown to be part of the least-cost programmes for meeting the demand which would develop at economically efficient price levels. Implicitly this approach incorporated all alternatives, including conservation measures, load management and efficiency improvement as well as new generating capacity of all forms, in an integrated strategy for supplying all worthwhile demand. Measures to mitigate environmental

> **Box 4.1: A Bank-financed Water Supply and Sanitation Project**
>
> A typical Bank-financed water supply and sanitation project should be a least-cost investment in physical infrastructure that is designed to respond to the policies and strategy for the sector in the country concerned. It will have the objectives of: (i) providing environmentally sound solutions to providing a 24-hour supply of potable water for a 5- to 10-year forecast population in urban areas and subsequent removal of residual wastewater; (ii) assuring an effective management system for the delivery and removal of existing and project-generated supplies; and (iii) identifying and applying sound economic and financial criteria to achieve these objectives after establishing adequate physical and financial mechanisms to provide water supplies and sanitation for those in poverty in the area(s) to be served.

impacts and compensate for social disruptions had to be fully reflected in the costs of power projects. Augmentation of power supply through hydropower generated by big dams, however, came under strong criticism by NGOs who believed that if there were an accurate accounting of all environmental and social impacts, including submergence of large areas of valuable land and displacement of large number of households, and full consideration of alternatives, rational decision-makers would decide not to build large dams and would rely on alternatives (Besant-John 1989).

The Water Resources Management Policy Paper 1993: A Strategy Overdue

The Bank's investments in the water sector during the pre-1993 period significantly contributed to development of water resources in its borrowing countries, in alleviating poverty and promoting food security through provision of irrigation lending, in developing least-cost solutions to infrastructure needs in the water supply and sanitation projects, and in encouraging production of least-cost supplies of electricity through development of hydropower. After decades of lending in the water sector, however, there was a realization within the Bank that the water sector was one of the poorest performing sectors in the Bank's investment portfolio. The OED sector reviews of irrigation and drainage (World Bank 1994) and water supply and sanitation (World Bank 1992) also pointed to the troubles with the water-lending portfolio of the Bank. The Waponhans Report of 1993 was also critical of the effectiveness of Bank lending in the water sector. Some of the relatively more important factors identified for the poor performance of the water portfolio of the Bank included:

- Both the irrigation and drainage sector and the water supply and sanitation sectors did not have either a comprehensive policy or detailed operational guidelines.
- Majority of the Bank operations focused on sub-sector development and failed to take a comprehensive view of inter-sectoral complementarities and interdependencies. Project evaluations were based on achievement of sectoral objectives and concerns for inter-sectoral allocation of water, downstream effects of water withdrawal, and rationing of water resource were generally overlooked.
- Although incorporated in the Bank loan covenants, there was a general failure in the Bank projects to adhere to the requirement of compliance with the provisions of cost recovery, and the implementation of water tariffs and charges, which were consistent with the principles of economic efficiency and social equity. However, a large part of the failure on this account was also due to policies and planning systems prevailing in the borrowing countries and their reluctance to bring in any changes in them and the Bank often succumbed to these pressures.
- Insufficient integration of engineering and social sciences jeopardized better irrigation service to people, lower unit costs, and water conservation.

- For irrigation and drainage sector, despite a marked shift during late 1980s towards sector loans and a definitive trend away from new construction towards rehabilitation of the projects, the issues of policy and institutions continued to be largely ignored.
- As a result of non-compliance with the principles of rational tariff setting and lack of incentive structures that enabled more participative institution structures, the financial sustainability of these investments became elusive.
- Poverty considerations were mostly bypassed in these lendings as the Bank responded to the powerful segments of the populations.
- The environmental issues were not addressed in most of the Bank projects.

To improve the efficiency of Bank investments in the water sector and help borrowing countries manage their water resources in a more holistic and efficient way, it was felt that there was a need for better policies and a strategic approach to guide the Bank's water investment and non-lending work. In response to such concerns and performance evaluation, work then began on 'Water Resource Management: A World Bank Policy Paper' which was published in 1993 (World Bank 1993). Water Resource Management is a comprehensive document, written with growing water scarcity in mind and, therefore, particularly relevant to irrigation in countries suffering from water scarcity. It advocates and pledges Bank support for a comprehensive approach to water resources and incentives for good management. The paper affirms the general desirability of marginal value pricing and recognizes the need for flexibility.

The Strategy paper recognizes that improving performance in meeting water needs requires borrowing countries to reform their water management institutions, policies, and planning systems. It also acknowledges that the Bank and the borrowing countries should adopt a new approach, which recognizes that water is a scarce resource, subject to many interdependencies in conveyance and use. Thus the twin requirements of comprehensiveness and country-specificity formed the basis of the new strategy. The guiding factors in formulation of this Strategy were (World Bank 1993):

- maximize the contribution of water to countries' economic, social, and environmental development while ensuring that resource and water services are managed sustainably;
- encourage and help countries establish comprehensive analytical frameworks to foster informed and transparent decision-making with an emphasis on demand management; and
- promote decentralized implementation processes and market forces to guide the appropriate mix of public and private sector provision of water services.

The paper also reflects the broad global consensus that was forged during the Rio Earth Summit of 1992. This consensus stated that modern water resources management should be based on three fundamental principles, which came to be known as 'the Dublin Principles' (Box 4.2).

The main areas of emphasis in the 1993 Strategy accordingly were:

- Build institutional and regulatory capacity in borrower countries sufficient to enable borrowers to implement and sustain the comprehensive approach to water sector planning and management.
- Support international cooperation on management and use of international waterways and bodies, recognizing that a truly comprehensive approach to water resource management extends beyond the borders of individual borrowers and beyond the time frame of individual projects.
- Draw on the comparative advantages of organizations outside the Bank and involve

> **Box 4.2: The Three Dublin Principles**
>
> 1. The ecological principle, which argues that independent management of water by different water-using sectors is not appropriate, that the river basin should be the unit of analysis, that land and water need to be managed together and that much greater attention needs to be paid to the environment.
> 2. The institutional principle, which argues that water resources management is best done when all stakeholders participate, including the state, the private sector and civil society; that women need to be included; and that resource management should respect the principle of subsidiarity, with actions taken at the lowest appropriate level.
> 3. The instrument principle, which argues that water is a scarce resource and that greater use needs to be made of incentives and economic principles in improving allocation and enhancing quality.

stakeholders in decisions that affect them. Decentralization, participation, and partnerships are key instruments to increase stakeholder ownership and accountability, build capacity, and ultimately power the cost and improve the effectiveness of operations, maintenance, safeguards, and monitoring and evaluation.
- Adopt water rights, pricing, and incentives (including adoption of new technologies and managerial approaches) to encourage rational and efficient allocation of water among competing uses, discourage waste, and ensure adequate water services.
- Ensure that water operations enhance human and natural environments with special attention to safeguards, social impacts (particularly on women) and meeting the needs of the poor.

The relevance of the key principles contained in the Bank's Strategy was reaffirmed by the 1997 UN General Assembly Session called to address the pressing issue of looming freshwater crisis and respond to the increasing concern of the Organization for Economic Cooperation and Development (OECD) about persistent water quality problems and the need for heavy investments needed in water delivery and treatment infrastructure (OECD 1998).

The Implementation of 1993 Strategy

To ascertain the extent to which the 1993 Strategy has been internalized and incorporated in the Bank lending, the OED (World Bank 2002b) undertook an evaluation of the strategy based on a comparison of events in the two six-year periods—before (1988–93) and after (1994–9). The OED opined that while the 1993 Strategy was highly relevant to the sound and sustainable management of water resources, its implementation, though broad, has been partial and uneven, with big differences across regions, countries and sub-sectors. Work remains to adapt the strategy to diverse country contexts, and to link water resource management to sustainable service delivery. To enable the Bank rededicate itself to implementing a comprehensive water management strategy, the OED made the following four recommendations:

- aim country dialogues and institutional development at integrating the social and environmental concerns with water resource development and project implementation;
- deploy Bank resources and instruments more effectively to nurture commitment to the Strategy through shared objectives, realistic diagnostics, and partnership aimed at policy reform and capacity building;
- create and sustain more comprehensive water management alliances with like-minded partners in the private sector, civil society, and the development community; and
- strengthen internal management, monitoring, and evaluation of water resource management activities through a streamlined organization, more cohesive sector and country strategies, enhanced core

competencies, additional operational guidance and training, and more rigorous quality assurance arrangements.

In addition to the OED review of 1993 Bank policy, another major review of the experience of implementing the Dublin Principles in the industrialized countries was carried out by the OECD (OECD 1998) which also concluded that progress in implementation has been difficult, slow and uneven, and that even the most advanced countries are far from full compliance with the Dublin Principles.

WATER RESOURCES MANAGEMENT POLICY PAPER: THE NEXT PHASE—THE 2003 WATER RESOURCES SECTOR STRATEGY

The World Bank formulated in 2003 a comprehensive Water Resources Sector Strategy (World Bank 2004) building on the well-received 1993 Water Resources Management Policy Paper, the OED review of the 1993 Policy Paper (World Bank 2002a), widespread consultations with various borrowers, the Report of the World Commission on Water presented at The Hague in 2000 World Water Forum (World Water Commission 2000), the Report of the World Commission on Dams (2000), and the World Summit on Sustainable Development (United Nations 2002). The Strategy focuses on how to improve the development and management of water resources, while providing the principles that link resource management to the specific water-using sectors. The main messages of the strategy are (World Bank 2004):

- Water resources management and development are central to sustainable growth and poverty reduction and, therefore, of importance to the mission of the World Bank. The World Bank should be available as a 'full service partner' to assist development of integrated, prioritized and consistent action in all four arenas—broad-based water resources interventions, poverty-targeted water resources interventions, broad-based water services interventions, and poverty-targeted water services interventions.
- Most developing countries need to be active in both management and development of water resources infrastructure. For the World Bank to be an effective partner, it must approach water resource challenges without preconceptions. The Bank must not fall into the trap of thinking that all problems can be solved with infrastructure, or the equally dangerous trap of assuming that even in environments with minimal infrastructure all problems can be addressed through better management.
- The main management challenge is not a vision of integrated water resource management but a 'pragmatic but principled' approach that respects principles of efficiency, equity, and sustainability while recognizing that water resource management is intrinsically political and that reform requires the articulation of prioritized, sequenced, practical, and patient interventions. To be a more effective partner the Bank must be prepared to pay more explicit attention in design and implementation to the political economy of reform. The art of reform is in picking the low-hanging fruit first, not in making the best the enemy of the good.
- The World Bank needs to assist countries in developing and maintaining appropriate stocks of well-performing hydraulic infrastructure and in mobilizing public and private financing, while meeting environmental and social standards.
- The World Bank will re-engage with high-reward–high-risk hydraulic infrastructure, using a more effective business model. This new business model puts development impacts first, assesses the development impact of engagement and non-engagement by the Bank, considers the rights and risks of those directly and indirectly affected by such projects, meets social and environmental standards, treats projects supported by the Bank as corporate projects from the start,

rewards and supports staff who manage such projects and aims at transparent, crisp, time bound, and predictable decisions.

- The Bank is perceived by many to have a major comparative advantage in the water sectors, and there is, accordingly, a strong demand for Bank services and a strong demand that the Bank engage. There are two dimensions to the Bank's comparative advantage. On the one hand, as water challenges grow in scale and complexity, the Bank is perceived as one of the few institutions that can provide integrated support on the macroeconomic, financial, technical, social, and environmental dimensions. On the other hand, borrowers find that the Bank is unique in convening power, relations with almost all riparian countries, a combination of knowledge and financial resources, engagement at all scales, and ability to integrate across these.
- The Bank's water assistance must be tailored to country's circumstances and be consistent with the overarching Country Assistance Strategies and Poverty Reduction Strategy Papers.

Completing this Water Resources Sector Strategy, the World Bank has formulated its Business Strategy. The Business Strategy defines principles that govern the Bank's work on water-using sectors (such as water and sanitation and irrigation and drainage) with particular attention to cross-cutting water resources development and management, focuses on the challenges of implementation, not on normative principles; covers only cursorily the many areas of water resources management where there is no contention and where progress is being made; and concentrates on a few, critical issues that have to be addressed at the senior management and board levels if the Bank is to be a more effective partner to developing countries in managing water resources—and the water services sectors—in an effective, integrated manner.

While the 2003 Strategy has been very comprehensive and broad based with an associated business model, it is, however, too early to judge to what extent it will be possible to internalize it and what effect it will be able to make in enabling countries move towards a more holistic management of their water resources.

Evolution of the World Bank's Water Policy in India[3]

The above discussion focused on the evolution of the Bank's water policies in general at the global level. In this section we focus on the Bank's policies as operationalized in India. To be consistent with the foregoing discussion, this section also reviews evolution of Bank policy for water and water-related investment before and after the Bank's 1993 Water Resources Management Policy. It shows that the Bank was overly focused on a project-by-project approach until the mid-1980s with little policy dialogue on anything other than engineering quality. Between 1987 and 1993 the Bank became increasingly involved in a policy debate on the means to arrest failing infrastructure and address critical institutional constraints and broader environmental safeguard issues. After 1991, the Bank's water policy and the first serious attempts at public sector reform by the GOI evolved simultaneously, thus providing a policy environment that, during the second half of the 1990s, became conducive to reform in the electricity, irrigation, and water supply sectors. Much of this was built on the reform debate within India—not least, the direction provided by India's 1987 Water Policy. The first major breakthrough in irrigation and water utility reform only happened because a new generation of reform-minded political leaders enabled the Bank's dialogue to move from technically oriented state line agencies to engage the body politic. Overall, the Bank's policy dialogue on water in India closely reflects the requirements of the Bank's water policy, which is highly relevant to India's needs.

[3] This section draws on World Bank (2002) besides other publications.

The World Bank's Role

The Bank's involvement in India's water development grew steadily from the early 1960s to reach a peak in the mid-1980s. Until 1992, India was the Bank's biggest borrower for water and water-related investment. Conversely, the Bank had always been the dominant development partner accounting for almost half of total concessional foreign investment among the development assistance community and was responsible for an even larger share of foreign assistance for irrigation. But compared with internal Indian investment it was marginal—around 10 per cent for the period 1985–97—and thus the Bank had little leverage for policy reform since these investments were thinly spread over a wide area/ in different states.

Other donors had also been active in the water sector in India. The UK Department for International Development (DFID), the Danish (DANIDA), FAO, and ADB had also been active participants in this sector. None, however, had a programme anywhere near the size of the Bank's programme. Some of these donors have had long-standing programmes in India. However, most of these focused on the rural and urban water sectors. Their programmes were generally small, more localized, and more committed to long-term involvement in specific projects or areas with close association with beneficiaries. The Bank's work programme was generally not coordinated with other donors and the Bank did not learn from their considerable experience at the local level.

Bank Policy in India Before 1993

Until the mid-1980s the Bank's policy in irrigation was to prefer project to programme lending because it provided major opportunities for agricultural investment and had the necessary absorptive capacity. However, while 'the Bank would have preferred to become involved at an early stage in practice, its role was in examining projects and deciding if they were suitable for financing without being able to develop lending based on a set of technical, regional or other criteria' (World Bank 1981a). Part of this policy was driven by the GOI's refusal to allow International Competitive Bidding (ICB) on Bank-financed projects, thus limiting procurement, and this impasse was only resolved by 1984. In consequence, the Bank developed a lending policy for irrigation based upon exclusion criteria. In particular, by 1981, it would not finance projects (a) affected by international or interstate water disputes, (b) early in the construction cycle to avoid drawn-out disbursements, (c) more than halfway through the construction cycle because the Bank could have little influence on the outcome, and (d) that the state would not increase its investment allocation because the GOI would not agree to additionality until 1984. As a result, the Bank tended to select projects and then retrofit design improvements to improve operational efficiency. The Bank staff and consultants unwisely became immersed in detailed project engineering. This was driven in part because the GOI also resisted Bank involvement in policy and planning issues.

Recovery of O&M costs continued to be a condition of every loan but generally remained ineffective. On the water management side, the preoccupation with irrigation efficiency led the Bank to strongly support command area development at the lowest levels of public irrigation projects. Bank policy often mandated canal lining. On the institutional front, although the institutional constraints were well known to Bank staff, they sought to bypass them: 'technical solutions can reduce the freedom of engineering and administrative staff to corrupt the operation of the system if technical improvements are proven effective and for all to see, (they) will become politically acceptable'.

Bank policy was set on a new track following nascent economic and sector work in the early 1980s (World Bank 1982). Some of these highlighted the need to address corruption and institutional problems plaguing state irrigation departments. Others pressed for elevating Bank support to national programmes to address systemic irrigation management and water resource problems, in particular, unreliable and inequitable water delivery. The GOI first approached the Bank for a national water management programme for the irrigation sector in 1982. After discussion and initiatives to improve water management in 17 ongoing Bank-supported projects, the GOI established a Water Management Cell to facilitate programme development in the (then) Ministry of Irrigation. By 1985, a joint GOI/Bank team agreed to a new policy that directed Bank finance to participating states following federal approval of scheme-specific operational plans.

Unlike most earlier Bank investments, the major foci under the new policy were: rehabilitation of deferred maintenance rather than new projects, an emphasis on strengthening the states' capacity to plan and implement O&M, and mutual farmer/irrigation department operation of irrigation systems below a certain water management level following re-engineering of water control structures. In comparison with the Bank's earlier policy, Bank management viewed this as an extremely ambitious and highly risky strategy and advised making it smaller and piloting the approach first.

As a lead-up to preparations for the Eighth Five-Year Plan, the Bank, in collaboration with the GOI, undertook an Irrigation Sector Review, which it completed in 1991. Following an extensive diagnosis of the sector's ills and their impact on agricultural productivity, it identified four areas for priority action and made 52 recommendations for reform. The areas for priority action included:

- forging a coherent water policy and implementing it;
- prioritizing investment and getting control of expenditure;
- improving productivity and ensuring sustainability; and
- building critical capacity within the public and private sectors in order to manage the sector more efficiently and effectively.

The Bank review noted that 'much of the current sectoral malaise stems from the fact that irrigation is largely managed by government monopoly, that a culture of "government must do it" prevails, and that the sector's bureaucracy has grown unwieldy, not adaptive to changing needs with narrow interests and lacking incentives to improve performance'. It recommended that both the states and the centre reassess their monopoly and ascribe new roles as necessary. And 'where appropriate, and opportunities abound', they should divest as much investment and implementation as possible to the energetic non-governmental sector. An ambitious prescriptive one-year action plan for sector reform at state and federal level was included. The 1991 review gave a clear signal that a new direction was needed and it ushered in a series of new-style projects—the water resources consolidation projects and a national hydrology project.

The 1991 Country Economic Memorandum (CEM) focused on the agricultural sector and, inter alia, built on the findings of the irrigation sector review. In particular, it highlighted the need to mitigate the adverse impacts of irrigation development on people and the environment. The main recommendations were that more attention be paid to the correct pricing of inputs and cost recovery. In 1991, Bank policy extended lending in a new direction for industrial pollution control that would have a significant impact on water quality. It also introduced the first loan to mitigate the environmental risk posed by dams and strengthen the institutional capability of the centre and the states to manage this risk and address rehabilitation. The macroeconomic crisis of 1991 occupied the 1992 CEM, but even so, it noted the difficulties of pushing the centre's reform agenda to the states, especially for irrigation. The 1993 CEM identified the absence of demanded irrigation through well-identified water-user groups as a major impediment to reform and further stressed that perverse price incentives must be removed. In a major change of Bank policy, it argued that 'rather than exhortations for blanket water pricing or user charges, there should first be a call for some form of system monitoring by independent system utility regulators to see who actually benefits from irrigation'.

Bank Water Policy in India After 1993

The intense international scrutiny of the Bank's water-related work in India, caused by the Narmada controversy and the International Review (Morse Commission), gave rise to new policies for water investment, augmented by the preparation and finalization of the Bank's 1993 Water Resources Management Policy.

By 1994 the Bank moved from project to sector water investment loans that would finance an agreed statewide programme generally in line with the new Bank water policy and some of the specific recommendations of the 1991 Irrigation Sector Review. These sector loans were implemented through WRCPs. Unlike earlier investments, WRCPs covered water resources planning, addressed current and future inter-sectoral needs, and provided support for institu- tional development and reform. This built upon broader-based lending to mitigate the environmental impacts of waterlogging in Uttar Pradesh through active and wide-scale beneficiary participation that took place in late 1993. This was followed by the first investment for environmental management capacity building which help address, inter alia, increasing Bank concern, raised in the 1994 CEM, about water pollution.

In the same year, the Economic Development Institute (EDI) of the Bank initiated discussions on, and provided a strategy for, the devolution of irrigation O&M to water users—a policy the 1995 CAS saw as key to improving natural resources management and efficiency in expenditure. In the event, the EDI intervention was well scheduled by the Bank as it provided 'just in time' input to the evolving policy dialogue then taking place between the Bank and the Government of Andhra Pradesh on initiating reform of public utilities and turnover of irrigation systems to water-users groups. The policy agenda for agriculture was elaborated in the 1995 and 1996 CEMs, which rehearsed the recommendations of the Vaidyanathan Committee and delivered the important message that there is room to spend 'less but better' on agriculture, provided that, in the short term, programmes are introduced to target the poor who are the most vulnerable to the phase-out of input subsidies.

The key policy breakthrough over the period 1996–8 facilitated water reform through comprehensive statewide public expenditure operations. Under this new policy, the Bank bundled its new loans into state-specific packages conditional upon implementing reforms. Not only did this give the Bank much greater leverage than it had before, it also ensured that Bank dialogue across sectors was consistent—a major problem in the past. The first policy packages were outlined in economic and sector reports on Orissa and Rajasthan in 1996, followed by Andhra Pradesh in 1997, and Karnataka and Uttar Pradesh in 1998.

The first of the new state economic restructuring packages was for Andhra Pradesh in 1998. Its primary objectives were to meet priority needs in human development (nutrition, primary health, and primary education) and maintenance of economic assets affecting the rural poor (irrigation, rural roads). Investments under the package were linked to a programme of fiscal reform aimed at maintaining a tight control over public expenditure and debt. Modernizing the state's irrigation sector was a substantial part of the package.

In 1998, the Bank completed a comprehensive water resources management sector review (World Bank 1998) that gave issues of water management a high profile in the 1998 CAS. The review was aimed at initiating and sustaining water sector reforms undertaken in partnership with the GOI. Unfortunately, however, the findings of the sector review were almost identical to those of the 1991 review: the top-down, supply-oriented, and fragmentary development framework still persists and present institutional arrangements do not enable comprehensive allocation, planning, and management of water. As the review aptly summarizes: 'in recent years there has been realization and policy pronouncements regarding the need to address these problems; however, the policies have not been translated into action'.

Implementation of Water Policy 1993

Has the Bank been able to implement its 1993 Water Policy in India? To answer this question we compiled a list of all the water projects lended by the Bank in India during the period FY 1982 to FY 2005 that is roughly 12 years before and 12 years after the issuance of 1993 water policy (see Appendix 4.1). This compilation, however, does not include the hydro lending. The data on proportion of portfolio lending for three broad water sector components—water resources, irrigation and drainage, and water supply and sanitation—show a marked shift away from the earlier project-by-project irrigation focus to a more integrated approach to the management of water resources (Figure 4.1). The number of projects listed as watershed management, water resources consolidation projects, water resources restructuring projects, etc. have significantly increased. Starting with the 1994 WRCP of Haryana, similar projects were launched in Tamil Nadu in 1995 and Orissa in 1996. This was followed by the Water Sector Restructuring and Improvement Projects in Rajasthan (2002), Uttar Pradesh (2002), and more recently in Maharashtra (2005). There was a renewed focus on Watershed Development Projects with Watershed Hills II launched in northern India in 1999 and in Karnataka in 2002. These projects were complemented by several other projects such as in environmental improvement and industrial pollution prevention and control to improve the environmentally sustainable design of water programmes and water projects. The National Hydrology Project (1996) launched during the post-1993 policy is also fully in line with the Bank's policy to build institutional capacity for water management and better water data monitoring and analysis.

The shifts in pattern of lending by Bank thus shows that the lending has become increasingly relevant to both—the Bank's 1993 policy as also India's institutional and water policy needs. While the design of the Bank's new projects on consolidation and sector improvement does aim at addressing complex inter-sectoral planning and beneficiary participation in management of water resources, their outcomes will only tell the extent to which they have been able to make a dent in India's water sector management.

WORLD BANK LENDING FOR WATER RESOURCE MANAGEMENT: 1993–2004

In this section we briefly review the water-lending portfolio of Bank lending. The analysis of lending has been restricted to a relatively more recent period 1993–2004.

The Water Projects Database

An in-depth analysis of the Bank lending for water resource management until recently was con-

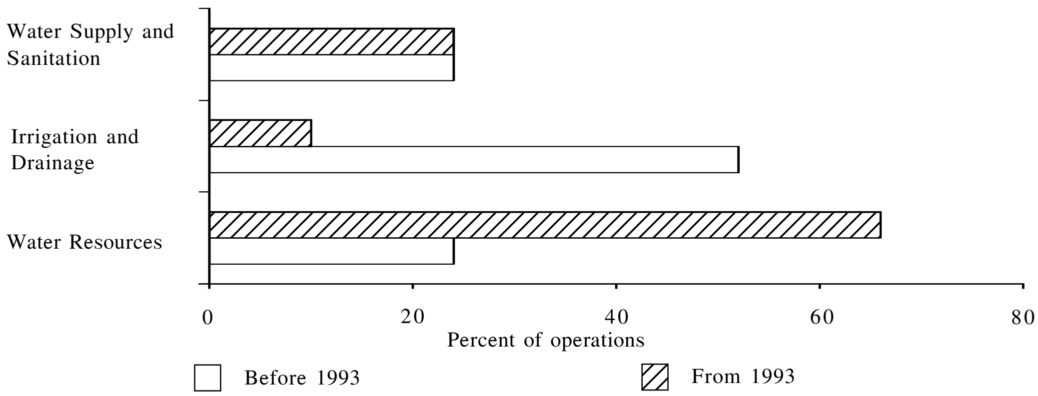

Figure 4.1: Total Operations in Different Sectors (%)

strained by the non-availability of a disaggregated and comprehensive database. As water resources are not formally a sector in the Bank, the project coding system contains no code for 'water resource management'. In addition, since most of the projects are usually a hodgepodge of components, it is difficult to strictly designate a project as a water resources management project. At the time of the formulation of the Water Resources Sector Strategy 2003, a need was felt for the creation of such a database. Two criterion were applied to decide whether the project is a water sector project and for its inclusion in the database: if the project has more than 33 per cent of its total costs devoted to water sector activities regardless of the total project cost, then the project was included in the database; and if more than US$25 million is spent on water-related components, regardless of the share of total project cost, then the project was included in the database. The water projects database thus includes all the projects with a major water-related component: irrigation and drainage projects, rural and urban water supply and sanitation projects, hydropower projects, flood management projects, watershed management projects, environmentally oriented projects, and water resource management projects. The database, however, does not include coastal zone management projects, seaports, or other predominantly ocean-oriented projects.

The Water Resources Management Group (WRMG) working with the OED designed a classification system for defining the water resources components of projects. This is illustrated in Figure 4.2. The Project Appraisal Documents (PAD) of the projects included in the database were then used to assign project costs to specific categories in the Project Cost Component

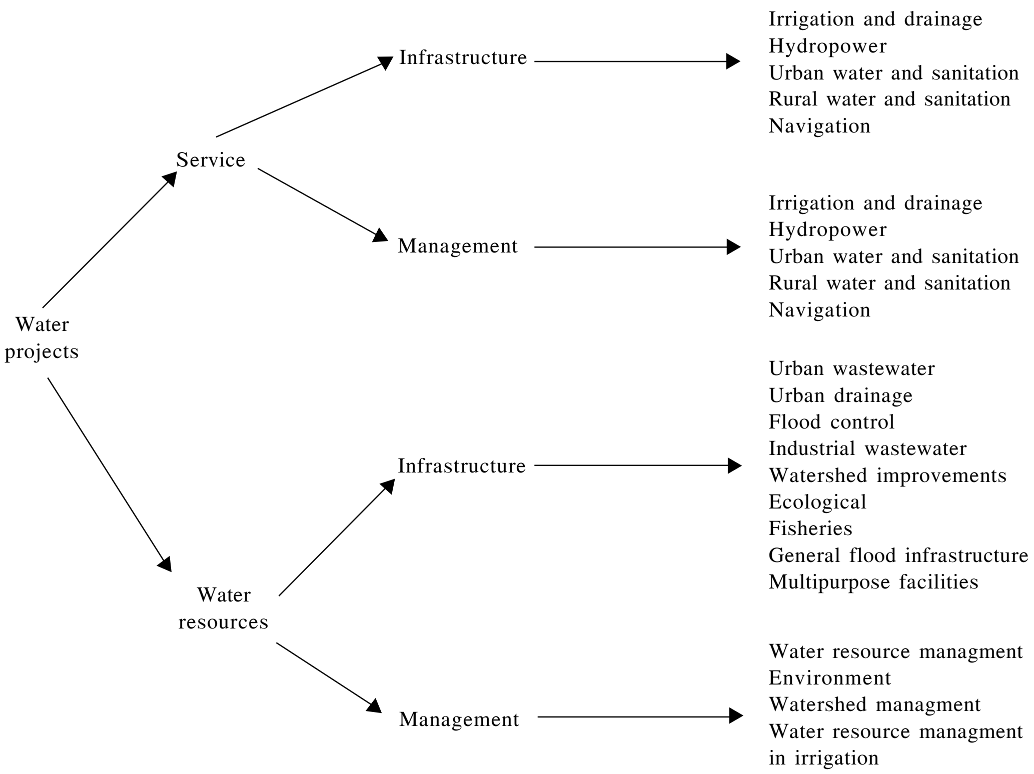

Figure 4.2: Classification of the Water Resources Components of a Project

Source: World Bank (2004).

Category table. The Project Cost Component Category table contains twenty-three possible categories for cost components, which are grouped into the following general sections: water infrastructure cost, water management institutional strengthening, water service institutional strengthening and other costs. The database of the water resources project portfolio so compiled included cohort of Bank financed projects subsequent to the 1993 Water Resources Management Policy Paper and included all projects approved between FY 1993 and FY 2002. Since then the database is updated on an annual basis and the currently available database covers the period from FY1993 to FY 2004.

WORLD BANK LENDING FOR WATER 1993–2004: THE GLOBAL SCENARIO

Lending for water constitutes one of the most important global lending portfolios of the Bank. During the period between 1993 to 2004, the Bank globally provided lending for 3564 projects, of which 465 projects (13 per cent of the total) had significant water components (Table 4.1, Figure 4.3). The ratio of number of projects with water component to total projects at 23 per cent was highest for the South Asia region. In the Africa region water projects constituted only about 6 per cent of the total Bank-funded projects. Of the total water projects undertaken by the Bank during this period, about 15 per cent of the projects were

TABLE 4.1: Number of Projects with Water Component, 1993–2004

	AFR	EAP	LAC	MENA	ECA	SA	Total
Total number of projects funded	934	528	766	266	760	310	3564
Number of projects with water component	81	84	84	59	85	72	465
Percentage of projects with water component	9	16	11	19	22	23	13
Percentage of total water projects in different regions	17	18	18	13	18	15	100

Note: The Six Bank regions are: AFR—Africa, EAP—East Asia and Pacific, LAC—Latin America and the Caribbean, MENA—Middle East and North Africa, ECA—Europe and Central Asia, SA—South Asia.
Source: Based on World Bank Data Base.

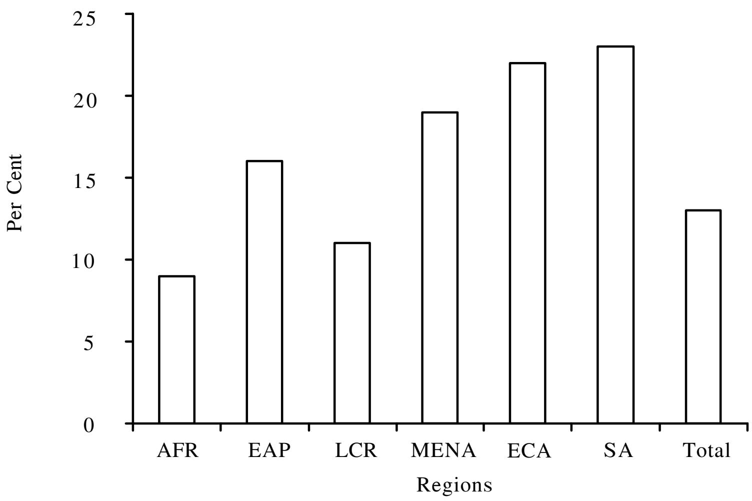

Figure 4.3: Funded Projects with Water Component to Total Projects (%), 1993–2004
Source: Table 4.1.

located in South Asia while EAP, LAC, and ECA regions each accounted for 18 per cent of the water projects.

In terms of quantum of lending, of a total of US$258 billion lending for all the projects during the period 1993–2004, the projects with water components accounted for about US$29 billion (or 11 per cent) of all lending (Table 4.2, Figure 4.4). The ratio of lending for projects with water resources component to total lending at 29 per cent was highest for the EAP region. Lending for water components per se during the period was of the order of US$20 billion constituting about 70 per cent of the total lending for projects with water component. The lending for water components formed about 8 per cent of all the Bank lending. In South Asia the ratio of lending for water components to total lending was about 11 per cent. Distribution of water component lending across different regions suggest that of the total water lending of US$20 billion, the highest 31 per cent went to the EAP region. South Asia accounted for 19 per cent of the total water component lending by the Bank.

The trend in the Bank lending for water during this period shows that after following the zigzag path from 1993 to 1996, global lending for water declined almost continuously from 1996 to 2001

TABLE 4.2: World Bank Lending for Water, 1993–2004

	AFR	EAP	LAC	MENA	ECA	SA	Total
Total WB lending—all sectors ($bn)	34	59	66	13	50	36	258
Lending for projects with water component ($bn)	3.0	8.3	5.8	2.6	3.2	5.7	28.6
Percentage of lending for water projects to total lending	9	14	9	20	6	16	11
Lending for water component ($bn)	1.7	6.3	4.1	2.0	2.1	3.9	20.1
Percentage of lending for water components to total lending	5	11	6	15	4	11	8
Percentage of total water component lending going to different regions	8	31	20	10	10	19	100

Source: Same as Table 4.1.

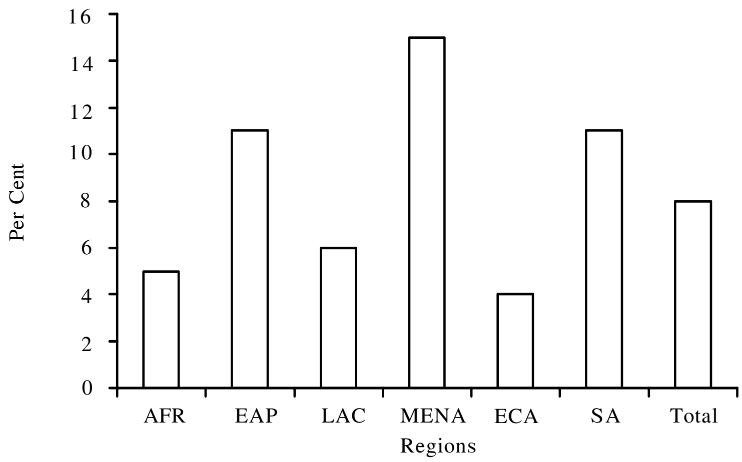

Figure 4.4: Lending for Water Components to Total World Bank Lending (%), 1993–2004
Source: Table 4.2.

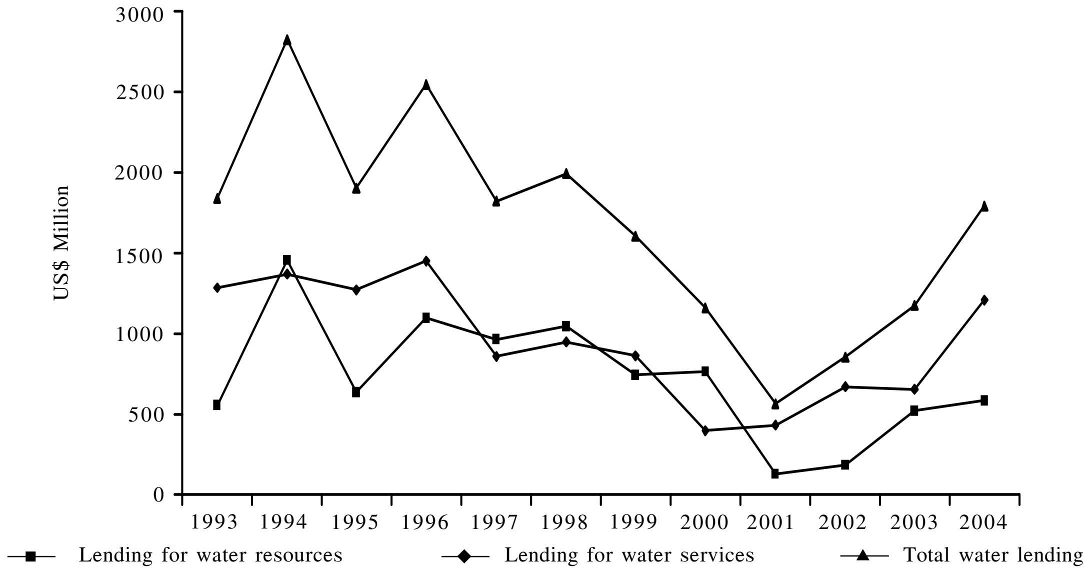

Figure 4.5: Trend in Global World Bank Lending for Water, 1993–2004

Source: Based on World Bank Data Base.

(Figure 4.5). The highest lending for water during this entire period was about US$2826 million made during 1994. In contrast the lending during 2001 was just around US$562 million. From 2001 the lending again picked up and in 2004 it was around US$1800 million. Another notable feature of the lending pattern is that during almost the entire study period, except during 1997–2000, the lending for water services was higher than for water resources.

An examination of the allocation of total lending for water in different regions into different water components suggests that of the total US$20 billion lending for water, 26 per cent lending was for irrigation, 36 per cent for urban water supply and sanitation (UWSS), 7 per cent each for rural water supply and sanitation (RWSS), and hydro components while the remaining 24 per cent was for stand-alone water resources component (Table 4.3, Figure 4.6). There were, however, marked interzonal differences in allocation of water lending amongst different components. Except for South Asia where the irrigation component accounted for the highest allocation of 45 per cent, and in MENA where the allocation between irrigation and UWSS was almost equal at 38 per cent, in all the remaining four regions the largest allocation was made for UWSS. The largest share of a region's total water lending for RWSS was made in South Asia. For stand-alone water resources component, as against allocation of 34 per cent of the water lending for this component in the LAC region, the corresponding allocation in South Asia was only 14 per cent, much lower than the global average of 24 per cent. The lending for hydro constituted only 7 per cent of the global water lending. In the SA region, hydro lending was 8 per cent of the total water lending. This hydro lending of about US$300 million was made for Pakistan's Ghazi Barotha Hydro Power Project.

The available data also enables us to analyse the component-wise lending in the water sector and its allocation between different regions. Of the total US$5.2 billion (at nominal prices) lending for irrigation component during 1993–2004, the highest 33 per cent was accounted for by the SA region followed by 25 per cent in the EAP region (Table 4.4, Figure 4.7). EAP accounted for the highest 31 per cent of the US$7.2 billion lending for UWSS component. SA region's share

TABLE 4.3: Region-wise Allocation (%) of Total Water Lending for Different Components, 1993–2004

	AFR	EAP	LAC	MENA	ECA	SA	Total
Irrigation	9	20	19	39	25	45	26 (5.2)
UWSS	60	35	37	38	47	17	36 (7.2)
RWSS	11	5	3	2	4	16	7 (1.4)
Hydro	9	10	7	0	2	8	7 (1.4)
St-al WR	12	29	34	21	23	14	24 (4.9)
Total	100 (1.7)	100 (6.3)	100 (4.1)	100 (2.0)	100 (2.1)	100 (3.9)	100 (20.1)

Note: Figures in parentheses denote water component lending in US$ billion. St-al WR–Stand-alone Water Resource.
Source: Same as Table 4.1.

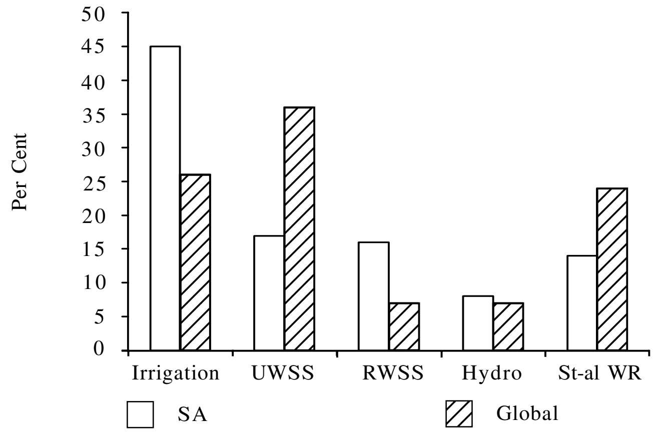

Figure 4.6: Lending for Water Components to Total Water Lending—SA and World, 1993–2004
Source: Table 4.3.

TABLE 4.4: Lending for Different Water Components, 1993–2004

	AFR	EAP	LAC	MENA	ECA	SA	Total
Total lending for water component (bn)	1.7	6.3	4.1	2.0	2.1	3.9	20.1
Percentage of total irrigation lending going to different regions	3	25	15	15	10	33	100 (5.2)
Percentage of UWSS lending going to different regions	14	31	21	10	14	9	100 (7.2)
Percentage of RWSS lending going to different regions	14	22	8	3	6	46	100 (1.4)
Percentage of hydro lending going to different regions	11	45	21	0	3	21	100 (1.4)
Percentage of lending for stand-alone WR projects going to different regions	4	38	28	9	10	11	100 (4.9)

Note: Figures in parentheses denote lending in undiscounted US$ billion.

Source: Same as Table 4.1.

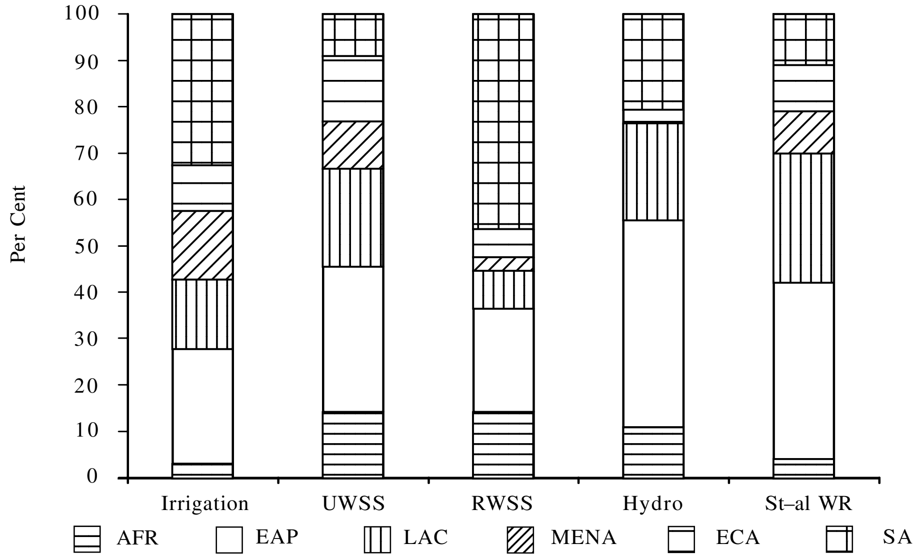

Figure 4.7: Different Component Lending Allocated to Different Regions of the World (%), 1993–2004

Source: Table 4.4.

in UWSS lending was a mere 9 per cent. Though the allocation to RWSS was just US$1.4 billion, SA accounted for 46 per cent of this lending. EAP with a share of 45 per cent in the hydro lending of US$1.4 billion accounted for the highest share of WB lending for hydro component. EAP also accounted for highest share of 38 per cent in the US$4.9 billion lending for stand-alone water component while SA region's share was just 11 per cent.

The trend in lending for irrigation during the study period has followed a trend broadly similar

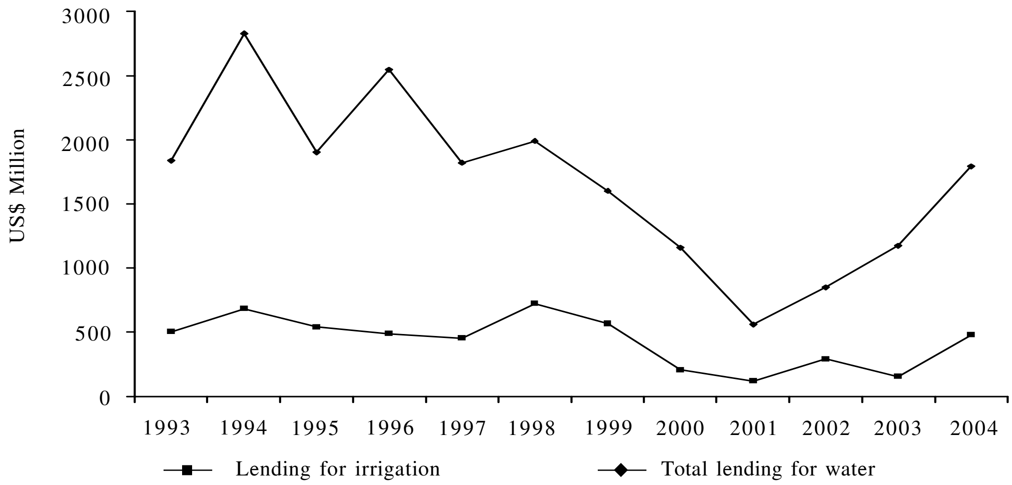

Figure 4.8: Trend in Global World Bank Lending for Irrigation and Total Water, 1993–2004

Source: Same as Figure 4.5.

to that of total lending (Figure 4.8). The lending for irrigation remained in the range of US$500 million mark during the period 1993–9, after which it declined to its lowest level of US$121 million in 2001. It again started picking up and in 2004 the lending for this component picked up to the level of US$478 million.

World Bank Lending for Water in India in a Global Perspective

The World Bank has been playing a very important role in the water sector in India. The first World Bank lending for the water sector in India dates back to 1954 when the Bank provided a specific investment loan of US$19.5 million for the Damodar Valley Project. Subsequently, the Bank lending was provided for some of the other important irrigation projects including the Sone Irrigation Project (FY 1963), the Kadana Irrigation Project (FY 1971), the Perriyar Vaigai Irrigation Project (FY 1978), etc. Concurrently the Bank also provided lending for water supply and sewerage projects including the Bombay Water Supply and Sewerage Project (FY 1974), the Water Supply and Sewerage Project of Uttar Pradesh (FY 1976), and similar projects in several other states. The Bank also provided lending for hydropower development.

Table 4.5 shows India's share in the World Bank total lending and lending for water sector during the period 1993–2004. During the period 1993–2004 the Bank provided lending for 124 projects in India which constitute 3.5 per cent of the total number of projects for which the Bank globally provided lending during this period. Out of the 124 projects funded in India, 26 (21 per cent) had significant water components as compared to the corresponding global figures of 465 out of 3564 (13 per cent). Thus the proportionate water projects lending in India have been much higher than the global average.

During the reference period, India's share in overall global Bank lending was 8.5 per cent. The lending for projects with water components in India constituted 20 per cent of the total Bank lending in contrast to 11 per cent water lending to total lending at the global level. The lending for water components per se to total India lending was 11 per cent as compared to the global average of less than 8 per cent.

In India of the total US$2.5 billion lending for water components, 71 per cent was for water

TABLE 4.5: Lending for Water—India and World, 1993–2004

	Unit	India	World	India as % World
Total number of projects	Number	124	3564	3.5
Number of projects with water component	Number	26	465	5.6
Total lending—all sectors	US$ bn	22	258	8.5
Lending for projects with water component	US$ bn	4.3	28.6	15
Lending for water components	US$ bn	2.5	20.1	12.4
Lending for water services	%	71	57	–
Lending for water resources	%	29	43	–
Percent lending for different components				
Lending for irrigation	%	56	26	27
Lending for UWSS	%	12	36	4
Lending for RWSS	%	20	7	36
Lending for hydro	%	0	7	0
Lending for st-al WR	%	12	24	6

Source: Same as Table 4.1.

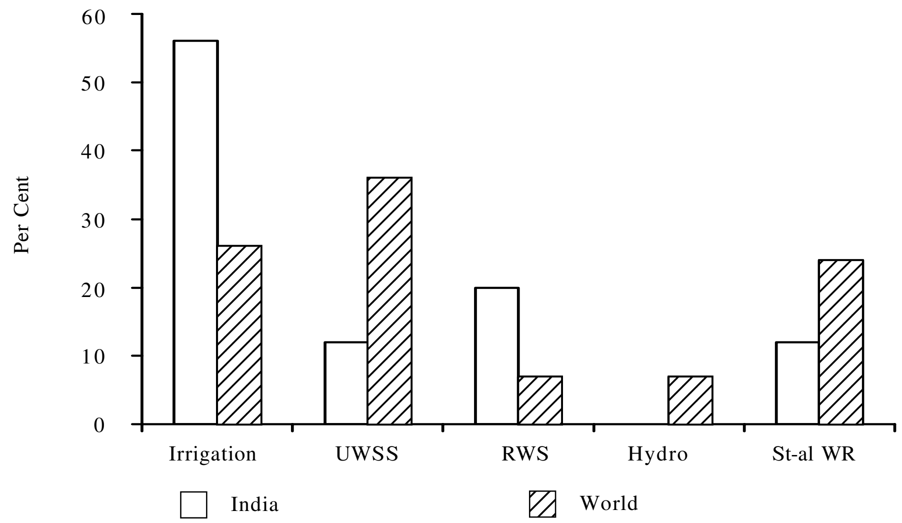

Figure 4.9: Lending for Water (%)—India and World, 1993–2004

Source: Table 4.5.

services and the remaining 29 per cent for water resources. At the global level, of the US$20.1 billion lending, 57 per cent was for water services and the remaining 43 per cent for water resources. Thus in India the major focus of funding has been on providing for water services delivery rather than for water resources per se.

A further break-up of lending for water into constituent components in India and at the global level provide some more interesting results. Of the total lending of US$2.5 billion lending for water components in India, irrigation accounted for the largest share of 56 per cent, followed by RWSS (20 per cent), and UWSS and WR projects (12 per cent each). There was no lending provided for hydro (Figure 4.9). In contrast at the global level, of the total lending of US$20.1 billion, irrigation accounted for only 26 per cent. UWSS accounted for the largest share of 36 per cent. The water resources projects accounted for 24 per cent while RWSS and hydropower accounted for 7 per cent each. An examination of India's share in lending for different components at the global level suggest that India accounted for 27 per cent of all lending in irrigation and 36 per cent in RWSS.

Trends in World Bank Lending for Water in India: 1993–2004

In this section we provide an overview of the pattern of the World Bank lending for water in India with a view to ascertaining if there is any systematic trend in provisioning of this lending. For this purpose we divide the entire period 1993–2004 into several sub periods.

TABLE 4.6: Number of World Bank-funded Projects in India

Period	Total Projects	Projects with Water Component	Per Cent Projects with Water Component
1993–5	34	8	24
1996–8	31	7	23
1999–2001	32	5	26
2002	10	3	30
2003	8	0	0
2004	9	3	33
All	124	26	21

Source: Same as Table 4.1.

The World Bank on an average has been providing lending for eight to ten projects per year and about one quarter of the projects have significant water lending (Table 4.6). In fact the proportion of projects with water component lending has over the years increased gradually from about 23–24 per cent in 1993–5 and 1996–8 period to 30–33 per cent in more recent years, except during 2003 when no project had any water-lending component.

There has, however, been some decline in the average cost of a water project for which lending was obtained from the Bank. The average size of the project has declined from around US$300 million in the earlier sub-periods 1993–5 and 1996–8 to around US$175 million in 1999–2002 period and further to about US$136 million in the most recent period 2004 (Table 4.7). There has

TABLE 4.7: Project Lending to Project Cost and IDA Share—Water Projects

Year	Av. Project Cost ($ mn)	Per Cent Lending to Cost	Per Cent IDA Share in Lending
1993–5	275	62	70
1996–8	324	71	56
1999–2001	175	69	52
2002	182	81	100
2003	0	0	0
2004	136	71	86
All	242	68	66

Source: Same as Table 4.1.

TABLE 4.8: World Bank Lending

(US$ million)

Year	World Bank Lending			Projects with WR to Total Lending (%)	Water Component as % Total Lending
	Total Lending	Projects with WR Component	For Water Component		
1993–8	11419	2977	1681	26	15
1999–2004	10547	1331	833	13	8
1993–2004	21966	4308	2514	20	11
Average/Year	1831	359	210	20	11

Source: Same as Table 4.1.

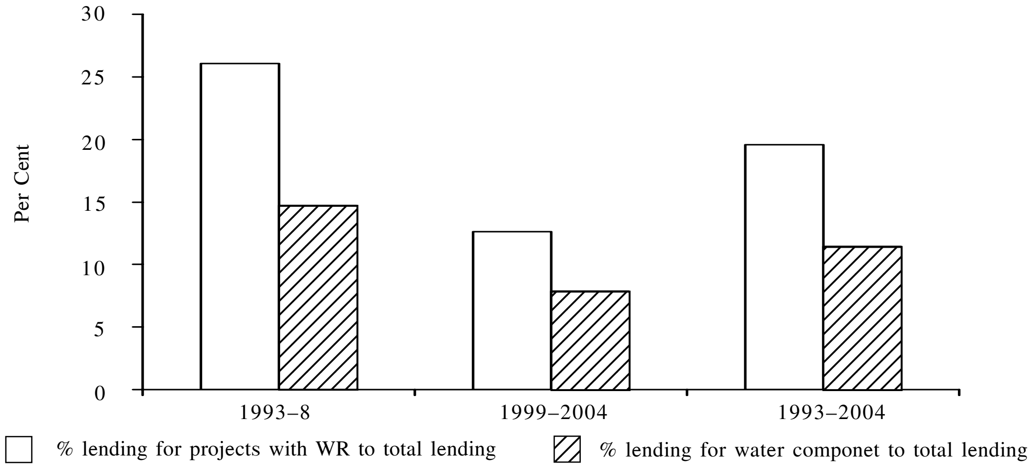

Figure 4.10: World Bank Lending for Water

Source: Table 4.8.

been no systematic trend in share of lending to cost during different sub-periods, though the share of IDA in total lending has increased somewhat during more recent periods.

The proportion of lending for water as a share of total lending has declined from 15 per cent during the sub-period 1993–8 to about 8 per cent during more recent period of 1999–2004. The aggregated lending for water as a proportion of total lending during the entire period 1993–2004 was thus of the order of 11 per cent (Table 4.8, Figure 4.10).

Of the total water lending during the period 1993–2004, about 54 per cent was for irrigation component, 13 per cent for UWSS, 19 per cent for RWS, and the remaining 14 per cent was for WR stand-alone projects. An analysis of the share of different components in the total water lending during the two sub-periods show changing priorities. In the first sub-period 1993–8, irrigation accounted for the highest proportionate allocation of 67 per cent with RWS accounting for the lowest share of 8 per cent. In the second sub-period 1999–2004 RWS accounted for the highest share of 41 per cent with only 29 per cent of the total water allocations going for the irrigation. In both the sub-periods there was no lending for the hydro sector (Table 4.9, Figure 4.11).

Of late the Bank has been emphasizing a relatively higher level of lending for delivery of water services as compared to development of water resources. As a result during the study period 1993–2004, 71 per cent of the total lending for water components was made for water services and the remaining 29 per cent for development of water resources (Table 4.10, Figure 4.12). A component-wise analysis of the proportion of

TABLE 4.9: Water Lending—Share of Different Components

Year	Component-wise Lending (%)					
	Irrigation	UWSS	RWS	Hydro	St-al WR	Total
1993–8	67	15	8	0	11	100 (1682)
1999–2004	29	10	41	0	20	100 (833)
Total/Av.	54	13	19	0	14	100 (2515)

Note: Figures in parentheses denote actual amount of lending in US$ million.
Source: Same as Table 4.1.

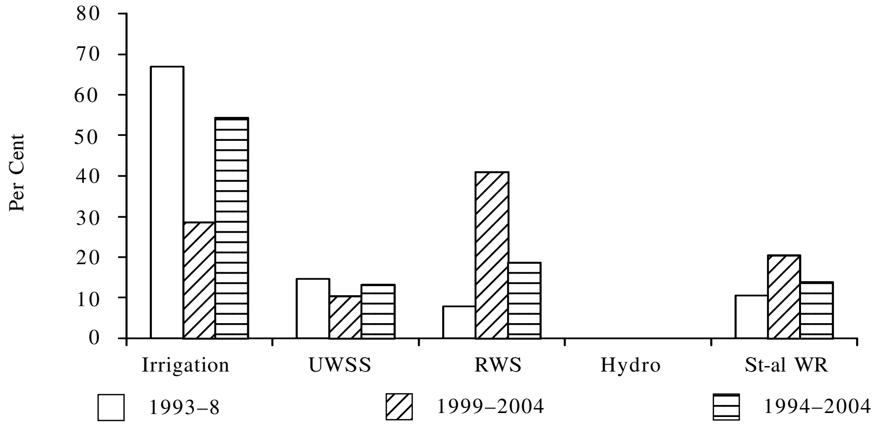

Figure 4.11: Total Water Lending Allocated to Different Components (%)
Source: Table 4.9.

TABLE 4.10: Lending for Water Resources (%) and Water Services

Year	Per Cent of Water Lending for Water Resources	Water Services
1993–8	29	71
1999–2004	31	69
Total	29	71

Source: Same as Table 4.1.

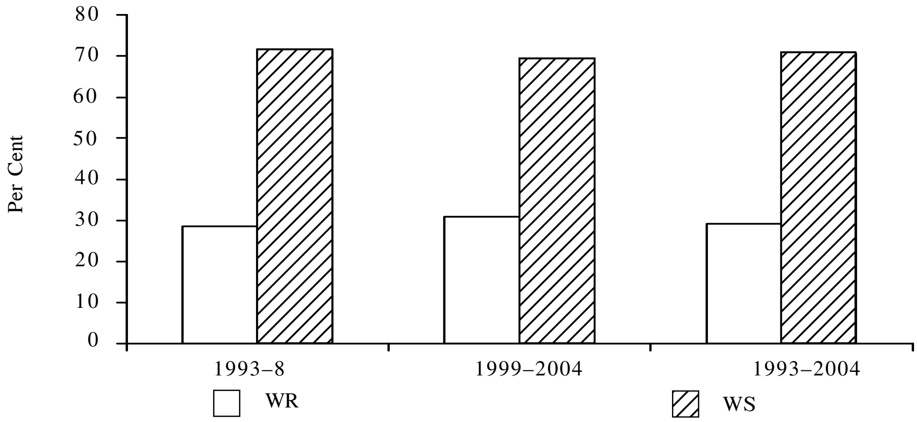

Figure 4.12: Total Water Lending Allocated to Water Resources and Water Services (%)

Source: Table 4.10.

TABLE 4.11: Lending for Water Resources and Services for Different Components

(per cent)

Year	Irrigation		UWSS		RWS	
	WR	WS	WR	WS	WR	WS
1993–8	13	87	62	38	0	100
1998–2004	22	78	38	62	0	100
1993–2004	15	85	56	44	0	100

Note: WR—water resource, WS—water services.
Source: Same as Table 4.1.

lending for services and development of water resources, however, provide a somewhat different picture. Thus while in the case of irrigation component almost 85 per cent of the total lending was for water services component, in the case of UWSS a relatively larger proportion, 63 per cent, of the total component lending was for development of water resources (Table 4.11). In the case of RWS component the entire lending was for development of water services.

Geographical Distribution of Lending for Water

While most of the Bank-funded projects are generally state specific there are several projects which are multi-state or have multi-state–central government lending components. While accounting for lending in the case of a single state project is straightforward, allocation of lending between different states in the case of multi-state projects with central government lending component is somewhat difficult. In the case of such multi-state projects we have divided the total lending equally between different participating states. While this may have brought in a slight margin of allocation error in lending between different states it is likely to be very small. Table 4.12 and Figure 4.13 show the state-wise and region-wise distribution of WB lending for water projects. Of the total lending of US$4.31 billion for projects with water components, the maximum lending went to southern states (48 per cent), followed by north (22 per cent), west (15 per cent), east (13 per cent), and the remaining about 2 per cent for the GOI. About two-thirds of the total lending went to five states—Andhra Pradesh (21 per cent), Tamil Nadu (17 per cent), Uttar Pradesh (12 per cent), Maharashtra (10 per cent), and Karnataka (9 per cent).

TABLE 4.12: Geographical Distribution of Lending for Projects with Water Component, 1993–2004

Region/State	Amount (US$ million)	Percent Share
South	2068	48.00
Andhra Pradesh	886	20.57
Tamilnadu	715	16.60
Karnataka	384	8.90
Kerala	83	1.93
North	954	22.14
Uttar Pradesh	518	12.03
Haryana	285	6.62
Uttaranchal	70	1.62
Punjab	27	0.63
Himachal Pradesh	27	0.63
Jammu and Kashmir	27	0.63
West	633	14.71
Maharashtra	424	9.85
Rajasthan	140	3.25
Gujarat	51	1.19
Madhya Pradesh	18	0.41
East	552	12.81
Orissa	309	7.16
Assam	126	2.92
Bihar	117	2.72
GOI	101	2.34
Total	4308	100.00

Source: Same as Table 4.1.

PROPOSED WORLD BANK LENDING FOR WATER SECTOR IN INDIA: 2005–8

The Board of Directors of the World Bank recently approved the CAS for India for the period FY 2005–FY 2008. During this four-year period the Bank proposes to provide lending to India to the tune of US$15.72 billion (Table 4.13). Of this committed lending, US$3.16 billion (about 20 per cent) has been earmarked for the water sector. While at this stage it is difficult to give a precise allocation of the total water lending to different water components, an approximate classification of the proposed water lending into different project components suggest that of the total proposed water lending of US$3.2 billion, about 44 per cent is for irrigation, 22 per cent for RWSS, 17 per cent for hydropower, 13 per cent for stand-alone WR, while the remaining about 3 per cent is for UWSS.

TABLE 4.13: Proposed Lending for Water Sector, 2005–8

(US$ million)

Component	Project Lending	Project Lending as Per Cent Total Bank Lending	Project Lending as Per Cent Total Water Lending
Irrigation	1390	8.8	43.9
UWSS	100	0.6	3.2
RWSS	700	4.5	22.1
Hydro	550	3.5	17.4
WR stand-alone	424	2.7	13.4
Total water lending	3164	20.1	100.0
Total bank lending	15723	100.0	

Source: Same as Table 4.1.

A comparison of the proposed per year average level of project lending for water components in

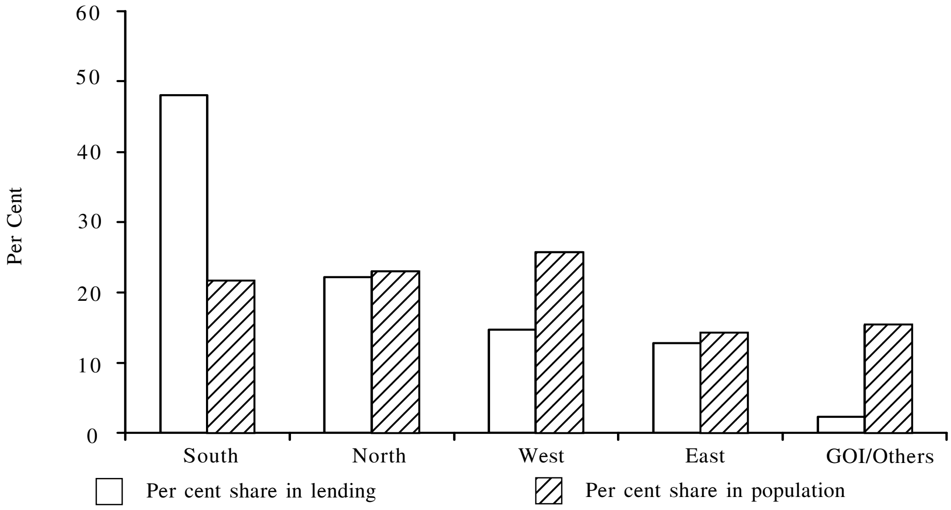

Figure 4.13: Different Regions in Total World Bank Lending and Total 2001 Population (%)

Source: Table 4.12.

2005–8 with the per year committed level of lending (at nominal prices) in the immediate past (1999–2004) and in recent years (1993–8) shows a significant step up in proposed level of lending (Table 4.14, Figures 4.14 and 4.15). The level of proposed lending per year is 2.8 times that of annual average lending during 1993–8 and about 5.7 times that of average annual lending during 1999–2004. In absolute terms the level of proposed lending for all the components, except UWSS, is much higher than that prevailing in both the earlier periods. The hydropower component which was hitherto neglected will get on an average US$138 million lending per year.

A comparison of the proportionate allocation of the committed/proposed water component lending amongst the constituent components with those prevailing in the immediate past period of 1999–2004 suggest an increase in irrigation and hydro and a decline in the remaining three—UWSS, RWS, and WR stand-alone projects.

TABLE 4.14: Average Lending (per year) for Water Components, 1993–2008

(US$ million)

Component	1993–8	1999–2004	2005–8
Irrigation	188 (67)	40 (29)	348 (44)
UWSS	41 (14)	15 (10)	25 (3)
RWSS	22 (8)	56 (41)	175 (22)
Hydro	0 (0)	0 (0)	138 (18)
WR stand-alone	30 (11)	28 (20)	106 (13)
Total water lending	281 (100)	139 (100)	791 (100)

Note: Figures in parentheses denote percentages.
Source: Same as Table 4.1.

SUMMING UP

Although World Bank lending for the water sector in India constitutes only a small part of India's total annual water sector outlays, yet the Bank has been recognized as the most important non-government partner for development and management of the water sector in the country. While the declining trend of Bank lending for the water sector in India is likely to be reversed somewhat in the coming years, the absolute amount of lending and the trends in lending when seen in conjunction with the squeezing of public funds for investment in the water sector and steeply rising demand for water because of increasing

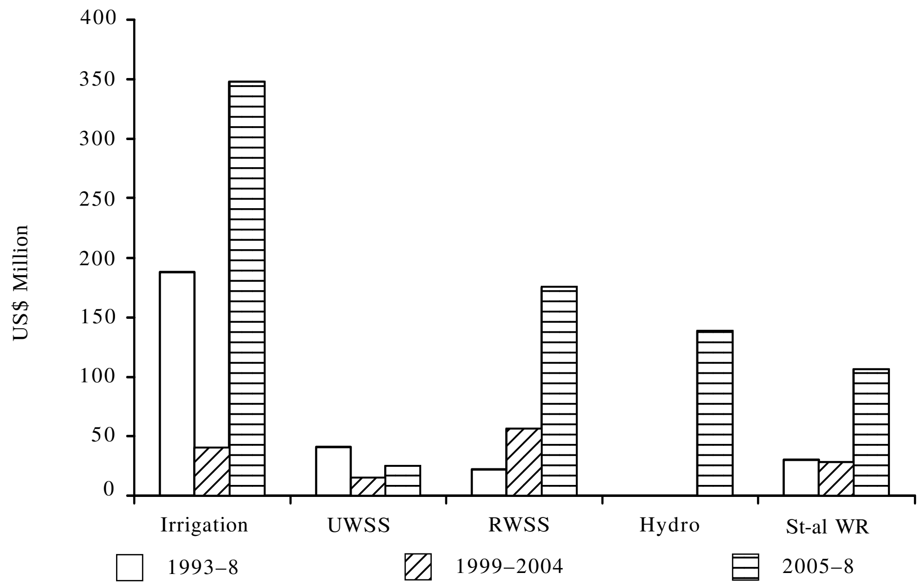

Figure 4.14: Average Per Year Lending for Water (US¯million)
Source: Table 4.14.

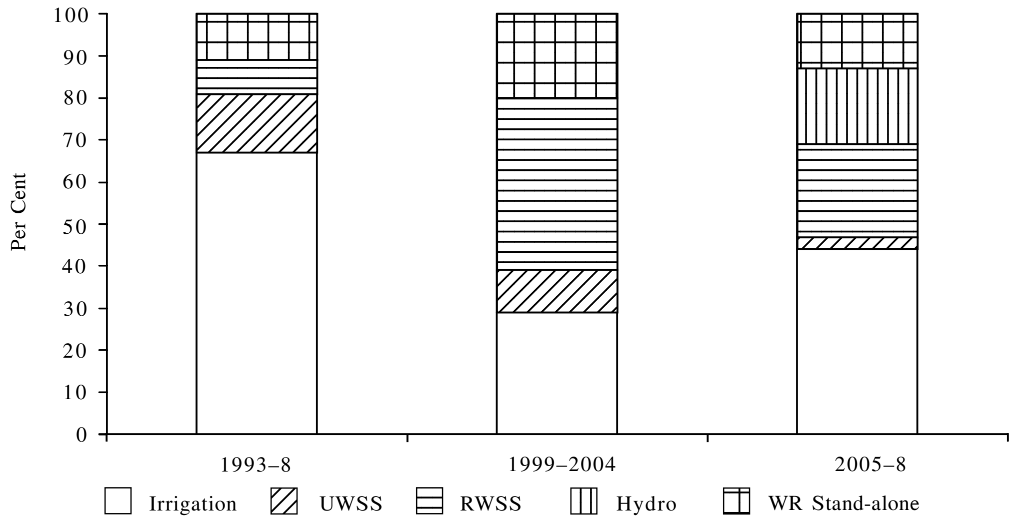

Figure 4.15: Allocation of Total Water Lending into Different Components (%)
Source: Same as Figure 4.5.

population and improving lifestyles, call for mobilization of massive investment resources from the non-traditional sources in both the development and the more efficient management of water resources. Failure to do so can have important implications not only for water sector per se but for the country's economic growth and poverty alleviation as well.

The prevailing circumstances would suggest that the private sector would have to play an important complementary role. Encouraging the private sector to invest, however, requires creating an investment climate conducive to its participation in the sector. That such an environment is lacking is corroborated by the fact that not only in India, but in the entire South Asia region, the private sector is nearly absent from any large-scale participation in the water and sanitation sector. Stimulating private sector investment either on stand-alone basis or in collaborative public–private projects would require wide ranging institutional, management, and policy reforms.

As the experience with some of the efforts made in this direction in the World Bank-funded projects in some of the Indian states demonstrate such reforms, though slow to come by, can be made. There has been a big change in the awareness and thinking of the planners. Speeding up these reforms to attract more investment funds and improve management and sustainability of the water sector is an important political–economic challenge which India will need to undertake.

Realizing the enormity of the task and the diversity and complexity of the socio-political environment, coupled with little attention to water resource management given in the past, India can prioritize these reforms in a more pragmatic way (catching the low hanging fruits first) keeping the far-sighted vision of achieving these reforms in due course. Reforms would need to be undertaken not only in the water sector but also in complementary sectors which have a bearing on the water sector. There is a vast demand–supply gap in the provision of electricity in India. The enormous untapped hydropower potential offers considerable scope for supply augmentation. The investments in hydropower, both from the World Bank and private investors, have, however, been slow to come due to financial non-viability of investment in hydropower as a result of distortions and slow progress in reforms in the electricity sector. Attracting larger funds for development of hydro potential would need acceleration of electricity reforms. Once the pace of these reforms has been set in motion, additional investments not only from the private and other sectors, but from the World Bank as well will come in to complement the public resources.

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APPENDIX 4.1

Table: A4.1 Portfolio of Bank Water Lending FY, 1982–2005[4]

Project ID	Project Name	FY Approval
9786	MP Minor Irrigation	1982
9798	Haryana Irrigation II	1983
9799	UP Tubewells II	1983
9797	Himalayan Watershed Management	1983
9801	Maharashtra Water Utilization Project	1983
9812	Rainfed areas Watershed Development	1984
9814	Periyar Vaigai Irrigation II	1984
9813	Upper Ganga Irrigation	1984
9815	Gujarat Medium Irrigation II	1984
9829	Narmada River Dev. S.S. Dam and Power	1985
9830	Narmada River Development Water Del & Drain	1985
9845	West Bengal Minor Irrg	1986
9893	Maharashtra Composite Irr III	1986
9828	Nabard Credit Project	1986
9843	AP Irrg. II	1986
9859	Bihar Public Tubewell	1987
9846	National Water Management	1987
9898	Upper Krishna (Ph II) Irrigation	1989
9965	Punjab Irr and Drainage	1990
996	UP Sodic Lands Reclamation	1993
9964	Water Resources Consolidation Haryana	1994
10476	Tamil Nadu WRCP	1995
10529	Orissa WRCP	1996

(Contd ...)

[4] Though part of water sector lending, this list does not include hydropower or other power projects. The selection of projects after 1993 is as per the Water Resources Database.

Table A4.1 (Contd ...)

Project ID	Project Name	FY Approval
35158	AP Irrigation III	1997
50646	UP Sodic Lands II	1999
41264	Watershed Management Hills II	1999
9860	Watershed Management Plains	1990
9882	Watershed Management Hills	1990
9877	Dam Safety	1991
10463	Industrial Pollution Prevention	1995
10485	Hydrology Project	1996
9810	Water Supply and Sewerage	1983
9827	Tamil Nadu Water Supply	1984
9858	Kerala Water Supply and Sanitation	1986
9857	Bombay Water Supply and Sewerage 3	1987
9954	Madras Water Supply and Sanitation	1987
9890	Hyderabad Water Supply and Sanitation	1990
10369	Maharashtra Rural Water Supply	1991
10418	Karnataka Water Supply and Environment	1993
10461	Madras Water Supply II	1995
10480	Bombay Sewage Disposal	1996
10484	UP Rural Water	1996
50637	Tamil Nadu Urban Development II	1999
10408	Bihar Plateau	1993
49385	AP Economic Restructuring Project	1998
10522	Assam Rural Infr Project	1995
9906	Industrial Pollution Control Project	1991
67216	Karnataka Watershed Development Project	2002
50653	Second Karnataka RWSS Project	2002
55954	Kerala Rural Water and Env Sanitation Project	2001
40610	Rajasthan Water Sector Restructuring Project	2002
50647	UP Water Sector Restructuring Project	202
43728	Environment Capacity Building Project	1997

5

Water and Economic Growth

RAMESH BHATIA

INTRODUCTION AND OVERVIEW

The development and management of water resources plays a crucial role in the economic growth and social development of India. Investments in water infrastructure (multipurpose dams, canals, small check dams, tubewells, and pumpsets) have generated direct and indirect benefits to the people in various regions of the country. Irrigation provides the bulk (55 to 65 per cent) of the foodgrains output and a substantial part of the output of commercial crops. Irrigated agriculture provides employment, incomes, and livelihood to millions of farmers and agricultural labour in the country. Hydropower constitutes 21 per cent of total electric power capacity in the country and generated 15 per cent of electricity in 2001. Adequate water supply and sanitation services have benefited millions in rural and urban areas. Water supply to rural enterprises and industrial units and thermal power plants has generated employment and incomes. Major dams and barrages have provided benefits of tourism, navigation, flood control, and reduction in the adverse impacts of drought. In addition to these direct impacts, water projects have indirect and induced economic impacts that have been as high as the direct economic impacts.

WATER RESOURCES AVAILABILITY AND USE

India's utilizable surface water resources are estimated at 690 BCM, in addition to the annual replenishable groundwater resources of 432 BCM (GOI 2002a). Thus, the total[1] utilizable water in the country is assessed at 1122 BCM. According to available estimates,[2] total water use (gross withdrawals) in the country was estimated at 552 BCM in 1990 out of which 460 BCM (gross) or 83.5 per cent was withdrawn for agriculture;[3] 25

[1] Actual utilizable water resources may differ from the total of 1122 BCM because the resource estimates of surface and groundwater have been made independently by the two organizations the Central Water Commission and the Central Groundwater Board respectively. In view of this, the inter-action between the two resources and the change in utilization possible from one source because of the development of the other source may not have been fully considered in the figures.

[2] Source: Inter-Sectoral Water Planning and Allocation. GOI (1997) as quoted in Pitman (2002). Also see World Bank: India: Water Resources Management Sector Review (1998a), Main Report.

[3] These estimates are for water withdrawals and do not reflect water demand for the agricultural sector or industrial sector. The estimates of river water diversion assume that all the diverted waste is consumed whereas more than half is recycled either through groundwater or through drainage.

BCM (or 4.5 per cent) for the domestic sector; and 12 per cent for industry and thermal power. Estimated withdrawals for the year 2000 were around 630 BCM. Given the growth of population, incomes, and urbanization, the demand for water in the domestic sector is estimated to increase from 25 BCM in 1990 to 70 BCM in 2025, an increase of 180 per cent. The growth of industries and thermal power will require 150 BCM of water (withdrawals) in 2025 compared with 65 BCM in 1990. Total estimated demand for water (gross withdrawals) for 2025 for irrigation is to increase from 460 BCM in 1990 to 730 BCM in 2025, an increase of 58 per cent.

INVESTMENTS IN THE WATER SECTOR

Investments in the water sector[4] have been mostly in the public sector supplemented by private sector expenditures on wells, tubewells, and pumpsets. Over the last 50 years, total estimated plan expenditures on the irrigation sector have been Rs 3830 billion (at 2002 prices) (GOI 2002b). Of this total, 65 per cent or Rs 2520 billion has been allocated for major and medium projects, Rs 700 billion to minor irrigation projects, while Rs 460 billion has been spent on minor irrigation through institutional finance. The share of plan expenditures on irrigation (as a ratio of total plan expenditures) declined (Figure 5.1) from 23 per

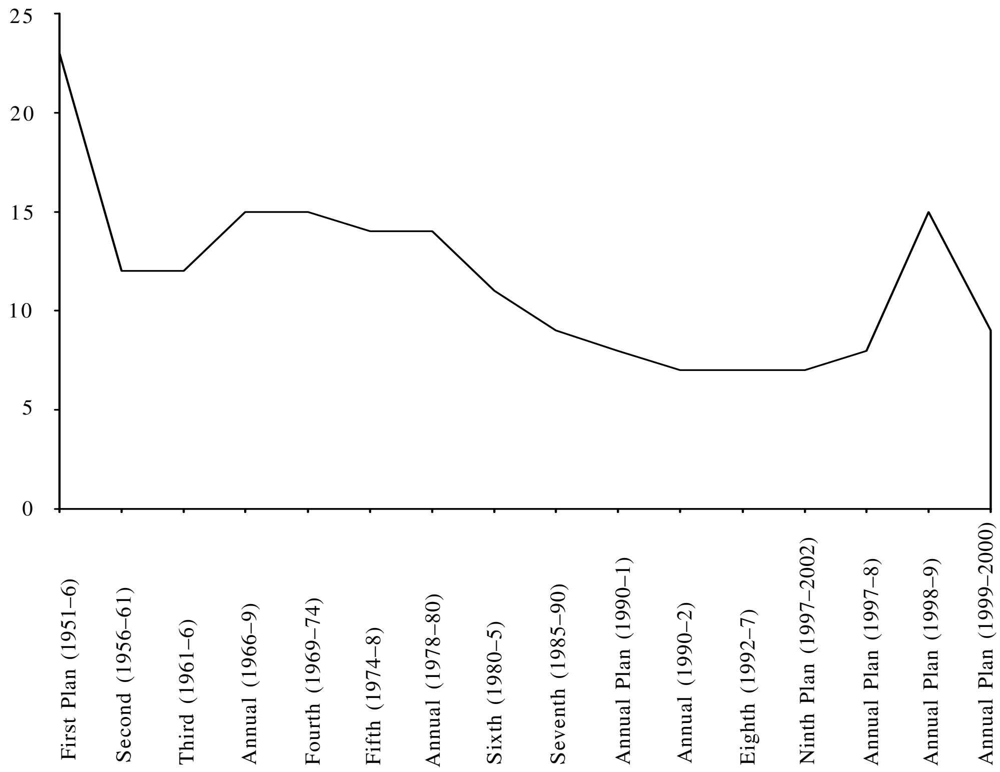

Figure 5.1: Financial Expenditures on Irrigation as Per cent of Total Plan Outlays, 1950–2000

Source: GoI (2006).

[4] The investment figures here are for major and medium projects, some of which are multipurpose and include hydropower.

cent during the First Plan (1951–6) to only 7 per cent during the Eighth Plan (1992–7) and to 9 per cent in annual plan for 1999–2000. Plan expenditures[5] on major and medium irrigation projects have been declining (in absolute terms at constant prices) from 1981 to 1997. Public investment[6] in agriculture (at 2002 prices) declined (by 14 per cent) from Rs 72.4 billion in 1993–4 to Rs 62.5 billion in 1998–9.

Irrigation expenditure by the states has declined significantly since the 1970s. In the early 1970s it was the largest budget item among total expenditures on infrastructure and rural development (irrigation, power, roads, rural development and agriculture) accounting for more than 40 per cent. But by the early 1990s, this had declined by half even though India was the largest spender on the agriculture sector among all Asian countries. States' capital expenditure on power and irrigation, in marked contrast to roads and rural development, significantly exceeded revenue expenditures until the late 1980s, but by 1991 revenue expenditures (mostly wages and salaries) on irrigation outstripped capital investment (Pitman 2002).

Public investments in rural electrification (RE) were primarily justified for energization of pumpsets for irrigation pumping. Investments in RE have been increasing steadily since the 1960s and were Rs 75 billion (6 per cent of the total outlay on the power sector) during the Ninth Plan (1997–2002). Public investments in rural electrification along with institutional credit available from banks and NABARD (National Bank for Agricultural Development) encouraged private investments in wells, tubewells, and pumpsets. Electric pumpsets[7] used for irrigation in India have increased steadily from 1.6 million in 1970–1 to 8.9 million in 1990–1 and to 13.0 million in 2001–2. In addition, diesel pumpsets used in irrigation have increased from 2.8 million in 1980–1 to 5.2 million in 1992–3.

Public expenditures in the provision of water and sanitation services (WSS) in urban areas under various plans since 1951 have been around Rs 630 billion (at 2002 prices). The corresponding figures for WSS in rural areas have been of the order of Rs 700 billion (at 2002 prices) over the last four decades or so.

Development and Impact of Irrigation

As noted in the above discussion, irrigation is the predominant user (more than 80 per cent) of water resources in the country. Agricultural performance is fundamental to India's economic and social development. Agriculture contributes 26 per cent of GDP, 60 per cent of employment, and is the primary source of livelihood in rural areas which account for 72 per cent of India's population. With all arable land under cultivation, increased agricultural output will depend on raising crop yields, increasing cropping intensity, and diversification to higher-value crops. Indian irrigation has been the principal force behind agricultural growth. Its role will be indispensable to future growth. The performance of irrigated agriculture, which contributes more than 55 per cent of agricultural output, will be the most important influence on the objectives of growth, employment generation, food security, and poverty reduction.

Although India has one of the largest irrigation systems in the world, irrigation development has not been impressive over time. By 1950, 21 m.ha. of land were under irrigation, about 40 per cent of which was from canals. During the last 50 years, net irrigated area (NIA) has increased by around 36.3 m.ha. only (less than 0.8 m.ha. per annum). In 2000, 57.2 m.ha. or only 41 per cent of the net sown area received irrigation (Table 5.1). Thus, the irrigated area in 2000 was substantially lower

[5] According to Rao (2002), even though as much as 40 per cent of the irrigation potential still remains to be exploited, public investment in major and medium irrigation schemes has been declining, in real terms, throughout the 1980s and the 1990s.

[6] *Economic Survey*, 2001–2, GOI, p. 202. It is not clear if this includes investments in rural electrification.

[7] Electric pumpsets data from TEDDY, 2002/03, p. 170; Oil pumpsets data from YES (Year Book of Energy Environment Statistics), 1999/2000, p. 709.

than the ultimate irrigation potential of 140 m.ha. As much as 83 m.ha. of cultivated area is still dependent on the uncertainties of rainfall. Estimated gross irrigated area (GIA) was about 68.4 m.ha. in 1993–4 and 76.3 m.ha.[8] in 1999–2000. This gives irrigation intensity[9] of 133.3 in 1993–4 and 1999–2000.

Changing Pattern of Irrigation

During the first three decades (1950–80), public investment in dams, barrages, and canals increased the area under canal irrigation from 8.3 m.ha. to 15.3 m.ha. (by 88 per cent or about 230,000 ha. per annum). A few of these projects

TABLE 5.1: Development of Irrigation, 1950–1 to 1999–2000

	1950–1	1960–1	1970–1	1980–1	1993–4	1999–2000
Net Irrigated Area (NIA) m.ha.						
Canals	8.3	10.4	12.8	15.3	17.1	18.2
Tanks	3.6	4.6	4.1	3.2	3.2	2.8
Wells and tubewells	6	7.3	11.9	17.7	27.8	33.6
Other sources	3	2.4	2.3	2.6	3.4	2.6
NIA total	20.9	24.7	31.1	38.8	51.5	57.2
Canals area as per cent of NIA	40	42	41	39	33	32
Wells and tubewells area as per cent of NIA	40	30	38	46	54	59
Gross Irrigated Area (GIA) m.ha.	23.2	27.2	38.2	48.5	68.4	76.3

Source: Directorate of Economics and Statistics, Ministry of Agriculture, Government of India, New Delhi.

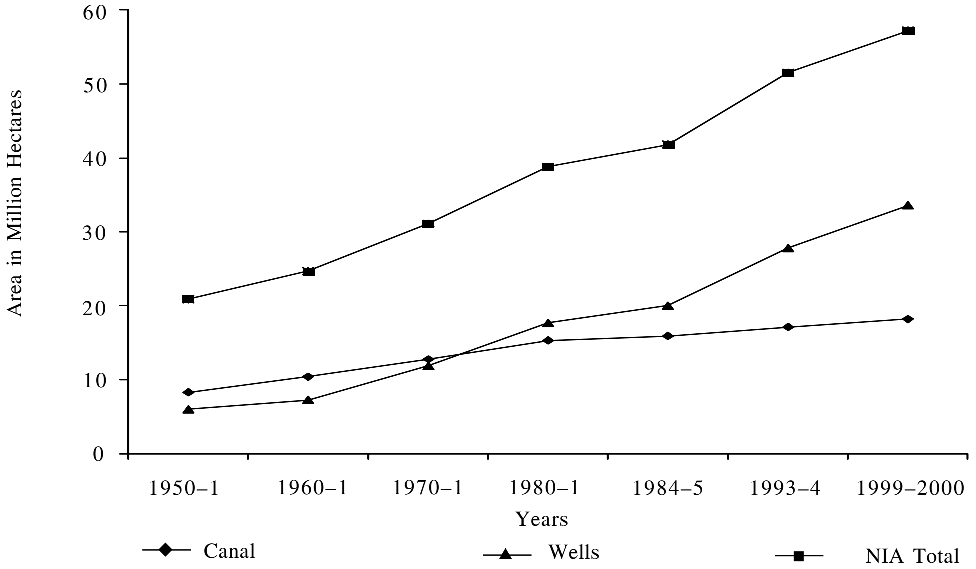

Figure 5.2: Net Irrigated Area by Canal, Wells, and Total
Source: Table 5.1.

[8] These figures have to be seen in the context of estimated Ultimate Irrigation Potential (UIP) of 139.89 m.ha. and the country's created irrigation potential of 94.7 m.ha. by 1999–2000 as given in *Economic Survey*, 2001–2002, GOI, New Delhi.

[9] Irrigation intensity is defined here as Gross Irrigated Area (GIA) divided by Net Irrigated Area (NIA) multiplied by 100.

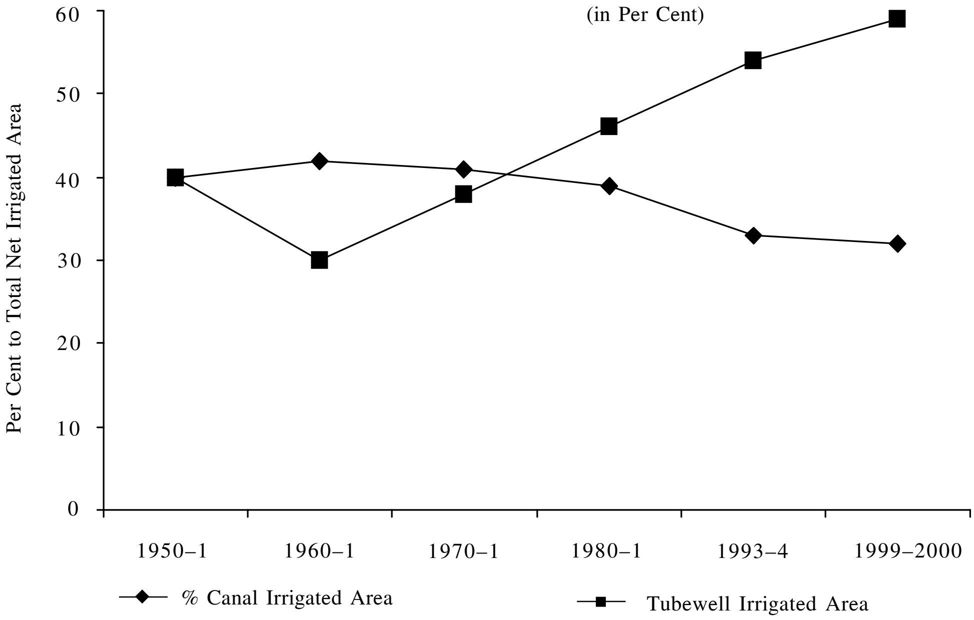

Figure 5.3: Declining Share of Canals and Increasing Share of Tubewells in Net Irrigated Area
Source: Same as Figure 5.2.

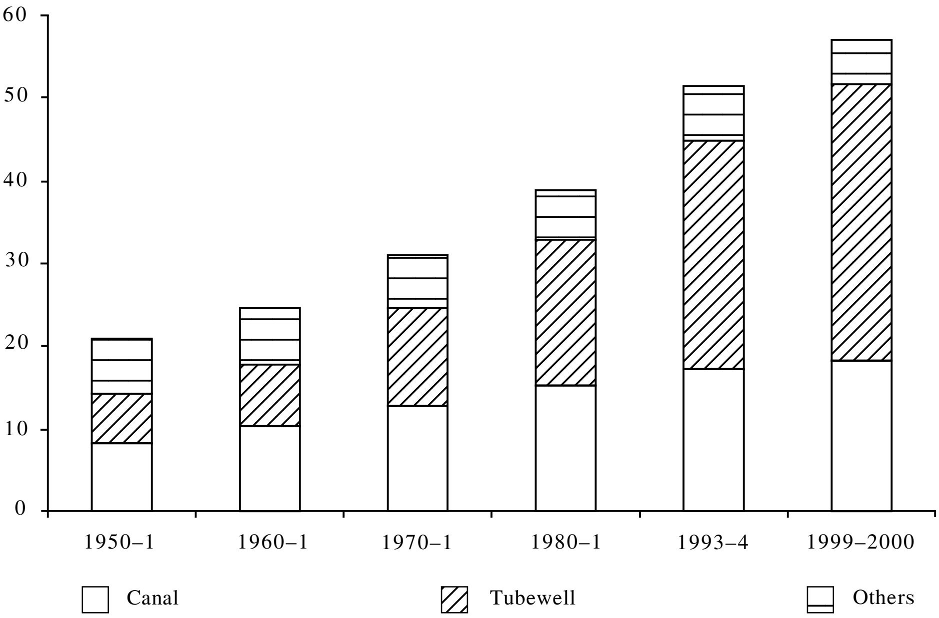

Figure 5.4: Net Irrigated Area by Canal, Tubewell, and Total
Source: Same as Figure 5.2.

were multi-purpose and provided hydropower, irrigation, and flood control. During the last two decades (1980–2000), only 2.9 m.ha. have been added under canal irrigation.[10] As much as 84 per cent of the additional net irrigated area of 18.4 m.ha. in the last two decades has come from private investment in tubewells/wells.[11] As a result of these developments, in 2000, net irrigated area from public canals was only 18.2 m.ha. compared with 33.6 m.ha. from private investments in tubewells, pumpsets, and water distribution channels. Thus, net area irrigated by private wells and tubewells was almost double the net irrigated area under canals in 2000.

As a result of rapid rural electrification, highly subsidized power, and focused rural credit, private sector groundwater-based irrigation provided irrigation to 33.6 m.ha. in 2000. The number of electric pumpsets increased to 10.3 million in 1993–4 and to 12.5 million in 1999–2000. This indicates that, in 2000, there were about 90 electric pumpsets per thousand hectare of net sown area or 372 electric pumpsets per thousand hectare of area irrigated by wells and tubewells. If diesel pumpsets are added, this gives approximately 460 pumpsets per thousand hectare of area irrigated from groundwater.

Thus, the share of area under canal irrigation that was around 40 per cent of the total NIA up to 1981, declined to 32 per cent by 1999–2000 (Figure 5.4). During the same period, the area under tubewells more than doubled from 17.7 m.ha. in 1981 to 33.6 m.ha. in 2000. Thus, the share of area under wells and tubewells increased from 30 per cent (of NIA) in 1961 to 46 per cent in 1981 and to 59 per cent in 2000.

However, it should be recognized that irrigated area under tubewells is partly sustained by the seeped in waters from unlined canals . For example, according to available estimates, the natural groundwater recharge in Punjab could sustain only half the existing number of tubewells in Punjab. In other words the investment in canal works has enhanced groundwater availability in Punjab by a factor of two.[12]

Apart from a rapid increase in the use of groundwater for irrigation, groundwater supplies 80 per cent of the rural and 50 per cent of the urban population (Pitman 2002). Its rapid utilization for irrigation is in direct competition with drinking water supplies and has led to the need to replace dried-up drinking water wells, as well as greatly increased pumping costs and agrochemical pollution in many parts of India. Areas identified as being at risk from overdraft increased at a continuous rate of almost 6 per cent per year over the period 1984–93, and if this continues over 35 per cent of India's groundwater will be at or near permanent depletion within 20 years (Pitman 2002). Externalities of excessive groundwater abstraction include the drying up of rivers that have important environmental benefits, including effluent dilution to acceptable levels. Other problems include saline water intrusion (in Chennai, in some districts of Gujarat), and from drawing fossil saline groundwater into fresh water aquifers in Haryana.

Table 5.2 presents data on interstate variations in irrigation in India. Gross Irrigated Area (GIA) is more than 5 m.ha. in Haryana, Andhra Pradesh, Madhya Pradesh, Punjab, Rajasthan, and Uttar Pradesh. Uttar Pradesh alone accounts for 17.7 m.ha. of GIA or about a quarter of the total. GIA as per cent of Gross Cropped Area (GCA) is higher than 60 per cent in north-western states of Punjab (91 per cent), Haryana (85 per cent), and Uttar Pradesh (66 per cent); and is higher than 50 per cent in Tamil Nadu. States where GIA as per cent of GCA is less than the all-India average of 40 per cent are: Kerala (16 per cent), Maharashtra (17 per cent), Karnataka (26 per cent), West Bengal (26 per cent), Orissa (30 per cent), Rajasthan (36 per cent), and Gujarat (38 per cent).

[10] The decline in the share of area irrigated by canals (from 40 per cent to 32 per cent) is a result of reduction in investments in irrigation by the central and state governments.

[11] Traditional surface water irrigation, mainly from tanks in the south, contributes around 3 m.ha.

[12] According to Dhawan (1989, 1993), 'therefore half the crop output originating from tubewell-irrigated lands in the Punjab state is from groundwater that is of canal origin'.

NIA under wells and tubewells as per cent of total NIA is higher than 50 per cent in Bihar, Gujarat, Punjab, Madhya Pradesh, Maharashtra, and Rajasthan. In Haryana and Tamil Nadu, share of NIA by tubewells is around 50 per cent while in Orissa and West Bengal the share is around 40 per cent. In 1987, the number of pumpsets per 1000 ha was the highest in Tamil Nadu (194) followed by Punjab (160), West Bengal (129), Haryana (120), and Uttar Pradesh (98).

TABLE 5.2: Gross Irrigated Area and Area under Tubewells, 1999–2000

(m.ha.)

State	Gross cropped Area	Gross Irrigated Area	GIA as % of GCA	Area under Tubewells as % NIA
Andhra Pradesh	13.0	5.7	44.1	43.3
Bihar	10.0	4.8	48.2	57.7
Gujarat	10.2	3.8	37.8	78.8
Haryana	6.0	5.1	85.0	49.6
Karnataka	12.1	3.2	26.1	37.6
Kerala	3.0	0.5	15.7	32.1
Madhya Pradesh	26.2	7.1	27.1	57.2
Maharashtra	22.4	3.8	16.9	64.6
Orissa	8.5	2.5	29.5	40.0
Punjab	8.2	7.5	90.9	67.6
Rajasthan	19.3	6.9	36.0	68.9
Tamil Nadu	6.5	3.6	55.0	48.9
Uttar Pradesh	26.6	17.7	66.4	72.9
West Bengal	9.5	2.5	26.1	37.3
Others	7.8	1.6	20.8	4.4
All India	189.4	76.3	40.3	58.7

Source: Same as Table 5.1.

Irrigation and Agricultural Production: Direct Impacts

Agricultural performance is fundamental to India's economic and social development. Agriculture contributes 26 per cent of GDP, 60 per cent of employment, and is the primary source of livelihood in rural areas which account for 72 per cent of India's population. With all arable land under cultivation, increased agricultural output will depend on raising crop yields, increasing cropping intensity, and diversification to higher-value crops. Irrigation in India has been the principal force behind agricultural growth. Its role will be indispensable to future growth. The performance of irrigated agriculture, which contributes more than 55 per cent of agricultural output, will be the most important influence on the objectives of growth, employment generation, food security, and poverty reduction.

Agricultural growth during 1970s to 1990s has relied almost entirely on increasing productivity due to growth in crop yields (including crop substitution to higher-value crops) and expansion of GCA due to cropping more than once per annum on the same land. This latter influence has been quite significant. GCA expanded from 155 to 176 m.ha. from 1965 to 1984 or by 21 m.ha. GCA expanded to 186.4 m.ha. in 1993–4 and to 189.4 in 1999–2000. Estimated GIA was about 68.4 m.ha. in 1993–4 and 76.3 m.ha. in 1999–2000. Thus, in 1999–2000, almost 41 per cent of net sown area (NSA) and 40.2 of GCA received irrigation.

Irrigation affects agricultural production by increasing the intensity of cropping, increasing crop yields, shifting to higher value crops, reducing the variations in output due to drought and so on.

Irrigation and Intensity of Cropping

During 1970s to 1990s, NCA has not changed and agricultural growth has relied almost entirely on increasing productivity due to growth in crop yields (including crop substitution to higher value crops) and expansion of GCA due to cropping more than once per annum on the same land. This latter influence has been quite significant. GCA expanded from 155 to 176 m.ha. from 1965 to 1984, by 21 m.ha. or at nearly 1 per cent growth per annum. In 1993–4, GCA was 186.4 m.ha. and in 1999–2000, the GCA was 189.4 m.ha.

Thus, the intensity of cropping[13] (IC) has increased[14] from 129 in 1984–5 to 135 in 1999–2000. The estimated IC varies across states as 194 for Punjab, 170 for Haryana, and 152 for Uttar Pradesh. Higher intensity of cropping across states (with the exception of West Bengal) is associated with higher per cent of GIA to GCA.[15]

The growth in cropping intensity has been quite variable between states mainly reflecting different rates of irrigation development, the kind of irrigation investment, and rainfall distribution. Rapid development of irrigation in Haryana, Punjab, and Uttar Pradesh has been accompanied by relatively high changes in cropping intensity; for instance, in Punjab from 127 in 1960–3 to 161 in 1980–3 and to 194 in 2000. The nature of the irrigation development in these northwest areas has had much to do with its impact on cropping intensity. Expansion of tubewells and availability of surface water from snow melt sources outside the monsoon season has enabled the growth of rabi and summer crops. Less impact from irrigation is found in areas where irrigation has been designed mainly as 'supplemental' irrigation for the kharif (monsoon) crop based on run-of-the-river irrigation schemes without storage or replenishment from snow melt. Here, irrigation water is itself dependent on rainfall, and cropping intensity has not been greatly influenced by surface water irrigation—a common situation in eastern and central India. In Bihar, substantial growth of surface irrigation has had no apparent impact on cropping intensity.

Various studies[16] show that there is a positive and significant relationship between intensity of cropping and per cent of gross area irrigated.

TABLE 5.3: Changes in Irrigated Area and Cropping Intensity in Major States, 1993–4 and 1999–2000

State	1993–4		1999–2000	
	GIA as a Per Cent of GCA	Intensity of Cropping %	GIA as a Per Cent of GCA	Intensity of Cropping %
Andhra Pradesh	39.6	122.4	44.1	122.7
Bihar	43.2	134.1	48.2	134.2
Gujarat	28.9	113.6	37.8	105.0
Haryana	77.6	165.5	85.0	169.8
Karnataka	23.9	115.2	26.1	117.9
Kerala	13.6	135.9	15.7	134.0
Madhya Pradesh	22.2	125.8	27.1	131.7
Maharashtra	15.3	118.5	16.9	126.3
Orissa	25.8	154.6	29.5	140.3
Punjab	94.9	180.9	90.9	194.4
Rajasthan	29.1	118.6	36.0	124.4
Tamil Nadu	49.5	121.3	55.0	119.3
Uttar Pradesh	64.1	148.1	66.4	151.6
West Bengal	28.7	159.0	26.1	174.5
All-India	36.7	131.2	40.3	132.4

Note: GIA—Gross Irrigated Area; GCA—Gross Cropped Area.
Source: Same as Table 5.1.

Narain and Roy (1980) using cross sectional analysis of statewide data concluded that a 1 per cent increase in NIA resulted in a 0.67 per cent increase in cropping intensity. They also found that cropping intensity was higher on smaller farms and that the impact of irrigation on cropping intensity was lower in higher rainfall areas. Dhawan's (1989) time series analysis led to the conclusion that a 1 per cent increase in the percentage of gross irrigated to gross cropped area had resulted in a 0.62 per cent increase in overall crop intensity. Recent estimates using state-wise data for 1993–4 and 1999–2000 (Table 5.4) indicate that a 1 per cent increase in the percentage of gross irrigated to gross cropped area had resulted in a 0.61 to 0.63 per cent increase in overall crop intensity. Rao et al. (1988) found a much lower impact on cropping intensity from

[13] Intensity of Cropping (IC) is defined as (GCA/ NCA) × 100.

[14] At the all-India level, irrigation intensity (irrigation of more than one crop per annum expressed by the ratio of gross to net irrigated area) increased from 110 per cent in 1950/51 to 129 per cent in 1984/85 to 133 in 2000. This has contributed to the growth in overall cropping intensity.

[15] The introduction of HYVs cropping technology on residual moisture has partly contributed to the increase in rainfed double cropping.

[16] Also see World Bank (1991).

TABLE 5.4: Impact of Irrigation (GIA/GCA) on Intensity of Cropping (IC)

Year	Dependent Variable	Constant (t-value)	Coeff. (t-value)	Rbar^2	N
1993–4	Intensity of Cropping/c	112.5389 (13.09)	0.6073955 (3.25)	0.4687	14
1999–2000	Intensity of Cropping/c	111.9938 (9.31)	0.6262339 (2.54)	0.3495	14

Source: Computed from data in Table 5.3.

irrigation, but had similar conclusions to the above regarding regional differences in impact.

Future prospects for expanding GCA will depend upon the type of irrigation investments feasible (World Bank 1991). The following developments will have particularly strong impact on cropping intensities. First, the expansion of groundwater irrigation will continue to have a very positive impact. Second, storage schemes for irrigation outside the monsoon period will have much greater impact than irrigation using run-of-the-river diversions. Third, irrigation investments that can provide some off-season water in drier regions would have a greater impact on GCA than in wetter eastern and central regions where somewhat longer monsoon periods and presence of residual moisture provide scope for a second yield of rainfed crops.

Irrigation and Crop Yields

Available data and studies indicate that productivity from irrigated lands is much higher than under rainfed conditions. Around 55 per cent of gross agricultural output can be attributed to production from irrigation, though some estimates put these figures even higher.[17]

Yield differences are, however, very variable and in particular are influenced by rainfall levels and the nature and quality of individual irrigation systems. The largest increments in yields are found in drier states with well-functioning irrigation systems. Table A5.3 presents state-level average yields for rice and wheat under irrigated and unirrigated conditions (1980–3). In Punjab, average yields of rice increase from 1 tonne/ha under rainfed conditions to 3 tonnes/ha under irrigation, while wheat yields increase from 1.6 to 3 tonnes/ha. In 2000, in Punjab where almost the entire area under foodgrains is irrigated, the foodgrain yield is around 4 tonnes/ha. Much lower impact is apparent in eastern and central India where rainfall is higher and the quality of the irrigation service is generally much lower. For example, the difference between irrigated and unirrigated rice yields is 700 to 800 kgs/ha in Bihar and West Bengal. In Orissa, the difference in rice yields was a mere 150 kgs/ha. Monsoon waterlogging and lack of drainage further reduces the yield augmenting impact of irrigation in this region. In the case of Tamil Nadu and Andhra Pradesh, the difference in rice yields are 1400 kgs/ha and 1200 kgs/ha, respectively. In the case of wheat, the yield differences between irrigated and unirrigated are 400 kgs/ha in Bihar and 845 kgs/ha in Madhya Pradesh.[18]

Similar observations can be made from Table A5.4 based on Dhawan's analysis (1988) of yields of foodgrains taken as a whole and of all major crops expressed in terms of food energy equivalents. For India as a whole, Dhawan found that foodgrain yields in 1983–4 under irrigated conditions averaged 1980 kgs/ha as compared with rainfed yields of 864 kgs/ha, an increment of

[17] According to Pitman (2002), 'Estimates of the contribution of irrigation to total agriculture production vary, but recent research indicates it may be in the range 55 to 78 per cent of total food production, and 95 per cent of non-food production'.

[18] The analysis by selected projects summarized in Table A5.6 provides some indication of the departures from state averages present at the level of individual irrigation schemes.

TABLE 5.5: Impact of Irrigation (GIA/GCA) on Yield of Foodgrains (kgs/ha)

Year	Dependent Variable	Constant (t-value)	Coefficient (t-value)	Rbar^2	Number of States (N)
1993–4	Yield (kg/ha)	552.96 (2.29)	27.23 (5.18)	0.69	14
1999–2000	Yield (kg/ha)	555.53 1.78)	29.95 (4.68)	0.64	14

TABLE 5.6: Impact of Area under Irrigation and Number of Pumpsets

Dependent Variable: Average Value of Output (Rs/ha)

Year: 1992–5

	Coefficient of Independent Variable				
Constant	% GCA Irri.	PS/Ha. 1987	E.PS/Ha 1993–4	R^2	N
5541	68.5			0.14	16
(3.26)	(1.83)				
4321		53.7		0.69	16
(5.16)		(5.87)			
5304			37.95	0.5	16
(5.44)			(4)		

Note: For details, see text.

1.1 tonne/ha or a 130 per cent increase in productivity per hectare. Taking all crops into consideration, food energy equivalent yields were 2208 kgs/ha compared with 877 kgs/ha under rainfed conditions, up 1.3 tonnes or by 150 per cent. Table 5.5 shows that there is a positive and significant relationship between per cent of GCA irrigated and the yield of foodgrains across 14 states in India. The coefficient shows that a 1 per cent increase in gross area irrigated will result in an increase of around 30 kgs of foodgrains per ha.

According to Dhawan (1985), the differential between land productivity per net irrigated hectare[19] between wells and canals was estimated to be as high as 3.9 tonnes/ha in Tamil Nadu to 3.3 tonnes/ha in Haryana, 2.3 tonnes/ha in Andhra Pradesh, and 2.2 tonnes/ha in Punjab. The difference between two yields is relatively lower in Karnataka (1.7 tonnes/ha) and Madhya Pradesh (0.8 tonnes/ha). The reason for this yield differential is that farmers with wells have much better control over water than is possible through canal irrigation. In turn, tanks were found to have lower yields than canal irrigation probably reflecting the greater dependency of tanks on seasonal surface water supplies. Some care must nevertheless be taken in interpreting these results for the purpose of orienting investment decisions. First, wells are frequently dependent on replenishment of groundwater by percolation from surface irrigation water supplies. This applies particularly in drier areas such as the north west. Second, part of the yield from wells may reflect conjunctive use of both surface and groundwater supplies. Notwithstanding, well irrigation, as necessary in conjunction with surface irrigation, is clearly an attractive means to increase yields.

The impact of irrigation on crop yields, cropping intensity and possibilities for substitution to higher value crops, translates to substantial

[19] In foodgrain energy equivalent units as explained in Dhawan (1985).

differences in income between irrigated and unirrigated farming. Table A5.8, based on a survey in Gujarat (Patel and Patel 1989) indicates that net income per hectare on irrigated farms was on average more than double the net incomes on rainfed farms.[20]

Table A5.9 compares data from three non-irrigated districts with three irrigated districts in Andhra Pradesh. Per capita monthly expenditure levels were used as a proxy for incomes. Per capita expenditures were on average 61 per cent higher in the irrigated districts. A striking feature is that even for the two farm size categories below one hectare (classified as marginal farms) in the irrigated districts, per capita incomes about equaled or exceeded incomes from rainfed farms in the top size category (4 hectares and above). The impact of farm size on the benefits from irrigation is also apparent. For a marginal irrigated farm (below 1.0 hectares), per capita expenditure was found to be on average 35 per cent greater than marginal rainfed farms, while for farms over 4 hectares, per capita expenditures were 123 per cent greater in the irrigated districts. Thus, while irrigation confers benefits in all farm size categories, the benefit is relatively greater for larger farmers.

According to Rao (2002), the green revolution has substantially raised yields in irrigated areas in India, resulting in a rise in the productivity of irrigation water. Since irrigated area under foodgrains accounts for the bulk of the increase in foodgrains output, growth of foodgrains output in relation to the growth of irrigated area under foodgrains would give a good measure of the changes in the productivity of irrigation water. During the 1970s, despite the green revolution, which was confined largely to wheat in the north western region, foodgrains output grew at about the same rate (2.31 per cent p.a.) as GIA (2.3 per cent p.a.). However, during the 1980s, the green revolution was broad-based covering rice in the central and eastern regions of the country where high rainfall supplements irrigation. Thus foodgrains output grew at a higher rate (2.9 per cent p.a.) than irrigated area (1.72 per cent p.a.) resulting in a positive growth in the productivity of irrigation water. However, in the post-reform decade of the 1990s, there was a deceleration in the growth of foodgrains output (2.0 per cent p.a.) during 1990–1 to 1996–7 along with a low growth of irrigation (1.7 per cent p.a.).

Value of Output With and Without Irrigation

Vaidyanathan (1987), in an analysis of the impact of irrigation in 12 major states covering 12 crops for the period 1974–5 to 1978–9 estimated that the average value productivity per hectare of irrigated crops was about Rs 1849, which is about 180 per cent more compared to rainfed lands. There is a lower impact of irrigation in eastern and central India than in the drier states of the north west and south India.

In a recent study, Vaidyanathan (2004) has provided estimates of the overall crop productivity (in terms of market value) under irrigated and rainfed areas for most major states for 1991–3 (see Table 5.7). Output per hectare is invariably higher on irrigated areas than on rainfed areas. Taking the 12 states as a whole, a hectare of irrigated area yielded, in 1991–3, around Rs 5300, nearly 2.2 times that of unirrigated crops (Rs 2400 per hectare). The extent of yield differential,[21] however, varied widely across states: the absolute

[20] Also of interest is that while net income per hectare is very similar across farm sizes in the rainfed sample, net income per hectare increases with larger farm size despite a tendency for cropping intensity to fall. Findings from other surveys indicate that this may not be typical. A possible explanation here is that increasing farm size was accompanied by an increase in technological sophistication and presence of higher return cash crops with larger farm sizes.

[21] According to the author (Vaidyanathan, personal communication), the estimates of value of output are approximations subject to several caveats and cautions. In particular, the estimates of irrigated and unirrigated yields for Punjab and possibly Haryana should be treated with caution because the sample survey estimates of rainfed yields are likely to have large margins of error. In the case of Orissa and West Bengal, the data on irrigated and unirrigated areas as well as their crop patterns are suspect.

TABLE 5.7: Output per Hectare of Irrigated and Rainfed Crops, 1991–3

State	Irrigated gvpi/gia Rs	Unirrigated gvpui/guia Rs	Ratio of Output/ha (irr/unirr)	Difference in Output/ha (irr/unirr) Rs
Andhra Pradesh	6331	2565	2.47	3766
Bihar	5694	1778	3.20	3916
Gujarat	5271	2175	2.42	3096
Haryana	4655	2789	1.67	1866
Karnataka	6769	1946	3.48	4823
Maharashtra	6378	2264	2.82	4114
Madhya Pradesh	3975	1829	2.17	2146
Orissa	4230	2067	2.05	2163
Punjab	5105	4398	1.16	707
Rajasthan	3545	1725	2.06	1820
Tamil Nadu	6582	2962	2.22	3620
Uttar Pradesh	5159	2429	2.12	2730
12 states	5300	2400	2.20	2900

Note: gvpi—Gross Value of production Irrigated, gia—gross irrigated area, guia—gross unirrigated area, irr—Irrigated, unirr—Unirrigated, gvpui—Gross Value of production Unirrigated.
Source: Vaidyanathan (in collaboration with Sivasubramaniyan) (2004).

yield differential ranging from a mere Rs 707 in Punjab to Rs 4800 in Karnataka; and the yield ratio of irrigated to unirrigated crops from 1.16 to 3.5.

Since irrigated yields are higher than non-irrigated yields everywhere, one would expect interstate variations in overall crop yields to be strongly correlated with variations in the extent of irrigation. Interstate differences in output per unit of total crop area, yields are strongly correlated (correlation coefficient = 0.84) to the irrigation ratio (gia/gca).

Since well irrigation permits much better regulation of quantum and timing of water allocation, areas with a higher proportion of irrigated area under wells are expected to show a better performance in terms of crop yields. However, the association between the crop yield and the proportion of area under wells is negative though non-significant.

Contribution of Irrigation to Agricultural Productivity

The contribution of irrigation has been estimated using econometric models in a number of studies. In these studies, irrigation is treated as one of the variables to explain variations in agricultural growth. In two recent studies on India's agricultural growth, irrigation has been considered both as an input as well as a type of public infrastructure investment (Evenson et al. 1999; Fan et al. 2000). In addition to considering irrigation as a direct input in the computation of TFP (total factor productivity), irrigation has been included as an independent variable (alongwith fertilizer) in the TFP equation. This is due to two reasons. First, the justification for the irrigation variable is that, in the absence of water markets and water price data, and due to massive subsidies for public and private irrigation, the estimate of the share of irrigation in the input aggregation is crude. It could thus understate the contribution of irrigation water. In addition irrigation systems are a type of public infrastructure investment and would be expected to contribute to productivity growth on these grounds. 'Most importantly, however, irrigation intersects with technology by making it possible to adopt high-yielding varieties and increasing their value when adopted. This interaction effect cannot be captured by computing the contribution of inputs directly' (Evenson et al. 1999).

According to the results reported, 'the estimated effect of irrigation on TFP is strongly positive, indicating that irrigation does influence productivity above and beyond its value as an input (as noted, however, that this may reflect poor measures of its value as an input)' (Evenson et al. 1999).

The study on agricultural research and productivity growth in India also recognized that the marginal effect of the expansion in irrigated area on TFP has also increased over time. This improvement can be attributed to the growth in private tubewell (groundwater irrigation), which was more rapid than the growth of public canal irrigation.

According to another study (Fan et al. 2000) linking irrigation with agricultural productivity, 'public irrigation systems have the third largest impact on TFP (total factor productivity) growth; an additional Rs 100 billion would add 0.6 per cent to the TFP growth rate. As a contrast, an additional investment of Rs 100 billion in R&D (agricultural research and extension) would increase TFP growth by 7 per cent while an additional Rs 100 billion invested in roads would increase TFP growth by 3 per cent. It must be emphasized, however, that these are marginal impacts of additional investments in R&D and roads and are available when investment in irrigation has already been made resulting in use of improved seeds, fertilizer, etc. resulting in higher output that is transported through these rural roads. Hence, it is the sequencing of investments in irrigation, R&D, and roads that affect their marginal impact on productivity. This has been recognized by the authors in the context of investments in power in rural areas. Government expenditure on power has positive but small and statistically insignificant impact on poverty and TFP growth. This may be because the government has already invested heavily in rural electrification and the marginal returns from additional investments are now low.

Irrigation and Regional Development

Irrigation has a strong influence on the level and growth of agricultural output in various regions/states of the country. Table A5.5 presents data on state and region-wise levels and growth of crops yields (average value of yields (Rs/ha) during 1962–5, 1970–3, 1980–3 and 1992–5. Data are available for 43 major crops (at 1990–3 constant prices). It may be seen that the north west region (Punjab, Haryana, Uttar Pradesh, and Himachal Pradesh) which has a high share of gross cropped area irrigated (67 per cent) also has the highest growth rates in the value of yields (among all regions) during each of the sub-periods considered. During 1992–5 over 1980–3, the growth rate is 2.9 per cent per annum (compound) in the north west region compared with the all-India average of 2.3 per cent per annum.

In Punjab and Haryana that have high per centage of area irrigated (95 per cent and 77 per cent), the level of average value of yields is higher than in all states (except Kerala and Tamil Nadu). Average value of yields in the central region (Gujarat, Madhya Pradesh, Maharashtra, and Rajasthan that have very low, 12 per cent of area irrigated) is almost one-half of that in the north west region where 67 per cent of area is irrigated. Average value of yields in the eastern region (Assam, Bihar, Orissa, and West Bengal that have 31 per cent area irrigated) is 76 per cent of that in the western region.

In Punjab where 95 per cent of area is irrigated, average value of yields (Rs 13,597/ha) during 1992–5 was almost double the all-India average (Rs 7388/ha) with 36 per cent of area irrigated (Table A5.5).

TABLE 5.8: Region-wise Levels of Crop Yields and Area Irrigated (Rs/ha at 1990–3 Constant Prices)

	Average Value of Yields (Rs/ha.)		Per Cent of Gross Cropped Area Irrigated	
	1980–3	1992–5	1980–3	1992–5
North west region	6423	9583	56	67
Eastern region	4944	7319	24	31
Central region	3464	4944	16	12
Southern region	6848	9991	29	33
All-India	5090	7388	29	36

Source: From Bhalla and Singh (1997). Also see Table A5.5.

Based on data in selected districts, it can be inferred that growth of irrigated agriculture has played an important role. Thus, in Gujarat, a tripling of net irrigated area in 20 years (1980–3 over 1960–3) may be substantially responsible for its high growth performance, while the still modest proportion of irrigated lands (21 per cent), would explain why, in spite of higher growth, the average productivity per hectare still remains lower than in Tamil Nadu and Andhra Pradesh. In Tamil Nadu, which has the highest agricultural productivity and a much higher proportion of irrigated land (48 per cent), growth in productivity has been low, as has been the rate of expansion of irrigated area.

Even when irrigation development and expansion was concentrated in certain regions of the country, it impacted positively on other regions through the government's procurement and public distribution policies. Labour movements to higher growth areas have also helped reduce inequalities. of rainfed agriculture. Further, India's agriculture pricing policy of purchasing in surplus regions (mainly the states in the north west for wheat and those in the south for rice) and selling at fixed prices in urban and deficit rural areas, partly offsets the regional imbalance of concentrated agricultural development in irrigated areas.

Table 5.9 presents some data on regional differences in agricultural developments in eastern and western Uttar Pradesh (UP). While western UP forged ahead with the green revolution in the 1960s and the 1970s, eastern UP lagged behind in most respects (Shah 2001). GIA as per cent of GCA was 76.7 per cent in western UP, it was only 46.9 per cent in eastern UP. Compared to western UP, fertilizer consumption in eastern UP is lower by 20 per cent; wheat yield is lower by 35 per cent and paddy yield is lower by 34 per cent. Gross income per ha of net sown area (in 1989–90) at Rs 8872 in eastern UP was 24 per cent lower compared with that (Rs 11,612) in western UP.

TABLE 5.9: Regional Disparities in Irrigation and Crop Outputs in Eastern and Western Uttar Pradesh

	Eastern UP	Western UP
Population/ km^2 (1991)	614	602
Gross irrigated area per cent of gross cropped area	46.9	76.7
% of total irrigated area served by Canal (1989–90)	29.3	23.4
% of total irrigated area served by tubewells (1989–90)	63.2	68.8
Fertilizer use kg/ha (1989–90)	81	101
Wheat yield kg/ha (1989–90)	18.1	24.5
Paddy yield kg/ha (1989–90)	16.1	21.7
Gross income per ha of net sown area 1989–90 (Rs)	8,872	11,612

Source: Shah (2001).

INEQUITIES IN IRRIGATION SUPPLY AMONG HEAD-ENDERS AND TAIL-ENDERS

In a set of new studies[22] the performance of major, medium and minor systems in six states—Gujarat, Maharashtra, Tamil Nadu, Karnataka, Haryana, and Orissa—show the extent of irrigation use by

[22] Studies were sponsored by the Development Support Centre and funded by the Planning Commission. See Shah (2001).

head-enders and deprivation by tail-enders. In Gujarat's Mahi Right Bank canal, half of the farmers surveyed got only one irrigation, and 73 per cent got only two irrigations during an entire irrigation season (compared to four irrigations in a season). In Maharashtra's Mula command, the extent of irrigation deprivation was 80 per cent in the kharif and 70 per cent in the rabi. The Haryana studies found that all surface irrigation systems had a built-in tendency to shrink their command areas with most water being cornered by head reaches and tail-enders being progressively excluded. The same in Karnataka, where head-reach farmers took to extensive cultivation of paddy which the systems were not designed for at all. In Orissa's Hirakud project, head-end farmers enjoyed 'negative deprivation': they irrigated far more areas than they are supposed to, obviously at the expense of the tail-enders. And in Tamil Nadu's Parambikulam Aliyar Major Project, water deprivation institutionalized by the government by extending the command of a water-stressed system from 1,75,000 acres to 3,77,000 acres. A related issue is that sugar cane producers (usually head-enders) divert bulk of the irrigation water (in western Maharashtra) while sugar cane produces the lowest additional income per hectare-metre of water compared to any other irrigated crop in the region.

For farmers receiving irrigation, by far the most important influence on their crop production possibilities and income is the quality of the irrigation service provided. An illuminating example is provided in Table A5.13 which compares returns per hectare from different locations in a Maharashtra surface irrigation scheme as well as returns from unirrigated farms (Brahmabhat 1988). Farmers at the head of the command, and presumably with the best access to water, got twice the net income per hectare of rainfed farmers. By contrast, farmers at the tail of the command had very similar gross incomes, expenditures, and net incomes per hectare as did rainfed farmers, a frequent situation at the tail of many commands where in practice the paucity, if at all, of water supply results effectively in little or no change to rainfed practices and returns for tail-enders. A very interesting finding is that farmers in the middle reaches had higher gross returns (by 28 per cent), marginally higher expenditures, and resultant higher net returns per hectare (by 48 per cent) than farmers at the head of the command. This result is consistent with field observations that can be made in many commands in India of head-end farmers frequently over-watering crops to the detriment of yields, while middle-reach farmers, while considering themselves under water shortage, may in fact be much nearer to optimum crop water requirements than their head-end counterparts. Better knowledge by farmers of crop water requirements would have significant productive and equity impact.

Irrigation and Stabilization of Output

Two studies have examined the role of irrigation in stabilization of farm output and its protective role during droughts. Dhawan (1988) and Rao et al. (1988) analysed annual data from irrigated and unirrigated agriculture in 11 states for the period 1970–1 to 1983–4 and both studies concluded that instability is reduced under irrigated farming The data by state illustrates that the stabilizing impact of irrigation is less evident in higher rainfall areas or where irrigation is itself substantially dependent on rainfall. In north western states with both snow-melt and high groundwater usage influencing reliability of irrigation, irrigated agriculture shows little annual variation. By contrast, in Bihar and Madhya Pradesh where uncertainties in irrigation water supply can be high, irrigated agriculture shows a (non-significant) slightly higher variability than rainfed agriculture. These analyses do not support the much disputed earlier inferences[23] on the impact of irrigation based on more limited data available then, that development of irrigation and associated inputs might be contributing to the instability of production that was notable in the

[23] See Hazell (1982) and Mehra (1981).

1970s compared to the 1960s. Some destabilizing impact might, however, be present at local levels where water supplies are uncertain yet conducive enough to farmers to take risks with higher yielding varieties and use of fertilizer. These practices would give good yields in favourable years, but are riskier than traditional practices in bad years. Situations like this may be common in Madhya Pradesh and Bihar. Nevertheless, in most states and at more aggregate levels the data that is now available points to a substantial stabilizing effect as a result of irrigation. Table compares data from drought years in the 1970s. Output reductions on rainfed lands are much larger than shortfalls on irrigated lands.

Impact on Food Imports and Availability

Production of foodgrains in India has increased from 51 million tonnes in 1950–1 to 130 million tonnes in 1980–1 to 212 million tonnes in 2001–2. Irrigation accounts for about 55 to 65 per cent of foodgrain production in India. The availability of additional foodgrains from irrigated areas in Punjab, Haryana, and west Uttar Pradesh during the 1960s (and later) significantly reduced the dependence of the country on imports of foodgrains for meeting the foodgrain requirement of the population, insulated the country to a large extent against droughts, made Indian agriculture more sustainable, contributed to the food security of the country, and helped in reducing wide fluctuations in prices of foodgrains. For example, increase in surface irrigation from the Bhakra dam and resulting groundwater pumping led to significant increases in foodgrain production. By 1980, the production of foodgrains in the two states of Punjab and Haryana was around 18 million tonnes or 19 per cent of the total all-India production. As much as 55 per cent of the total increase in foodgrain production in the country over two decades (1980 over 1961) came from the Bhakra dam system. As a result of such high increase in domestic production, the net imports of foodgrains declined substantially from 10.3 million tonnes in 1966 to almost zero in 1972. Even though the imports declined, the net availability of foodgrains continued to increase. Further, even though the population increased from 442 to 666 million during the period 1961 to 1979 the net availability of foodgrains per capita did not go down substantially and remained around 470 grams per day.

Impact on Employment

Various studies[24] confirm the expected impact of irrigation on employment creation at farm level, but results differ widely depending on crops grown, the yield and cropping intensity, the degree to which irrigation influences the switch to more labour intensive crops, and other factors such as mechanization. Results from Daines and Pawar's work in Maharashtra (1987) in Appendix Table A 5.7 is illustrative of the variability found. For most crops, the range of additional employment per hectare as a result of irrigated rather than unirrigated agriculture is between 50 to 100 per cent. The lower impact in the case of wheat may be due to the labour-saving impact of accompanying increases in mechanization. These indicate only on-farm employment figures, and do not take account of employment multipliers. The results in Maharashtra indicate an overall incremental labour usage of 75 man days/ha under irrigation compared to typical labour inputs on millets and sorghum before irrigation of 50 days/ha. The high average estimate for incremental labour usage is influenced by switches to very labour-demanding crops such as sugar-cane. A switch from coarse cereals to paddy or groundnuts would involve incremental labour of about 35 to 40 days per hectare. Roy found lower incremental labour usage under irrigation of about 30 man days/ha in Rajasthan. Kamble's analysis of labour usage before and after well irrigation in Karnataka has much higher labour use figures for both rainfed and irrigated agriculture, with incremental labour of between 90 to 110 days per hectare. Perhaps of greatest interest is the finding in that study that

[24] Based on different studies. See Roy (1983) and World Bank (1991).

while family labour increased, additional hired labour was substantial. Others have commented that irrigation, especially on smaller farms, primarily impacted on greater family labour input. A detailed analysis of labour use in Ferozepur district, Punjab, showed a 40 per cent increase in labour input per hectare during the period from the mid-1950s to late 1960s which was made up of switches in cropping pattern to more labour intensive crops and the output impact of irrigation (Mehra 1976). Another important finding was that the output impact of irrigation on labour was partly neutralized by rapid mechanization in the district. These various studies clearly indicate a strong employment impact from irrigation, though the variability of the results makes it difficult to provide a precise assessment of the average impact.[25]

Another perspective can be gained from examination of agricultural employment elasticities (responsiveness of employment to changes in agricultural output). Based on cost of cultivation surveys for 1971–2 to 1983–4, an average agricultural employment elasticity of 0.59 has been estimated (World Bank 1989). As a principal engine of past agricultural growth, irrigation can be assumed to have played a large role in the growth of employment resulting from agricultural growth.

Watershed Development and Irrigation Impact

Watershed development has many positive and potentially long-term impacts. For instance water retention works on agricultural lands result in better yields due to residual moisture.[26] Cleaning and deepening of tanks and open wells increase common access for washing, bathing, feeding of livestock, and in some cases irrigation of nearby fields. Check dams have a number of benefits such as storage of water for fisheries and/or irrigation, infiltration of water into the ground and therefore recharge of open wells and boreholes. For example, it is observed that on an average each check dam supports three wells in Kadiridevara-palle, Andhra Pradesh. Farmers with access to groundwater are reaping stable benefits from the watershed activities because such activities have improved and stabilized the groundwater yields. However, access to groundwater is limited to large and medium farmers in most of the cases. More than 80 per cent of the beneficiary households owning borewells and open wells have farm sizes more than 10 acres. Often marginal farmers do not have access to groundwater. Therefore, while in short-run agriculture labour (landed as well as landless) benefit from the activities, farmers, especially with access to water, benefit in the medium and long runs.

Irrigation and Returns to Investment in Education

Pritchett (2001) has found that for India irrigation infrastructure has a major impact on returns to investments in education. Returns to investing in five years of primary schooling compared to no schooling in Indian districts where agricultural conditions were conducive to adoption of 'green revolution' technologies was as high as 32 per cent. However, in districts where conditions were not conducive to such irrigated agriculture, estimated returns to such schooling were negative.

[25] Plan documents have also commented in the past on the employment generated during construction of irrigation schemes. In October 1988, a study of 40 projects indicated an average employment generated by one million rupees investment expenditure of 32 man years. Some 3.6 million man years of jobs, over 70 per cent unskilled labour, are, estimated to have been created during the construction programme of the Seventh Plan.

[26] See Reddy, V. Ratna Reddy, and Y. V. Malla Reddy: Water and Poverty: Watershed Development in Andhra Pradesh, Asian Development Bank, August 2003. According to the authors, watershed development helps in improving agriculture productivity of rainfed areas through in situ moisture conservation, vegetative cover, increased availability of water, etc. However, this is not to suggest that watershed development is a substitute for irrigation development.

INDIRECT ECONOMIC IMPACTS OF WATER PROJECTS

The indirect or secondary effects of agricultural growth are in large part regionally concentrated as well, though they are significant in areas where irrigation is present and has effective production impact. Hazell and Haggblade (1990) estimated that a 100-rupees increase in agricultural income generates an average Rs 66 of rural non-farm income, Rs 38 in rural areas, and Rs 25 in rural towns. The multiplier was found to be higher in more developed states because of higher consumption linkages and input intensity. Thus, while a 100-rupees increase in agricultural income will generate Rs 106 of non-farm income in Punjab and Haryana, the impact on non-farm incomes in Bihar and Madhya Pradesh was found to be only Rs 41.

In a study of the impact of the green revolution in the North Arcot region of south India, Hazell and Ramaswamy (1991) showed that large farmers did benefit from the green revolution—their incomes increased by 18 per cent over the decade. But by far the biggest winners were the landless whose incomes increased by 125 per cent as a result of the large increase in demand for their labour. The results of the study (based on a Social Accounting Matrix (SAM) based multiplier model for the region) shows that 'each rupee increase in value added in agriculture stimulated an additional value added in the region's non-farm economy. About half of this indirect income gain is due to agriculture's demands for inputs and marketing and processing services, and the rest is due to increased consumer demands as a consequence of higher incomes' (Hazell and Ramaswamy 1991). The study also shows that multipliers for 'basic productive infrastrcuture' are much higher than for social spending and other sectors.

Economic Impacts and Synergy Benefits of the Bhakra Dam System

The Bhakra dam system (including dams, power houses, canals) is a large multipurpose water project in north India producing several benefits including water for the irrigation, domestic, and industrial sectors; hydropower for industries, agriculture, and households; flood control; tourism and non-irrigation benefits of canals, etc. In the case of Bhakra system there has been a synergy among various outputs of the project that enhanced the overall benefits from the project. Such synergy benefits (total benefits *minus* the sum of separate benefits from each output) are expected to be quite significant as a hydropower plant provides relatively cheap power for water pumping for irrigation and as an input to fertilizer production (through electrolysis of water at Nangal fertilizer factory in the initial years).

The Bhakra dam system has contributed significantly to the increases in irrigated area in the northern part of India and the output of agricultural commodities and electricity over the last 45 years[27] or so. The availability of irrigation water through the dam–canal network and groundwater pumping has helped in bringing large tracts of cultivated area under irrigation. Additional gross irrigated area has been of the order of 9.6 m.ha. per year in 1996–7 and beyond. The total foodgrain production in the Bhakra command area during the year 1996–7 was of the order of 27 million tonnes, an additional output of 25.2 million tonnes compared to the food output in the mid-1950s. It may be emphasized that in a low-rainfall (less than 600 mm per year) area such as the Bhakra command, adequate and timely irrigation is an essential input without which the high-yielding variety seeds cannot be used. Further, the level and mix of the use of chemical fertilizers will also critically depend on the availability of reliable irrigation water. It is in this context that irrigation from the Bhakra dam and from groundwater pumping in the area is a 'leading input' without which it would not be possible to attain such high crop yields in rice, wheat, and cotton as have been obtained in Punjab and Haryana.

[27] The conversion rate for the Indian currency, rupees (Rs) has changed significantly over time. The current (mid-2004) rate is Rs 45 per US$. In 1979–80, the conversion rate was Rs 7.9 per US$ and was Rs 4.75 per US$ before devaluation in 1966.

The hydropower stations installed in the Bhakra system have a combined generating capacity of 2880 MW, which currently generate about 14,000 million units (kWh) of electricity in a year. These increases have inevitably generated downstream growth in many other sectors of the regional economy as well as in other parts of the country.

In a recent study, the results of direct economic benefits and synergy benefits of the Bhakra system have been presented (Bhatia 2004). These results can be summarized as follows:

- The Bhakra multipurpose dam system project is a very profitable investment giving very high Net Present Value (NPV) and Benefit–Cost ratios under several assumptions. At 6 per cent rate of discount, using market prices for outputs and costs, the NPV is Rs 118.3 billion and the benefit–cost ratio is 22.1. At 1 per cent rate of discount the NPV is Rs 62.3 billion and the benefit–cost ratio is 16.2.
- In the case of the multipurpose Bhakra dam system providing both irrigation and hydro-power, there have been significant synergy benefits. The NPV of canal irrigation alone are positive but rather low at Rs 31.7 billion. The benefits of electricity alone are also rather low an NPV of Rs 13.3 billion. The sum of these separate benefits, in present value terms, are Rs 45.0 billion. As against this, the NPV of the joint benefits of canal irrigation, electricity for water pumping and electricity for other uses is relatively high at Rs 131.3 billion. Thus, the total (discounted) benefits from canal irrigation and hydropower *together* are almost three times the sum of separate benefits from canal irrigation and hydro-electricity. This is mainly because hydro-power plants provide relatively cheap power for water pumping for irrigation and as an input to fertilizer production (through electrolysis of water at the Nangal fertilizer factory in the initial years). Similarly, the demand for hydropower increased due to backward and forward linkages of increased irrigation and consumption-induced by higher income in agriculture, small and medium industries.
- Using shadow prices instead of market prices for the estimation of agricultural benefits and electricity benefits results in more than doubling of total benefits. Assuming no premium on savings and investments (that is, no shadow price of investment), the estimated values of NPV and benefit–cost ratios are quite high both at 6 per cent and 10 per cent rates of discount. At 6 per cent rate of discount, the NPV is Rs 308 billion on an investment cost of Rs 5.9 billion (present value). At 10 per cent, the NPV is Rs 175 billion. Even when a shadow price of investment (I2.5) is used on capital costs, this adjustment reduces the NPV by Rs 8.9 and remains at Rs 299.3 billion. The corresponding figures for 10 per cent discount rate is Rs 173.2 billion. Thus, the use of shadow price of investment does not make much difference on account of low capital costs. Thus, the project is highly profitable from the point of view of society.

Direct and Indirect Economic Impacts of the Bhakra Dam System in the Punjab State

In addition to direct economic impacts in terms of additional agricultural output and hydro power (valued in the previous section), major outputs from a dam generate both inter-industry linkage impacts and consumption-induced impacts on the regional/national economy (Bhatia et al. 2006a). Water released from a multipurpose dam provides irrigation that results in the increased output of agricultural commodities. Changes in the output of these commodities require inputs from other sectors such as seeds, fertilizers, pumpsets, diesel engines, electric motors, tractors, fuels, electricity, etc. Further, increased output of some agricultural commodities encourages setting up of food processing (sugar factories, oil mills, rice mills, bakeries) and other industrial units. Similarly, hydropower produced from a multipurpose dam provides electricity for households in urban and rural areas and for increased output of industrial products (for example, fertilizers, chemicals, machinery). Changes in the output of these industrial commodities require inputs from other sectors such as steel, energy, chemicals, among others. Thus, both increased output of electricity and irrigation from a dam result in significant backward linkages (that is, demand for higher input supplies) and forward linkages (that is, providing inputs for further processing).

Increased outputs of industrial and agricultural commodities generate additional wages and incomes for households. Higher incomes result in higher consumption of goods and services that, in turn, encourage production of various agricultural and industrial commodities. Changes in wages and prices have both income and substitution effects on expenditure and saving decisions of different owners of factors, which further impacts the demand for outputs both within the region and throughout the economy. Induced impacts reflect the feedbacks associated with these income and expenditure effects, and also include any impacts of changes in government revenues and expenditures that resulted from the project.

As discussed above, major outputs from a dam generate both inter-industry linkage impacts and consumption-induced impacts on the regional/national economy. The level of indirect impacts of a dam on the regional output and value-added will depend on the strength of linkages among various sectors of the economy. Multiplier analysis is one of the approaches for quantifying the magnitude of inter-industry linkages and consumption-induced effects, relative to purely direct impacts.

The Bhakra case study uses a SAM-based fixed-price multiplier model for the Punjab[28] for the year 1979–80. The model has been used to compute the values of relevant variables in the 'With Project' situation with their counterparts in the hypothetical case that the project had not been undertaken. This set of variables comprises all the elements of a SAM for the region in each situation, assuming fixed prices. The analysis has been done for a year (1979–80) for which adequate data were available from a detailed study (Bhalla et al. 1990). In measuring the impact of the project, an attempt is made to assess the situation in the region (the Punjab state) for the hypothetical case of 1979–80 in the absence of the project. This has been done by assuming that all autonomous changes would have taken place except the effects of changes due to major outputs of the project, namely irrigation and hydro-electricity. This hypothetical case in the absence of the project is termed as 'Without Project' scenario for 1979–80.

Differences in Aggregate Value-added under 'Without Project' and 'With Project'

In the study on direct and indirect economic impacts of the Bhakra dam system (referred to earlier), the results show that in 1979–80 in Punjab (Table 5.10), the aggregate value-added in the Punjab economy under 'With Project' scenario at Rs 42.4 billion[29] was larger than the value-added under 'Without Project' scenario by Rs 9.5 billion or by 29 per cent. Compared with this, the value-added from sectors affected directly by the project (agriculture and hydropower) at Rs 15.3 billion was larger than the corresponding value-added under 'Without Project' scenario by Rs 5.0 billion. This shows that the value-added in sectors directly affected by the dam (agriculture and hydropower) was almost 50 per cent higher under 'With Project' situation than 'Without Project' situation. Further, in the aggregate, the project induced an increase of Rs 9.5 billion in regional value-added. Of this, Rs 5.0 billion was due to increase in the outputs of sectors directly affected by the Bhakra dam system. This gives a multiplier value of 1.90, that is, Rs 9.5 billion/5.0 billion. Thus, for every rupee of additional value added directly by the project in agricultural sectors and hydropower, another

[28] The Punjab state accounts for 41 per cent of the total irrigated area in the Bhakra command and for 38 per cent of the total electricity generated in the Bhakra system.

[29] The current (September 2002) conversion rate is Rs 47.5 for a US$. The exchange rate during 2001–2 was approximately Rs 40 to a US$. In this report we have used Indian rupees (Rs) for value figures using 2001–2 prices.

Re 0.90 (or ninety paise) were generated in the form of downstream or indirect effects.

TABLE 5.10: Differences in Regional Value-added—'With Project' and 'Without Project' Situations in Punjab, 1979–80

(Rs billion)

Sectors/Total	With Project	Without Project	Difference (with Project over Without Project)
Sectors directly affected by the Bhakra dam system (irrigation and hydropower)	15.3	10.3	5.0 (49 %)

Source: Bhatia et al. (2006a).

Economic Impacts of a Small Check Dam in Haryana[30]

In India, a number of community-managed small check dams have been constructed during 1980s and 1990s. These check dams provide water for irrigation and livestock and have contributed significantly to the increase in income of villagers and others around these villages. In the Bunga village, near Chandigarh, two check dams have provided irrigation (since 1984 and 1996) to about 276 hectares of land in this small village of 178 families (1100 persons). In addition to the direct increases in the gross irrigated area, output of foodgrains and fodder, the check dams resulted in indirect economic impacts (milk production and sale; shops in the village, sale of grass) that increased the income levels of almost all households in the village.

Differences in Aggregate Value-added under 'Without Project' and 'With Project' in Bunga Village

In the study on direct and indirect economic impacts of the check dam (referred to earlier), the results show that in 2001–2 (Table 5.11), the aggregate value-added in the village economy under 'With Project' scenario at Rs 10.24 million[31] was larger than the value added under 'Without Project' scenario by Rs 3.48 million or by 52 per cent. Compared with this, the value-added from sectors affected directly by the project at Rs 4.71 million was larger than the corresponding value-added under 'Without Project' scenario by Rs 2.48 million. This shows that the value-added in sectors directly affected by the dam (food crops, fodder, and income from sale of water) was more than double (higher by 110 per cent)

TABLE 5.11: Differences in Regional Value-added—'With Project' and 'Without Project' Situations, 2001–2

(in Rs million)

Sectors/Total	With Project	Without Project	Difference (With Project over Without Project)
Sectors directly affected by the check dam (agriculture and fodder)	4.71	2.23	2.48 (110 %)
Sectors affected indirectly by the dam (milk production, other incomes from trade, etc.)	5.53	4.53	1.00 (22 %)
Total value-added (direct and indirect)	10.24	6.76	3.48 (52 %)

Source: Simulations using SAM for Bunga. See Malik and Bhatia (2006).

[30] For details, see Malik and Bhatia (2006).

[31] The current (September 2002) conversion rate is Rs 47.5 for a US$. The exchange rate during 2001–2 was approximately Rs 40 to a US$. In this report we have used Indian rupees (Rs) for value figures using 2001–2 prices.

under 'With Project' situation than 'Without Project' situation. Further, in the aggregate, the project induced an increase of Rs 3.48 million in regional value added. Of this, Rs 2.48 million was due to increase in the outputs of sectors directly affected by the Bunga dam. This gives a multiplier value of 1.41, that is, Rs 3.48/2.48. Thus, for every rupee of additional value added directly by the project in agricultural sectors, another Re 0.41 were generated in the form of downstream or indirect effects.

Differences in Aggregate Income Levels of Various Household Categories under 'Without Project' and 'With Project'

Per capita income in the village under 'With Project' situation was estimated to be Rs 9465 in 2001–2, about 50 per cent higher than per capita income of Rs 6375 under 'Without Project' situation. The results on income distribution impacts of investment in check dams show that small and marginal farmers (operating between 1–3 hectares of land) benefit relatively more than the medium or large farmers. Workers do not benefit much from the dam since farm households have enough family labour and there is no pressing demand for hired labour. For example, in the case of small farmers, the aggregate income under 'With Project' situation is 59 per cent higher than the income level under the 'Without Project' situation. Further, 67–77 per cent of income gains for farm households come from the agricultural sector and a quarter of the benefits come from indirect effects of the dam. However, in the case of workers, the difference in the income levels under the two situations is relatively low, only 23.3 per cent. The worker households did not benefit much from the dam because the demand for increased labour from irrigated crops was met from family labour by most of the farm families. Due to relatively small farm holdings, the farm households did not increase their demand for hired labour that would have benefited landless households. However, the worker households benefited indirectly from the dam in terms of higher incomes from milk production and shops.

Returns to Water Use in Rural Enterprises

Water use in small rural enterprises can provide significant non-farm employment and income to many families. At the village-level there are several water-using activities besides domestic and agricultural activities, including brick making, pot making, dairying, rope making, individual or community gardens and plantations, salt making, running tea stalls, etc. There are not many studies linking employment and income with water use in rural enterprises. The results of a survey[32] of several rural enterprises supported by SEWA (Self Employed Women's Association) are as follows:

- total annual profit varies across enterprises, as does the profit per unit of water. Brick making brings the operator a profit of Rs 188,000 during the four months of the enterprise, which is around 40 paise per litre of water;
- tea making during the 'peak' groundnut season (December–February) yields Rs 4500 to the tea-stall owner, at a rate of 52 paise per litre of water used;
- enterprises run at a loss if all inputs costs are included, that is, if own inputs like human labour, implements, equipment, work space, storage, etc. are valued at opportunity cost (that is, the cost if hiring these in the village), nearly all enterprises would make losses; and
- even existing activities may not generate additional output or income if only given more water. Factors such as market demand, access to credit, efficiency of production, and economies of scale are critical considerations to transform a set of inputs into sustainable output and income.

WATER AND GROWTH: FUTURE DIRECTIONS

Given the growth of population, incomes, and urbanization, the demand for water in the domestic

[32] See James (2003).

sector is estimated to increase from 25 BCM in 1990 to 70 BCM in 2025, an increase of 180 per cent. The growth of industries and thermal power will require 150 BCM of water (withdrawals) in 2025 compared with 65 BCM in 1990. Total estimated demand for water (gross withdrawals) for 2025 for irrigation is to increase from 460 BCM in 1990 to 730 BCM in 2025, an increase of 58 per cent.

Total estimated demand[33] for water (gross) for 2025 is 1027 BCM, an increase of 98 per cent over 27 years. Meeting these demands will need to increase water availability from around 630 BCM in 2000 to more than 1000 BCM in 2025. This would require substantial investments in water infrastructure such as multipurpose dams, barrages, irrigation canals, check dams, rain water harvesting structures, tubewells, and rural electrification.

In 2000, 57.2 m.ha. or only 41 per cent of the net sown area received irrigation. The total irrigated area in 2000 was substantially lower than the ultimate irrigation potential of 140 m.ha. As much as 83 m.ha. of cultivated area is still dependent on the uncertainties of rainfall.

Need for Increasing Investments Substantially

Net irrigated area is required to increase by at least 35 m.ha. (upto 92 m.ha. by 2025) for meeting the demand for foodgrains and commercial crops. Most of this additional irrigation will have to come from new surface irrigation projects since the past trends in increasing tubewell irrigation cannot be sustained due to declining groundwater tables in arid and semi-arid regions, Further, in the high-rainfall eastern region with adequate groundwater resources, private investments in tubewells and electric pumpsets are not sustainable without subsidized or free electricity for water pumping. Thus, the bulk of the additional investments of Rs 75 billion per year required in irrigation over the next 25 years will have to be spent on major multipurpose projects, medium schemes, and small check dams. This will require substantial increases in public investments and loans from multilateral agencies apart from raising funds from the capital markets and from raising user charges. Another Rs 125 billion per year will need to be invested in water supply, sanitation, and sewerage systems within the next few years. Large multi-purpose and stand-alone hydropower projects, alongwith micro hydro schemes, will have to be undertaken to tap the potential of this clean, renewable energy.

Investments in Water Storages Need to be Increased

In most of India, rainfall is received for just about 100 hours each year and there are large geographical variations in its occurrence. The natural response to such a pattern of rainfall is to invest in storage of water. Given the large water requirements for meeting the food, drinking water, sanitation, and industrial water demands of the growing population, coupled with increasing water requirements for ecological uses, there is a need for investing in all forms of storages, including in underground aquifers and small and large surface storages. However, in India the available storage capacity, at around 130 cubic metres (cum) per person is abysmally low in contrast to the storage capacity of more than 6000 cum/capita in North America and around 2400 cum/capita for China. Further, dams on the Colorado River (US) and Murray Darling (Australia) are able to store 900 days of river flow, thus providing assurances against floods and droughts. Rich countries have developed about 80 per cent of their economically viable hydro-electricity potential. India has developed only about 20–25 per cent of its hydropower potential.

Investment in major water storage infra-structures is necessary not only to correct these water availability–demand imbalances and meet the requirements of water, these investments also often form the basis of broad regional development. It is these broad, systematic impacts that have made water-related infrastructure an essential building block for regional and national

[33] Resources and Environment Group: India Water Vision 2025, Working Paper 2, June 2004.

development in many OECD countries (Japan, the Netherlands, Norway, Spain, the western United States, and others) and developing countries (Brazil, Egypt, Mexico, India, Pakistan, South Africa, and Thailand).

Allocation of Water Among Competing Uses

In the absence of these new investments of all types (surface and groundwater development) it would not be possible to meet the water needs for food security, livelihood security for millions of small and marginal farmers, and employment and incomes to landless labour. Water scarcity can become serious constraint to growth of industries and to increased production of agricultural crops. Major policy decisions would have to be taken to minimize the adverse economic, social, and environmental effects of water shortages.

Water availability for irrigation will be reduced by 50 per cent from the current use if additional supplies are not available and 220 BCM is allocated, on a priority basis, for domestic, industrial and thermal power sectors (India Water Vision 2025). Further, in the absence of significant increases in investments in water infrastructure, it would be impossible to meet the objectives of poverty reduction and the Millennium Development Goals (MDG) targets for water and sanitation services in developing countries.

Flexible Water Allocation vis-à-vis Fixed Allocation

A recent study has analysed the implications of a switch from command-and-control water allocation policies to flexible allocation policies, which facilitate the re-allocation of the limited quantity of water which is available, from low- to high-value uses (Bhatia et al. 2006b). The results of the study show the economic, environmental, and social impacts of the flexible allocation policy that would lead to marked changes in water use by different sectors (when compared to the fixed allocation). Specifically:

- agricultural water use would be 32 per cent less (20.0 BCM per year rather than 29.4 BCM per year) and the proportion of water used in agriculture would decline from 87 per cent to 70 per cent;
- the dominance of agricultural water use would decline substantially (from 87 per cent under the fixed approach to 70 per cent under the flexible approach);
- the water constraints under which industry operates would be substantially relieved, with industrial use accounting for 4.3 BCM/year under the flexible scenario versus 1.3 BCM/year under the fixed scenario; and
- similarly, domestic users would benefit substantially, with their use rising from 1.4 BCM per year under the fixed allocation scenario to 2.9 BCM per year under the flexible scenario.

The SAM-based multiplier model (that incorporates the input–output model) takes the results of the optimization models as inputs, and then determines the aggregate (direct plus indirect) impacts of different scenarios. The results show that if the Government of Tamil Nadu were to adopt flexible water allocation policies, the state income (as measured by Gross Value Added, GVA) in 2020 would be 21 per cent greater than if allocations to sectors were to remain fixed. The composition of production would, however, be markedly different. Agriculture's share of GVA would fall from 1.8 per cent (in the 'fixed allocation scenario') to 1.1 per cent (in the flexible scenario), whereas the contribution of industry would rise (6 per cent under 'fixed'; 11 per cent under 'flexible'). The contribution of the tertiary sector would fall in relative terms, but increase by 11 per cent in absolute terms.

The SAM-based multiplier model (incorporating the input–output model) disaggregates the impacts by different household categories, namely,

- the overall impact is a 20 per cent increase in household income;
- both rural and urban populations benefit

from flexible allocation, but the urban benefit more (22 per cent versus 14 per cent);
- the big winners (with gains between 18 per cent and 24 per cent) would be: all three urban categories (self-employed, salaried, casual labour) and non-agricultural rural people who are either self-employed or labourers. These groups together comprise about 72 per cent of the population; and
- there are no big losers in absolute terms, but, relative to all others those employed in agriculture (either self-employed or labourers, comprising 28 per cent of the population) would be in about the same position if flexible allocation procedures were followed as they would have been if sectoral allocations remained fixed.

The analysis also throws some light on the likely environmental impacts of the different approaches to water management. Adoption of the flexible rather than fixed allocation approach would substantially reduce the pressure on the water resource base and, accordingly, have a substantial positive impact on the environment. Specifically, there would be:

- a 15 per cent reduction in total water use (from 33.8 BCM per year to 29.2 BCM per year) and
- about 24 per cent less water pumped from aquifers (15.0 BCM per year rather than 19.8 BCM per year).

Since there are significant gains from flexibility of water allocations, the policy actions required are:

- to provide institutional framework for sale, transfer of water among users;
- to provide technical measures for such a transfer (infrastructure); and
- to review priorities of water allocation—domestic, industry, agriculture, and others.

This may require water rights including rights to transfer/sell water to other users as well as institutional interventions such as the WUAs. This will also include needed interventions in terms of control structures for transfer and delivery mechanisms including the needed secondary and tertiary system improvement options such as lining and OFD works for effective water control.

The study on Tamil Nadu resoundingly answers 'yes' to the question 'Is it worth moving away from a command and control system of water allocation' and towards a flexible allocation system.

Institutional Issues

The water sector would have to carry out major institutional reforms in order to improve efficiency of water use in irrigation, rural water supply, and urban water supply. These include, inter alia, RBOs for multi-purpose projects, WUAs in irrigation management, village level water and sanitation committees, and urban community associations for delivery of water and sanitation services.

Irrigation in the Eastern Region

According to Rao (2002) the known potential from the green revolution is yet to be fully realized in the eastern states where productivity of irrigation water can be raised significantly both on account of high precipitation which supplements irrigation water and the controlled nature of irrigation from groundwater sources which are abundant in this region.

Whereas eastern India has over one-fourth of India's usable groundwater resources, less than one-fifth of this is developed. The eastern region needs a strong push in its agriculture sector to promote wider spread of the high-yielding variety (HYV) seed. Micro-level studies based on sample surveys show that pump-irrigated farms perform much better compared to those irrigated by any other source in terms of cropping intensity, input use, and yields (see, for example, Dhawan 1985). This difference between areas irrigated by private tubewells and those irrigated by gravity flow canals is obviously explained by the superior quality—in terms of reliability, timeliness, adequacy—of irrigation that tubewells offer compared to other sources (Chambers et al. 1987 Shah 1993). As far back as in 1985, a study group constituted by India's Planning Commission to explore agricultural strategies in eastern India noted that 'one major reason for the low yield levels of eastern region states compared to the rest of India, particularly the chief rice-growing states viz., Andhra Pradesh and Tamilnadu, is the much lower level of irrigation in the former. About three-fourths of the rice area in the eastern region is still cultivated under the uncertain monsoonal conditions affected by floods as well as droughts' (GOI 1985).

As discussed by a number of government commissions and other reports (RBI 1984, GOI 1985, World Bank 1989), a complexity of constraints have applied in these states including high population pressure (resulting in very small farms with little financial capability to make investments or take risks) a high level of land fragmentation, tenurial practices in some sub-regions such as share cropping, and poor devel- opment of roads, commerce, and government services. Paradoxically, this region is far better endowed with rainfall and potential for irrigation development than any other region.

Irrigation is poorly developed in the eastern and central states (during 1992–5, the share of net irrigated area in net cropped area was only 21 per cent in Madhya Pradesh, 26 per cent in Orissa, about 43 per cent in Bihar, and 54 per cent in West Bengal). This can be expected in wetter regions as productivity from rainfed agriculture should be higher. An important factor, however, has been the quality of surface irrigation and drainage in these states which has been unresponsive to agricultural needs. For the kharif rice and rabi wheat cycle prevalent in eastern Uttar Pradesh, Bihar, and parts of Madhya Pradesh and West Bengal, the critical crop need is for the provision of water before the monsoon for rice nurseries and subsequent early transplanting of rice seedlings before the main rains. This ensures good tillering and resultant crop density as well as allowing application of fertilizer before monsoon flooding inhibits tillering and benefits from fertilizer. A good rice yield is possible where such early establishment is feasible. Earlier harvesting of rice then permits early establishment of wheat, important for using the cool winter months to ensure good growth. Farmers in the eastern and central region who have been able, through tubewell irrigation, to adjust their planting calendars have obtained excellent yields, nearly comparable to those in the northwest. Only a small proportion of farmers, however, have had this opportunity. Private tubewell development, while increasing in eastern Uttar Pradesh and Bihar, is less prevalent in the eastern region due to the investment and social constraints besetting marginal and fragmented farming in eastern and central India. Surface irrigation has mainly been designed as protective irrigation for supplemental watering during the kharif (monsoon season). Predominant reliance on run-of-the-river diversion schemes (with no or minimal storage and thus dependent upon advent of the monsoon), means that the start-up of irrigation is itself monsoon dependent. Further, management difficulties have meant that, even during the monsoon, irrigation is unreliable and poorly distributed between the head and tail ends of commands. Public tubewells could theoretically allow for more temporally optimal applications of water, but management difficulties have seldom enabled this to be achieved. Finally, the prevalence of monsoon waterlogging and, in large areas, of flooding, with little drainage infrastructure to reduce these problems, also reduces yield prospects. Thus, in the eastern and central region, irrigation and drainage development are both limited in extent and, where present, have usually been unable to have major productive impact (see World Bank 1991).

Remedying this situation requires tackling of a number of technical, institutional, social, and organizational constraints. With regard to irrigation and drainage, the two most important government actions would be to substantially improve water management in existing surface irrigation schemes and to install drainage to reduce the impact of monsoon waterlogging. In much of eastern India, lack of drainage is a larger problem than the deficiencies of the surface irrigation system. In the context of water management, maximum effort is needed to find ways to provide water for establishment of rice nurseries and subsequent early field growth and tillering of the rice crop before the major monsoon rains arrive. A third important emphasis is to foster through credit and other support programmes, the development of private shallow tubewells.[34] Successful attainment of these objectives will require major management improvements in the institutions concerned. Agricultural extension, research, and input supply also need major emphasis. Land consolidation is also often an important need.

According to Shah (2001), UP's groundwater resources can irrigate around 20.3 m.ha. (with a delta of 0.38 m), taking the ultimate irrigation potential of the state to 34 m.ha. In future, the best role for public policy lies in catalysing and supporting private action According to Shah, the strategy should involve:

- discontinuation of government-initiated minor irrigation programmes; instead focus on private tubewells as the primary mode for groundwater development;
- improvement of the electricity-supply environment for agriculture by reintroducing metred tariff, decentralized retailing of electricity, and the use of prepaid electricity cards;
- initiating planned interventions to improve the energy efficiency of agricultural pumping sets; and
- introducing small diesel pumps and manual irrigation technologies for vegetable growers and marginal farmers.

World Bank's Role in India's Water Sector

The World Bank can play a significant role as a source of funds for investments in priority projects in the water sector such as multipurpose projects, hydropower plants, new irrigation schemes, and small check dams. Through its economic and sector work, the World Bank can play a critical role in analysing the socio-economic impacts of multipurpose projects, hydropower projects, river-linking schemes, and watershed development programmes.

World Bank's Investments in the Water Sector[35]

During 1993–5, World Bank lending for the water sector was 264 million US$ per year and increased marginally to 297 million US$ per year during 1996–8 (Table 5.12). Total lending for the water sector in 2004 was estimated at 259 million US$. The just-approved India CAS includes a major re-engagement with the water sector where the share of lending to the water sector is estimated to increase to about 20 per cent of the total lending (compared with around 11 per cent of the total lending during 1993–2002).

The average lending of the World Bank for the irrigation sector declined significantly from about 300 million US$ per year during 1980–9 to 76 million US$ per year during 1990–3. The average lending for irrigation was 150 million US$ per year during 1993–6 and 220 million US$ per year during 1996–8. Estimated lending for irrigation was 240 million US$ during 2002 but declined to zero after that.

The composition of the active portfolio in irrigation changed significantly from the period

[34] Refer to 'Assisting Poor Rural Areas Through Groundwater Irrigation. Exploratory Proposals for East India, Bangladesh and Nepal', Kahnert (1989); World Bank, Asia Regional Series, Report No. IDP 44; and 'Uttar Pradesh Groundwater Development, Issues and Options', India Agriculture Operations Division, World Bank, 1991.

[35] For details see Malik, 'Development and Management of Water Resources: Evolution of World Bank Policies and Lending Assistance', Chapter 4 in this book.

TABLE 5.12: Water: Component-wise Lending

Year	Component-wise Lending (%)					
	Irrigation	UWSS	RWS	Hydro	St-al WR	Total
1993–5	58	31	10	0	0	100 (791)
1996–8	74	0	6	0	20	100 (891)
1999–2001	0	22	26	0	52	100 (218)
2002	67	0	33	0	0	100 (356)
2003	0	0	0	0	0	0
2004	0	15	63	0	22	100 (259)
All/Average	54	13	19	0	14	100 (2514)

Source: Chapter 4, this volume.

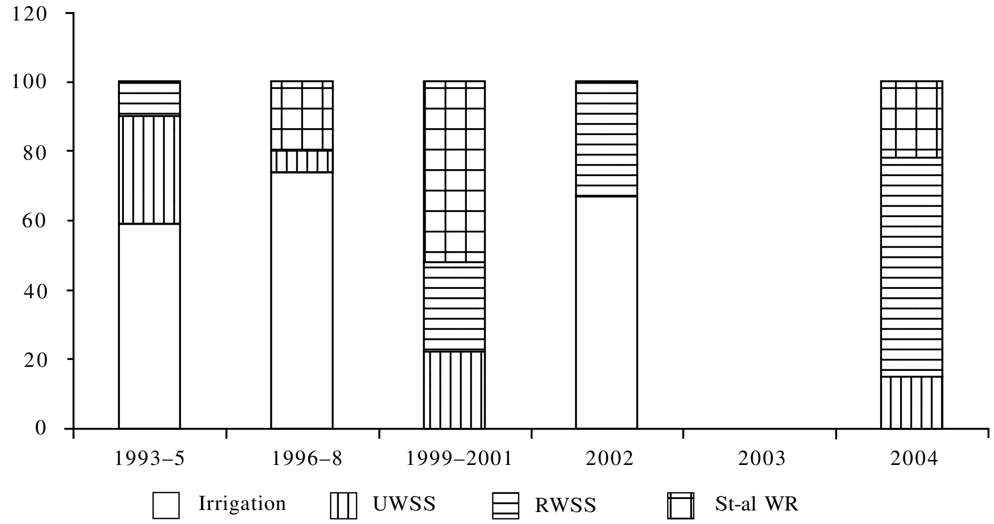

Figure 5.5: The Composition of Bank Lending for Water

Note: Figures in parentheses denote actual amount of lending in US$ million.
Source: Table 5.12.

1979–87 to 1988–99, moving away from its earlier heavy irrigation focus to encompass broader water resource issues. The water supply and sanitation portfolio was about 40 per cent of total water sector lending during 1993–5 (Figure 5.5) but declined to only 6 per cent during 1996–8. The share of water supply and sanitation increased to about 48 per cent during 1999–2001. During 2004, water and sanitation lending was $200 million, about 76 per cent of the total water sector lending.

The World Bank's Role in Policy Reforms

Over the years, the Bank has contributed both to the debate on water sector reforms, including the need for developing allocation mechanisms based on formal Water Rights and Entitlements (WR&E)[36] system, through its investment programmes and technical assistance. These contributions have been significant, especially since 1993, when there was a radical shift in Bank's policy from project and engineering focus to

[36] See Saleth (2004).

sectoral and resource management focus (Pitman 2002 p.13). With such a changing focus, the Bank has become increasingly involved in Indian policy debates on institutional reforms both within and outside the water sector.

Against the backdrop of the reform debate witnessed during the early to mid-1990s, some of the Bank-funded projects (for example, the Water Resources Consolidation Projects in Andhra Pradesh, Tamil Nadu, and Orissa, and the Water Sector Restructuring Project in Rajasthan) have also promoted some of the basic conditions for water allocation and management such as the organizational reforms, system improvements, creation of basin and user organizations, capacity building and data generation, and technical upgradation of water management. The policy debate on WR&E system was mainstreamed by the 1991 Irrigation Sector Review carried out jointly by the GOI and the World Bank. More specific reform agenda including the legal, organizational, and technical conditions for the development of WR&E system has been outlined in the Water Resources Management Sector Review jointly conducted by the GOI and the World Bank during 1996–8. The Ministry of Water Resources and the World Bank has agreed, in principle, to establish a WR&E framework (World Bank 1998a–d). It has been recognized that in promoting the WR&E system, in particular, and water institutional reform, in general, it is necessary to recognize some key rules (Briscoe 2002).

The Bank's Comparative Advantage

As part of the World Bank Water Resources Sector Strategy (2004), the Bank could assist in the development of an adequate stock of well-performing hydraulic infrastructure and mobilizing public and private financing. The Bank could assist in the utilization of the vast untapped potential of the hydropower sector by helping in the process of reforms of the electricity sector.

The Bank's involvement could have significant benefits in terms of institutionalizing national/international good practices for design and management of large multi-purpose water projects involving several states. The Bank could help in setting up of river basin organizations on the lines of Tennessee Valley Authority (TVA) or assist in the restructuring of the Damodar Valley Corporation (DVC).

In order to gain from flexibility of water allocations, there will be a need to provide institutional framework for sale and transfer of water among users and to provide technical measures for such a transfer (infrastructure). The World Bank could encourage regulation/legislation that provides water rights and entitlements of farmers so that the transfer of water from low- to high-value uses is facilitated, and that those who give up their implicit water entitlements do so voluntarily in exchange for appropriate compensation.

The Bank could also help in institutional development of the irrigation sector on the lines of the hydropower development in the country. This will remove the dichotomy of the two sub-sectors (irrigation and hydro) where there is a growing disequilibrium between a modernized and aggressive power sector and a traditional water resources sector. With an irrigation sector that is financially responsible, it may be possible to avoid a situation where investment decisions on major infrastructure do not give adequate attention to the multi-purpose benefits of dams, but focus only on the delivery of power.

The Bank could promote the scaling-up of pilot programmes of institutional reforms, decentralization of responsibilities to communities, targeted subsidies and leveraging of funds for urban and rural water supply and sanitation services.

The Banks' policy dialogue with the central and state governments could help in policy reforms for the irrigation sector where direct targeted subsidies are provided to marginal farmers and price of electricity used for pumping is raised over time. This will also provide an incentive for irrigation departments to raise charges for surface water supplies.

The Bank's policy dialogue with the

government and the Central Electricity Regulatory Commission (CERC) could help in establishing a true economic pricing and incentive regime for hydro projects, dealing appropriately with such issues as premiums for peaking power supplies. Other financial institutions would have more confidence in the hydropower sector if the Bank were to be involved. The Bank's advice and provision of long-term financing could leverage and facilitate a time-slice approach to new investment in hydropower. Thus, the Bank's support would help reduce the high upfront costs, and lead to reduced generation costs and lower tariffs.

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APPENDIX 5.1

TABLE A5.1: Financial Expenditures on Irrigation and Total Outlays under Various Five-Year Plans (at 1980–81 Constant Prices)

(Rs crores)

	Expenditure on Irrigation	Annual Average	Total Plan Expenditure —All Sectors	Irrigation Expenditure as a % of Total
First Plan (1951–6)	2530	506	11226	23
Second (1956–61)	2780	556	23984	12
Third (1961–6)	4180	836	35238	12
Annual (1966–9)	2860	953	19220	15
Fourth (1969–74)	5578	1116	36526	15
Fifth (1974–8)	5929	1482	41538	14
Annual (1978–80)	4174	2087	29292	14
Sixth (1980–5)	10015	2003	94938	11
Seventh (1985–90)	11821	2364	137913	9
Annual Plan (1990–1)	2207	2207	29228	8
Annual (1990–2)	2059	2059	28512	7
Eighth (1992–7)	11529	2306	164232	7
Ninth Plan (1997–2002)	16094	3219	238901	7
Annual Plan (1997–8)	2765	2765	36079	8
Annual Plan (1998–9)	3200	3200	21973	15
Annual Plan (1999–2000)	3982	3982	43420	9
Total	91704		992217	9

Source: Water and Related Statistics, 2002, Ministry of Water Resources, GOI.

TABLE A5.2: Changes in Irrigated Area and Cropping Intensity in Major States, 1960–3 and 1980–3

	Rainfall (Normal) (mm)	Per Cent Net Sown Area Irrigated		Crop Intensity	
		1960–3	1980–3	1960–3	1980–3
Low rainfall region					
Punjab	590	53	82	127	161
Haryana	610	32	62	133	149
Rajasthan	500	13	20	108	116
Gujarat	870	7	21	105	112
Medium rainfall region					
Maharashtra	870	6	11	105	110
Andhra Pradesh	900	27	32	111	115
Tamil Nadu*	990	41	48	121	124
Karnataka	840	9	14	104	108
Uttar Pradesh	1040	29	54	127	142
High rainfall region					
Madhya Pradesh	1140	6	12	113	114
Bihar	1260	24	36	135	135
West Bengal**	n.a.	25	35	117	135
Orissa	1450	16	20	112	141
All-India		19	28	115	124

Note: * for 1979–80; ** for 1983–4. Reported net and gross irrigated area are equal.
Source: Area and Production of Principal Crops, Ministry of Agriculture, GOI.

TABLE A5.3: Irrigated and Unirrigated Yields of Rice and Wheat in Major States, 1980–3

(kg/ha)

	Rainfall (Normal) (mm)	Rice (Autumn)			Wheat		
		Irrigated	Unirrigated	Per Cent Increase	Irrigated	Unirrigated	Per Cent Increase
Low rainfall region							
Punjab	590	2957	1029	187	2960	1616	83
Haryana	610	–	–	–	2458	1644	50
Rajasthan	500	1737	613	183	1719	887	94
Gujarat	870	–	–	–	2506	510	391
Medium rainfall region							
Maharashtra	870	n.a.	n.a.	–	1159	471	146
Andhra Pradesh	900	2115	920	130	–	–	–
Tamil Nadu	990	1880	401	369	–	–	–

(Contd ...)

Table A5.3 (Contd ...)

	Rainfall (Normal) (mm)	Rice (Autumn)			Wheat		
		Irrigated	Unirrigated	Per Cent Increase	Irrigated	Unirrigated	Per Cent Increase
Karnataka	840	1854	1460	27	1083	383	183
Uttar Pradesh	1040	1426	950	50	1176	1101	7
High rainfall region							
Madhya Pradesh	1140	1143	758	51	1645	800	106
Bihar	1260	1552	704	120	1416	1020	39
West Bengal	n.a.	1552	873	78	–	–	–
Orissa	1450	922	670	38	–	–	–

Source: Area and Production of Principal Crops, Ministry of Agriculture, GOI.

TABLE A5.4: Foodgrain and Overall Crop Yields by Major States, 1983–4**

	Irrigated Yield (kg/ha)		Unirrigated Yield (kg/ha)		Yield Differential (kg/ha)	
	Foodgrain	Total	Foodgrain	Total	Foodgrain	Total
Punjab	2999	3025	1359	1314	1640	1711
Haryana	2258	2328	583	606	1675	1722
Gujarat	2291	2364	930	926	1361	1438
Rajasthan	1519	1509	635	661	884	848
Bihar	1412	1429	838	890	574	539
Uttar Pradesh	1914	2292	983	977	931	1315
Orissa	1651	1755	964	961	687	794
West Bengal	1953	1918	1092	1078	861	840
Madhya Pradesh	1566	1637	945	943	621	694
Maharashtra	1285	2563	752	767	533	1796
Andhra Pradesh	2083	2257	684	796	1399	1461
Karnataka	2377	3058	803	808	1574	2250
Tamil Nadu	1938	2373	730	852	1208	1521
Kerala	1795	1795	1521	1521	274	274
Average*	1980	2208	864	877	1116	1331

Note: *Average also includes Assam, Himachal Pradesh, and Jammu and Kashmir.
** (Yield of non-foodgrains is in food energy equivalents, FEES).
Source: Dhawan (1988).

TABLE A5.5: State- and Region-wise Levels of Crops Yields—Major 43 Crops
(at 1990–3 Constant Prices)

	Average Value of Yields (Rs/ha)			% of Gross Cropped Area Irrigated		
	1962–5	1980–3	1992–5	1962–5	1980–3	1992–5
Haryana	3927	6229	10129	31	62	77
Himachal Pradesh	3048	3918	5196	17	17	18
Jammu and Kashmir	2987	5759	5567	36	40	41
Punjab	5396	9708	13597	58	87	95
Uttar Pradesh	3970	5805	8656	27	47	62
North West Region	4093	6423	9583	32	56	67
Assam	5728	7907	8197	–	–	–
Bihar	3680	4049	5678	20	34	43
Orissa	4114	4375	5979	12	23	26
West Bengal	5075	5944	9958	23	25	54
Eastern Region	4338	4944	7319	17	24	31
Gujarat	3673	5693	7460	8	23	29
Madhya Pradesh	2603	3070	4773	6	12	21
Maharashtra	2899	3795	5177	7	13	15
Rajasthan	1740	2335	3715	13	21	27
Central Region	2654	3464	4944	8	16	12
Andhra Pradesh	4065	6276	9391	29	35	40
Karnataka	3208	4990	6970	10	16	23
Kerala	11376	12334	15626	20	13	12
Tamil Nadu	6689	8756	14074	45	49	48
Southern Region	4873	6848	9991	26	29	33
All-India	3738	5090	7388	19	29	36

Source: Bhalla and Singh (1997); Data obtained Reports of Area and Production of Principal Crops in India (various issues) Ministry of Agriculture, Government of India.

TABLE A5.6: Yield Impact of Irrigation from Selected Government Projects
(Yield expressed in Rice Equivalent Units)

Project Name	State	Irrigated Yield (kg/ha)	Unirrigated Yield (kg/ha)	Per Cent Increase
Bhakra Nangal	Punjab	2596	1167	122
Rajasthan Canal	Rajasthan/Punjab	1930	–	–
Jayakwadi	Maharashtra	2109	437	383
Nagarjunasagar	Andhra Pradesh	3077	1022	201
Tungabhadra	Karnataka	3353	1031	225
Gandak	Uttar Pradesh	2498	1053	137

(Contd ...)

Table A5.6 (Contd ...)

Project Name	State	Irrigated Yield (kg/ha)	Unirrigated Yield (kg/ha)	Per Cent Increase
Sarda Sahayak	Uttar Pradesh	1734	700	148
Tawa	Madhya Pradesh	1986	834	138
Mayurakshi	West Bengal	3638	1053	245
Mahanadi Delta	Orissa	1398	834	68

Source: Dhawan (1989).

TABLE A5.7: Estimates of Employment Generated by Irrigated and Rainfed Crops in Maharashtra (person days/ha)

Name of Crop	Rainfed Employment	Irrigated Employment	Additional Employment (Irrigated over Rainfed)
Fodder Crop	12–44	28–55	11–16
Rice	32–54	53–80	21–26
Jowar	22–50	37–64	14–15
Bajra	22–44	27–54	5–10
Wheat	22–33	27–39	5–6
Pulses	22–33	32–53	10–20
Oilseeds	22–33	32–43	10
Cotton	95–240	125–350	30–90
Groundnut	60–120	100–190	40–70
Spices	120–190	240–320	120–130

Source: Daines and Pawar (1987).

TABLE A5.8: Income Impact of Irrigation at Farm Level in Gujarat

(Rs/ha)

Farm Size	Net Income		Difference in Net Income	Cropping Intensity	
	Irrigated	Unirrigated		Irrigated	Unirrigated
Marginal	1228	666	562	196	122
Small	1390	872	518	169	129
Medium	1783	733	1050	162	124
Large	1862	819	1043	150	120
All farms	1695	799	896	159	126

Source: Patel and Patel (1986).

TABLE A5.9: Average Monthly Per Capita Expenditure for Different Land Holding Groups in Six Rural Andhra Districts, 1983

(Rs)

	Unirrigated			Irrigated		
Land Holding Group (ha)	Anantapur	Kurnool	Mahboob Nagar	East Godavari	West Godavari	Krishna
0.00–0.12	68.0	60.9	73.2	94.8	86.7	93.1
0.13–1.00	80.3	77.7	100.0	131.8	95.3	120.2
1.01–2.00	87.3	68.3	85.6	140.3	110.4	135.7
2.01–4.00	83.0	76.1	95.4	188.2	169.3	154.3
4.01 and above	101.1	83.2	100.4	283.6	132.6	219.6
All cultivators	87.9	79.5	95.4	152.3	116.9	154.7

Source: Country Economic Memorandum, World Bank Report No. 7616-IN (1989) (based on National Sample Survey, 38th Round).

TABLE A5.10: Population Below Poverty Line (%) in Relation to Area Irrigated (%), 1973

Gross Irrigated Area as Per Cent of the Gross Cropped Area in the Triennium Ending 1973	Number of National Sample Survey Regions	Per Centage of Population below the Poverty Line
Below 10 per cent	16	68.8
10–20 per cent	13	53.7
20–30 per cent	10	45.6
30–50 per cent	8	48.4
Above 50 per cent	7	26.5

Source: Rao et al. (1988).

TABLE A5.11: Stabilizing Impact of Irrigation on Productivity (Coefficients of Variation in % on Trends between 1970–83, Aggregate Data from 11 States)

	Irrigated Lands	Rainfed Lands
Crop area	1.9	2.9
Yield	4.3	9.3
Production	5.4	11.4

Source: Same as Table A5.4.

TABLE A5.12: Impact of Drought Years on Output from Irrigated and Unirrigated Lands (Per cent Reduction from Trend Output)

	Total Output		Foodgrains Output	
Drought year	Irrigated Lands	Rainfed Lands	Irrigated Lands	Rainfed Lands
1972–3	7	20	8	18
1974–5	7	13	10	14
1979–80	10	20	6	22

Source: Same as Table A5.4.

TABLE A5.13: Gross Income, Expenditure, and Net Returns per Hectare of Cropped Area by Different Canal Zones in Maharashtra

(Rs/ha)

Canal Irrigator	Gross Income	Expenditure	Net Income
Head	10461	5203	5258
Middle	13344	5559	7785
Tail	6518	3686	2832
Overall	10419	4886	5333
Non-Canal Irrigator	6042	3295	2747

Source: Brahmabhatt (1988).

TABLE A5.14: Distribution of Districts and Input Use by Productivity Level, 1980–3

	Productivity Levels (Rs/ha)*						
	2000 and Above	1500–2000	1000–1500	500–1000	0–500	All Levels	Above All-India
No. of districts	26	37	74	115	29	281	132
Gross irrigated area as % of total cropped area	65.11	95.18	76.15	38.83	20.98	29.57	46.16
Fertilizer consumption (kg/ha)	87.94	131.27	91.96	36.76	10.85	34.07	58.55
Pumpsets (per '000 ha)	44.31	116.60	68.99	40.36	21.50	28.25	41.06
Tractors (per '000 ha)	5.34	5.25	3.52	1.60	1.26	1.57	2.68
Per cent share in input use							
Gross cropped area	8.33	10.56	24.92	44.96	11.22	100.00	41.94
Gross irrigated area	18.34	16.80	32.17	28.57	4.13	100.00	65.48
Output	18.19	17.58	29.23	31.52	3.49	100.00	63.16
Fertilizer	21.50	19.91	32.94	23.53	2.11	100.00	72.08
Pumpsets	13.07	21.38	29.43	31.10	5.03	100.00	60.96
Tractors	28.37	16.56	28.04	22.63	4.39	100.00	71.73

Note: * All India Average Productivity based on 41 crops at constant prices during 1980–3: Rs 1039 per ha.
Source: 'Pattern in Indian Agriculture Development–A District Level Study', G.S. Bhalla and D.S. Tyagi, 1989.

6

Water and Poverty

R.P.S. MALIK

INTRODUCTION

Concern for increasing agricultural production to either fulfil the rising foodgrain demand of increasing population and/or to minimize the impact of vagaries of weather on agricultural production has invariably driven public agencies and donors in bringing larger area under irrigation and in investing huge resources for development of small, medium, large—single and multipurpose—irrigation structures. For an individual farmer, investing in a private tubewell, the main concern is to have a larger control over irrigation water and thereby increase production on his farm. Concern for providing safe drinking water and sanitation facilities for rural and urban population has often guided large public and donor investments in rural and urban water supply and sanitation programmes. Investments in hydropower have consistently been governed by the need for producing energy. Similarly, investments in flood control structures have been guided by the concerns for minimizing the impacts of the floods on the property and life of the affected population.

These water development and management concerns have by and large not been viewed as poverty[1]-reducing strategies per se,[2] though the poverty-reducing impacts of these investments, specially that of investments in canal irrigation infrastructure, have often been recognized. Such investments have generally been justified for realizing broad-based growth, for increasing agricultural production and achieving food security, for increased hydropower generation, for making drinking water available to rural and urban areas, etc. with poverty-reducing impacts of these investments being assumed implicit. Given the complexity of the process through which water–

[1] Poverty is a multi-dimensional phenomenon though it has invariably been interpreted to imply lack of access to cash which is adequate enough to buy the required amount of food which could provide a defined level of nutrients. The non-income dimensions of poverty, such as access to other minimum needs for human survival such as clothing, water and sanitation, shelter, education, health, etc. have often not been given adequate attention while defining and interpreting poverty. For the present paper we define poverty in a more broader sense to consider both money indicators of poverty as also other social indicators to understand the real extent of deprivation of the poor.

[2] Only a few irrigation projects or project evaluations refer to poverty reduction as the primary goal of irrigation development or attempt to evaluate the impact of irrigation on poverty (Lipton et al. 2003).

poverty interrelationships operate and given the multifaceted dimension of poverty, it has often proven to be difficult to ascertain if the availability of water per se has lead to a reduction in poverty. While a number of studies, conducted under varying underlying conditions, have attempted to articulate the linkage between water availability and poverty reduction, the empirical evidence presented in support is often either indirect, sketchy, or vague and mostly inconclusive. Large amount of literature available on poverty provides no coherent analysis of the relationship between water access and use and poverty. As a result the debate on poverty-reducing impacts of water has generally been unconvincing and vacillating.

Water–Poverty Nexus

Water and poverty are inextricably linked. Water affects poverty and gets affected by poverty through a multitude of processes. We attempt to present in Figure 6.1 a schematic, though not very comprehensive, presentation of the complex relationship between water and poverty. While the depictions in Figure 6.1 are self-explanatory, we nevertheless consider it appropriate to highlight some of the salient features of this multifarious relationship.

The availability of water impacts poverty, both positively and negatively, through provisioning of water for agriculture, water for people, and water for nature. Availability of water for agriculture enables adoption of improved seeds and higher levels of technology, increases cropping intensity and crop yields and helps in diversification of cropping pattern towards more remunerative, and generally more employment-generating, crops. These changes in the agricultural scenario, brought about by the availability of water, have both forward and backward linkages with their resultant impact on poverty. The backward linkages occur as a result of increased demand of such farm inputs as seed, fertilizer, agricultural machinery, etc. The forward linkages of increases in agricultural production results in lower foodgrain prices for rural and urban population, increases in the real wages, increases in incomes for the farmers and in lowering the requirements of foodgrain imports. The increased agricultural production imposes additional processing and marketing requirements with their resultant impacts on secondary and tertiary sector activities including larger employment opportunities. The larger incomes of farmers increase the overall savings in the economy, which combined with lower outgoes in importing food, makes available larger investible resources with their consequent multiplier impacts. The increased incomes of the farmers also increases their disposable incomes causing increased consumption-induced demand for manufacturing goods and the resultant impacts on industry, tertiary sector, and employment.

Making water available within easy reach of people helps save significant amount of money—which poor people have to spend on procuring water—and time—which a large majority of poor people, specially women and girls, have to spend to fetch drinking water from long distances. The time so saved can be used in productive employment with resultant impact on income and poverty. Girls can be encouraged to attend school. The availability of larger quantities and improved quality of water also helps in improved sanitation and resultant health and hygiene impacts leading to lower number of working days lost due to illness, lower expenditure on medicines, doctors, and care of the sick. The availability of water, in addition, has important implications for growth and functioning of the industry and the consequent macroeconomic growth, employment generation, and resultant poverty impacts.

The water for nature apart from helping improve the quality of water in reservoirs and rivers, helps in greater fishery, forestry, and recreational activities with their resultant employment and income-generating impacts for the poor.

The availability of water does not necessarily always impact poverty positively: the development and use of water resources sometimes also have associated poverty-inducing impacts. Year after year floods cause widespread loss to life and

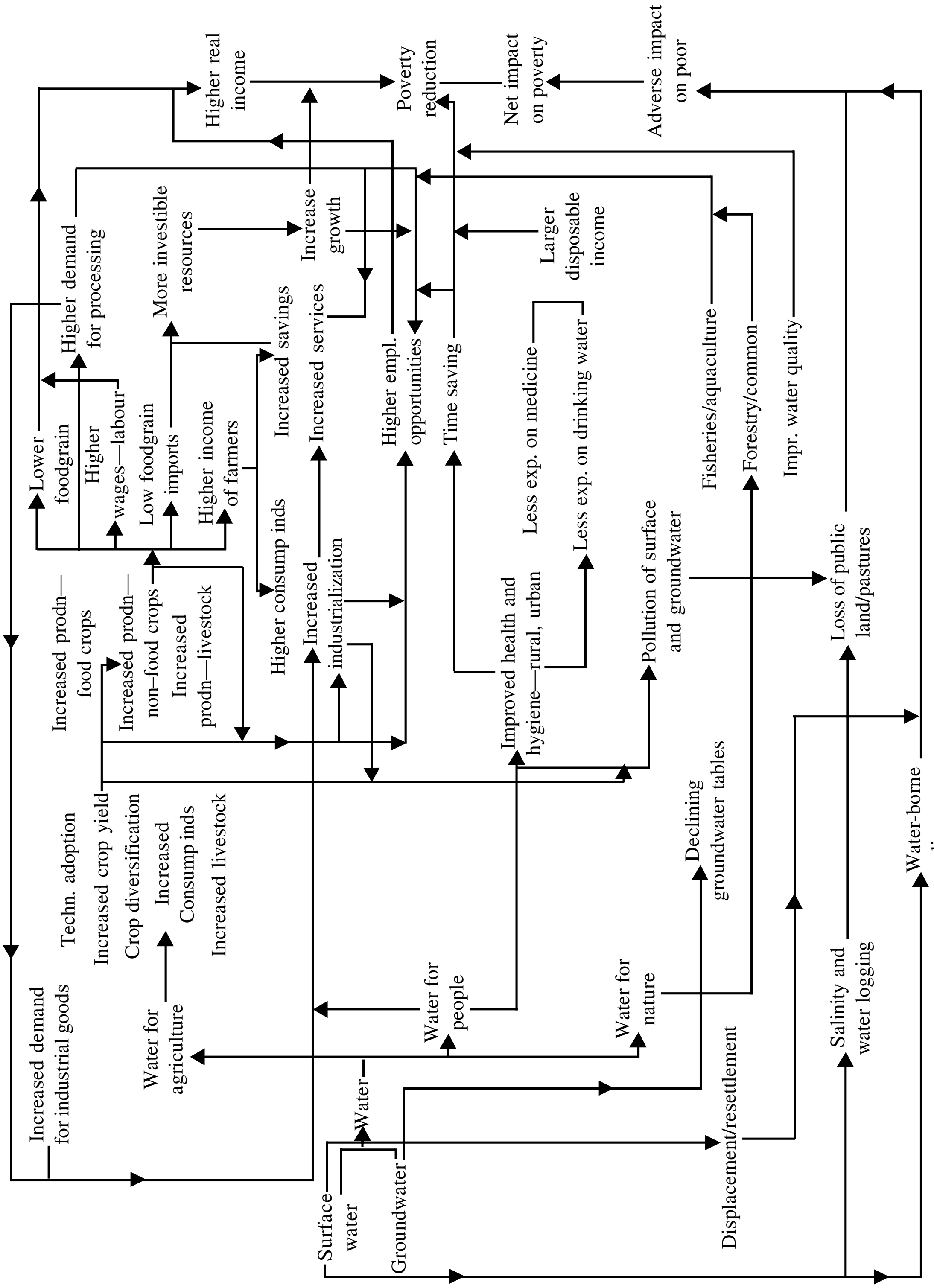

Figure 6.1: How Water Impacts Poverty

property, severely affecting the poor. The use of fertilizers and other chemicals in irrigated agriculture have both on- and off-site impacts on water quality. The excessive withdrawals of groundwater, beyond their sustainable yield levels, have implication for water availability, water quality, and agricultural sustainability. The larger industrialization has implications for water quality deterioration through effluent discharge in streams and rivers. The development of large-scale surface water infrastructure has implications for forest submergence, displacement of people, in causing waterlogging and soil salinity and in spread of water-borne diseases.

Some of these negatively impacting effects of development and use of water on poverty can, however, often be minimized through adoption of appropriate policy, management and technological interventions. The resultant impact of water resources on poverty is thus the difference between these positive and negative impacts.

Water–Poverty Interlinkages: The Analytical Framework

Water development and management are relevant to poverty reduction in a number of different and complementary roles. Figure 6.2 provides a rudimentary but useful four quadrant analytical framework, proposed in the World Bank Water Resources Sector Strategy, for assessing how water development and management may affect poverty (World Bank 2004). Type I interventions are broad-based water resource interventions (including major water storage infrastructures) that provide national and regional economic benefits to all, including the poor. Type II interventions improve water resources management (such as watershed projects in degraded

		Nature of Intervention	
		Broad	Poverty-targeted
Affecting Water	Resources, development, and management	Type I Broad region—wide water resource interventions For example, multipurpose river basin development and aquifer management	Type II Targeted water resource interventions For example, watershed management in degraded areas with poor farmers
	Service delivery	Type III Broad impacts through water service delivery reforms For example, reform of water supply utilities and water users associations for irrigation management	Type IV Targeted improved water services For example, rural water supply and sanitation projects

Figure 6.2: How Water Interventions Affect Poverty

Source: World Bank (2004).

environments) in ways that directly benefit poor people. Type III interventions improve the performance of water service utilities, which benefit everyone, including the poor. Type IV interventions provide targeted services (including water and sanitation, irrigation, and hydropower) to the poor.

Type I Interventions: Broad Policies and Investments that Affect the Development and Management of Water Resources

The uncertainty and variability in rainfall and the resultant impact on availability of water affects all—from an individual household to a nation. At the household level water availability and variability contribute significantly to the risks that poor people face in their daily life and this uncertainty constrains their economic expectation and their willingness to invest. In the case of farming households, for example, the risks associated with uncertainties and unpredictability in rainfall makes investment in complementary inputs—land improvement, technology adoption, new investments—less attractive, affecting agricultural production with attendant implications for industrial production, employment creation and poverty. This inconsistent nature of rainfall also frequently translates into the perennial dichotomy of simultaneously occurring droughts and floods with devastating impacts year after year on the loss of human and animal life, economic growth, fiscal deficit, inflation rate and poverty, not only in the short run but in the long run as well.

In most of India, rainfall is received for just about 100 hours each year and there are large geographical variations in its occurrence—the thumb rule being that the number of hours of rain a place receives in a year is equal to the number of centimetres of rain it receives annually. Moreover, half the rainfall is precipitated in just one-fifth of the total hours of rain in a year. In the country as a whole, half of the total annual rainfall is received in about 20 hours.[3] The devastating effects of such highly seasonal nature and truant monsoon on the Indian economy are well known. In fact the dependence of the entire economic planning and performance in India, including preparation of annual government budgets, on the occurrence of normal rainfall in a given year is well known to any observer of Indian economy. The close association between rainfall and the economic development has been exemplified time and again by researchers, media, and government agencies. The national daily the *Hindustan Times* in its cover page recently remarked 'if rains had been normal this fiscal, India's economy could have hit 8 per cent mark again' (*Hindustan Times*, 1 February 2005). Similar devastating effects of truant monsoon on the economy are observable not only in India[4] but in several other countries of the world as well.

Rainfall and snowmelt are the primary sources of freshwater supply. The natural response to an erratic and highly seasonal pattern of rainfall is to invest in storage of water. The storage of water is warranted not only as a hedge against these natural calamities in an abnormal year but is also necessitated for making water available round the year even during a normal rainfall year. Given the large water requirements for meeting the food, drinking water, sanitation and industrial water demands of the growing population, coupled with increasing water requirements for ecological uses, there is a need for investing in all forms of storages, including in underground aquifers and small and large surface storages, depending on the nature and pattern of rainfall, topography, soil conditions and other related factors (Keller et al. 2000). The response of different countries to

[3] These observations about the pattern of rainfall in India have been made by P.R.Pisharoty, one of India's leading meteorologist as reported in Agarwal and Narain (1997).

[4] Droughts and floods have played havoc not only with the economy of India but of several other countries as well: the Zimbabwe drought of the early 1990s was associated with an 11 per cent decline in GDP, the recent floods in Mozambique led to a 23 per cent reduction in GDP, the 2000 drought of Brazil led to a halving of projected economic growth (World Bank Staff estimates for Zimbabwe and Mozambique and *Financial Times* (2001) for Brazil).

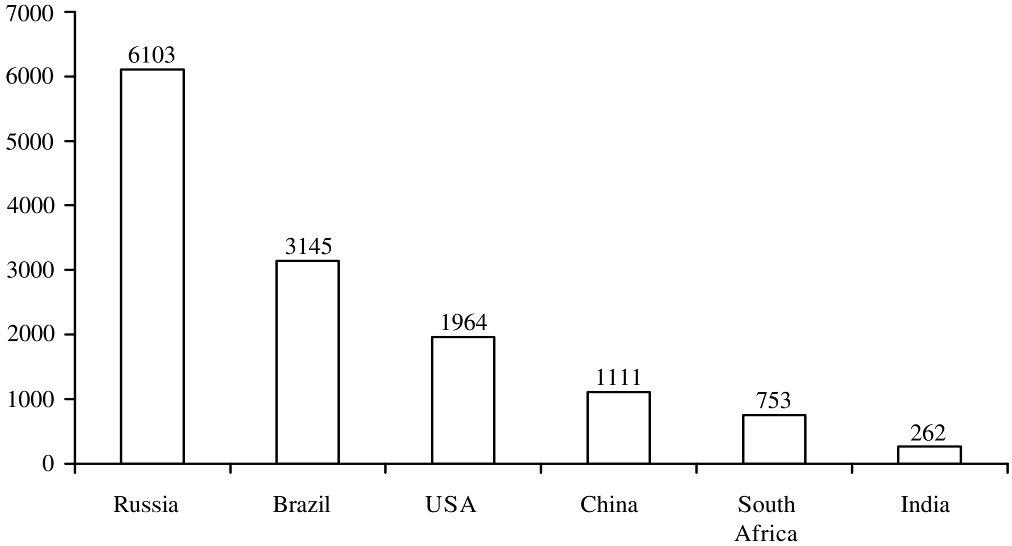

Figure 6.3: Per Capita Storage (Cubic Metres) in Select Countries

Source: GOI (2004)

varying patterns of rainfall has been to invest in storages. However, in contrast to a storage capacity of 6103 cubic metres per capita in Russia, 1964 in the USA, and 753 in South Africa, the per capita storage capacity available in India is a meager 262 cubic metres (Figure 6.3) (GOI 2005). Dams on the Colorado River (US) and the Murray–Darling (Australia) are able to store 900 days of river flow, thus providing assurances against floods and droughts. Rich countries have developed about 80 per cent of their economically viable hydro-electricity potential. India has developed only about 20–25 per cent of its hydropower potential.

Investments in major water storage infrastructures is necessary not only to correct these water availability–demand imbalances and to meet the year round requirements of water, these investments also often form the basis of broad regional development. It is these broad, systematic impacts that have made water-related infrastructure an essential building block for regional and national development in many OECD countries (Japan, the Netherlands, Norway, Spain, the western United States, and others) and developing countries (Brazil, Egypt, Mexico, Pakistan, South Africa, and Thailand).

Investments in major water infrastructure have, however, been criticized by many on several counts including on equity considerations: the benefits of the development are reaped by relatively better-off land-owning households alone and non-land-owning and poor households are left out[5] (see, amongst others, Pellekaan 2002). As a result, it is argued, such water resource development projects have either limited, nil, or negative impact on poverty. We, however, premise that this is not an objective assessment of the impact of water resources infrastructure. Economic growth, initiated either by policies of investments in water resources infrastructure and/or other forms of investments generally tend to benefit everyone in the society, including the poor, proportionately. A recent World Bank study in a sample of 92 countries covering the period

[5] It is sometimes opined that in irrigation projects most of the benefits accrue to those who own land and who by definition are not the poor (Pellekan 2002). This is implied to mean that benefits of irrigation do not reach the poor.

during the 1960s to 1990s shows that when average incomes rise, the average incomes of the poorest fifth also rise equi-proportionately. This holds true across periods, regions, time, income levels, and growth rates (Dollar and Kraay 2001). This implies that increased investments, including those in water infrastructure and management, benefit all including the poor. We present below some empirical evidence to demonstrate that investments in water resources development has not lead to iniquitous distribution of water, has led to reduction in incidence of poverty, and that benefits of such investments have been shared by all sections of the society, including the poor and the landless, thereby serving as a major mechanism for combating poverty.

Equity in Access to Irrigation

It has often been argued that the benefits of irrigation are cornered by relatively well off and better endowed farmers and as a result the poor, marginal, and small farmers and non-land-owning households are deprived of the benefits emanating from public investment in irrigation. It is important to mention that the allocation of water from public irrigation works in India is not guided by any policy of favoring either the small or large farmers. The allocation policy, wherever it exists, is often neutral amongst the land-owning farm households because the available water is allocated in direct proportion to the area of holding. Such a policy, however, implicitly results in allocating larger amounts of water to those who have larger holdings as compared to those who have small and marginal holdings and to that extent can be regarded as 'not neutral'. While the inequities in land holding do result in inequities in absolute amount of water allocation, it is not correct to infer that the benefits of irrigation have been cornered by the relatively better off. The data available on access to irrigation by different size groups of farms,[6] presented in Table 6.1, show that small farmers appropriate the scarce irrigation resource more than proportionately to their share in the land resource. The per cent of operated area irrigated on marginal and small farms is in fact much higher than that on medium and larger farms. Marginal and small farms, which account for 32.46 per cent of the operated area account for 40.57 per cent of the total irrigated area available. The proportion of area irrigated by canals, the major public investment in the irrigation sector, to total irrigated area available in different size groups of farms show that in all the size groups about 35 per cent of the irrigated area is irrigated by canals. In fact, of the total canal-irrigated area available, about 41 per cent is utilized by marginal and small farms. Even in terms of access to private means of irrigation, despite the problems of indivisibility of investment, uneconomic size of holding, and problems associated with accessibility of resources for investment, the small and marginal farmers do not lag behind the large farmers.[7]

While the apparent inequities in allocation of irrigation water, when seen in conjunction with the inequities in distribution pattern of land holdings, are to some extent unavoidable, there are other types of inequities which arise not as a result of any intended policy resolution but on account of sharing of available water amongst different farms within a given canal command. While the reasons for such inequitable distribution of water amongst farms could be many—absence of appropriate institutions, unclear water distribution rules, absence and/or poor maintenance of the water distribution network, negligence or connivance of the irrigation department staff,

[6] It is admittedly important to mention that aggregate data often tends to conceal large inter- and intra-regional variations. A more disaggregated study of the inter-class distribution of irrigation facilities by states and regions is necessary for a more definitive assessment of irrigation benefits. See also Vaidyanathan (1999).

[7] This is, however, not to deny that availability of irrigation does not cause income inequalities. The income impact is linked to the existing wealth and asset structure, including land, of the community. Larger farmers benefit more, at least in absolute terms, than small farmers, and direct benefits go only to land-owning households though landless households benefit from increased employment opportunities and lower food prices.

TABLE 6.1: Distribution of Operated and Irrigated Area—All-India, 1991

	Per Cent Share of Different Classes in Operated and Irrigated Area				
	Operated Area	Irrigated Area	Operated Area Irrigated	Area Irrigated by Canals to Total Irrigated Area	
Marginal	15.04	20.69	37.99	35.40	
Small	17.42	19.88	31.52	33.69	
Semi-medium	23.19	24.00	28.59	33.22	
Medium	27.04	24.69	25.22	34.12	
Large	17.32	10.73	17.12	35.92	
Total	100.00	100.00	27.61	34.28	
	Per Cent of Area Irrigated by Different Sources in Different Size Groups				
	Canals	Tanks	Tubewells	Others	Total
Marginal	21.37	31.79	18.22	25.33	20.69
Small	19.54	23.06	19.45	21.75	19.88
Semi-medium	23.27	22.12	24.67	24.45	24.00
Medium	24.58	17.01	26.44	19.53	24.69
Large	11.25	6.02	11.22	8.98	10.73
Total	100.00	100.00	100.00	100.00	100.00
	Per Cent Share of Different Sources in Area Irrigated in Different Size Groups				
	Canals	Tanks	Tubewells	Others	Total
Marginal	35.40	9.94	45.83	8.83	100.00
Small	33.69	7.51	50.91	7.89	100.00
Semi-medium	33.22	5.96	53.47	7.35	100.00
Medium	34.12	4.46	55.72	5.71	100.00
Large	35.92	3.63	54.41	6.03	100.00
Total	34.28	6.47	52.04	7.21	100.00

Source: GOI (2001).

etc.—the available evidence suggest that such inequities are large—both within and between head- and tail-end farmers.

In a recent study carried out in six major states of the country—Gujarat, Haryana, Karnataka, Maharashtra, Orissa, and Tamil Nadu—it has been shown that contrary to the generally held belief that the farmers at the tail end only are deprived of their share in the water, there are 'other deprived' farmers located at the head and middle end who also do not get their share of water. In fact deprivation is a widespread problem and in most of the cases farmers throughout the system suffer from deprivation. This holds true not only under conditions of water scarcity but even under conditions of surplus water (DSC 2003). Table 6.2 below demonstrates the extent of deprivation in Gujarat under both the water availability scenarios—Sabarmati, a water-deficient project and Mahi, a water-surplus project.

TABLE 6.2: Extent of Tail-enders and Others Deprived

Different Parts of the Main Canal	Tail-enders (% of the Command Area)		Other Deprived (% of the Command Area)	
	Dharoi	Mahi	Dharoi	Mahi
Head	30	8	28	28
Middle	36	18	24	56
Tail	41	4	19	10
Overall	37	7	22	20

Source: DSC(2003)

In contrast, in the case of a tank, Maravanoor, located at the tail end of a chain of four village tanks, and another tank, Venkaram, in Tamil Nadu, there were no significant differences in water supply conditions and productivity across different reaches in the tank command even during scarcity times. This was due to presence of strong, local institutional arrangements for water management. It was found that these traditional institutions take important decisions on management of water depending upon its availability. They employ watermen who are able to enforce discipline if required. The only disadvantage the tail-enders seem to suffer otherwise even when they get water is 'day watering is practiced by head reachers, while night watering by tail enders'.

IMPACT ON POVERTY

Major water resources development projects impact the economy and poverty through both direct and indirect effects. The direct and induced impacts of water availability on diversification of cropping pattern, in increasing cropping intensity, in technology adoption, in increases in crop yields, increases in incomes, larger employment opportunities, evening out the seasonal demand for labour, increase in nominal and real wages, drought proofing, output stabilization, reduced production instability, etc. have been amply researched into and widely documented in the literature on the subject (see amongst others Hussain and Wijerathna 2004, Narayanamoorthy and Deshpande 2003, Ravallion and Dutt 1995, Bardhan 1973). Availability of irrigation is not only accompanied by technological and other changes at the farm level, but at state and district levels also higher development of irrigation has frequently been accompanied by development of other infrastructure (road, credit, marketing, electrification, schooling, etc.). Isolation of the impact of irrigation per se on various agricultural performance variables has, however, proven to be difficult because of the complex interactions it induces in isolation and in combination with other policies and development investments. In a recent study Fan et al. (1999) argued that government expenditure on irrigation has the fifth largest impact (after roads, agricultural research and extension, education, and rural development) on rural poverty. Another million rupees of expenditure on irrigation would raise 7.4 poor people above the poverty line in contrast to 165, 91.4, 31.7, and 27.8 people who would rise above poverty line if similar amounts were to be invested in roads, agricultural research and extension, education and rural development, respectively. It may, however, be important to emphasize that these poverty-reducing impacts are essentially marginal impacts of additional investments in different sectors and their estimated poverty-reducing impacts (such as of investments in roads) would not yield the benefit had there been no irrigation (and consequently higher agricultural production) which would have enabled effective utilization of these roads. It is essential to take into account not only the quantum of investment but the sequencing of investments as well. Provision of effective irrigation nevertheless fundamentally alters the agricultural environment permitting agricultural response along a more productive and intuitively more elastic production function. Productivity improvements and related changes translate into income improvement per unit of land, influencing income levels and incidence of poverty (World Bank 1991b).

Keeping in view the methodological problems discussed above, we attempt to provide some

TABLE 6.3: Irrigation and Rural Poverty—All-India

	1973–4	1977–8	1983	1987–8	1993–4	1999–2000
% GIA/GCA	23.74	26.64	29.91	32.94	36.82	39.22
% Rural poverty	56.44	53.07	45.65	39.09	37.27	27.09

Source: Same as Table 6.1.

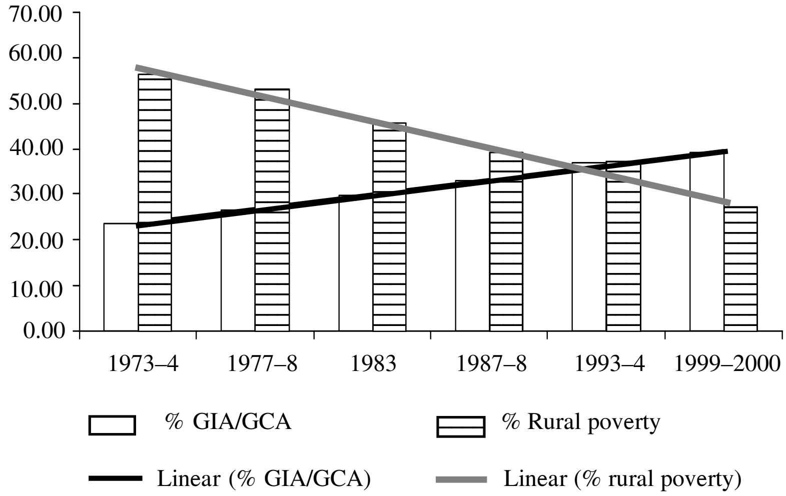

Figure 6.4: Irrigation and Rural Poverty—All-India

Source: Table 6.3

empirical evidence, using a partial analytical framework, to show how availability of irrigation has impacted rural poverty. We present in Table 6.3 and Figure 6.4 the all-India aggregate data on per cent rural poverty and irrigation availability (measured as per cent of gross irrigated area to gross cropped area) for certain select years for which official estimates on extent of poverty are available. At the all-India level, during the period between 1973–4 to 1999–2000, while the per cent GIA/GCA increased from about 24 per cent to 39 per cent, the per cent of rural people below poverty line declined from more than 56 per cent to 27 per cent.

To quantify the impact that increased availability of irrigation has had on reduction in rural poverty and to understand how this relationship has been changing over time, we fitted simple linear regression with per cent of rural people below poverty line as the dependent variable and per cent GIA/GCA as the independent variable. The regressions were estimated using cross-section data from 14 major Indian states[8] which together account for about 87 per cent of the total population of the country and about 86 per cent of the total poverty in India (as per 1999–2000 poverty ratios). The data on percentage of rural population below the poverty line (head count ratio) in different states has been taken as per the official estimates of the Planning Commission for the years 1973–4, 1977–8, 1983–4, 1987–8, 1993–4 and 1999–2000. The data on extent of irrigation availability, measured as per cent of gross irrigated area to gross cropped area (% GIA/GCA), has been taken from published sources. The

[8] The 14 states included are—Punjab, Haryana, Rajasthan, Uttar Pradesh, Bihar, West Bengal, Orissa, Madhya Pradesh, Gujarat, Maharashtra, Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu.

TABLE 6.4a: Irrigation and Poverty—Major Indian States
(Per Cent of Rural People Below Poverty Line as a function of Per Cent GIA/GCA)

Year	N	Constant	Regression Coefficient	R Bar Squared
1973–4	14	65.23(4.70)	–0.41*(0.14)	0.37
1977–8	14	65.12(6.23)	–0.52*(0.18)	0.37
1983	14	54.29(7.53)	–0.36**(0.19)	0.17
1987–8	14	45.87(6.16)	0.28**(0.14)	0.17
1993–4	14	39.68(6.75)	–0.17(0.15)	0.02
1999–2000	14	30.47(7.82)	–0.18(0.16)	0.02

Note: Figures in parentheses denote standard errors; * and ** denote significance of regression coefficients at 1 and 5 per cent level of significance.

results obtained are presented in Table 6.4a and Figures 6.5 and 6.6.

The results of regression:

- provide a clear and significant evidence of inverse relationship between availability of irrigation and rural poverty;
- the estimated regression coefficients for the above six study years work out to – 0.41, – 0.51, – 0.36, – 0.28, – 0.17, and – 0.18, respectively, implying that a unit increase in the per cent GIA/GCA has been associated with a reduction of between 0.17 and 0.41 per cent of rural people below poverty line. In other words a 1 per cent increase in the ratio of GIA/GCA could have moved 1.89, 2.64, 1.98, 1.69, 1.11, and 1.34 million rural people out of poverty during these years (Table 6.4b); and
- the weakening strength of the availability of irrigation, over the study period, as a variable in explaining interstate variation in rural poverty. The weakening strength of the relationship between the two is possibly on account of the fact that development in irrigation per se has limits up to which it can contribute towards poverty alleviation, that is, the marginal returns to irrigation declines and invest-

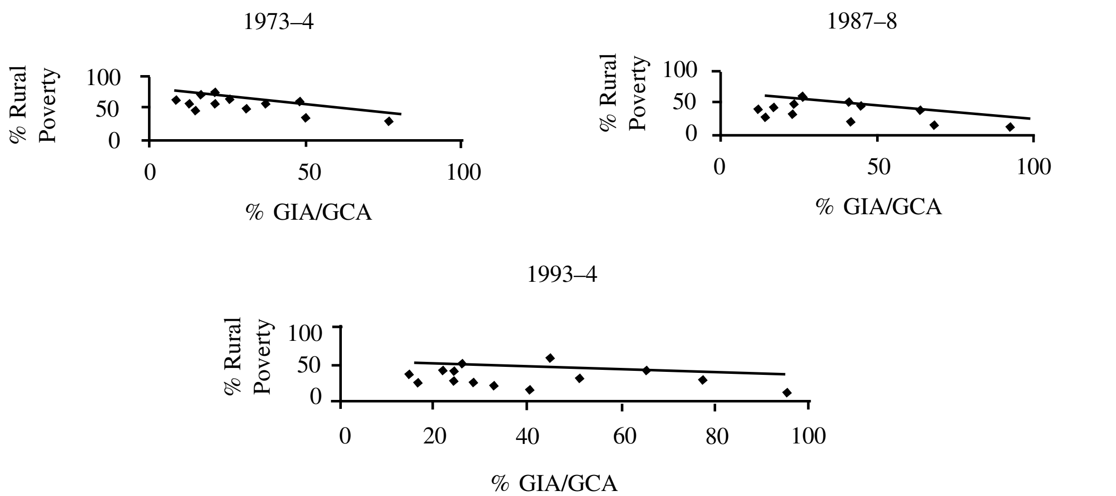

Figure 6.5: Changing Relationship Between Irrigation and Rural Poverty

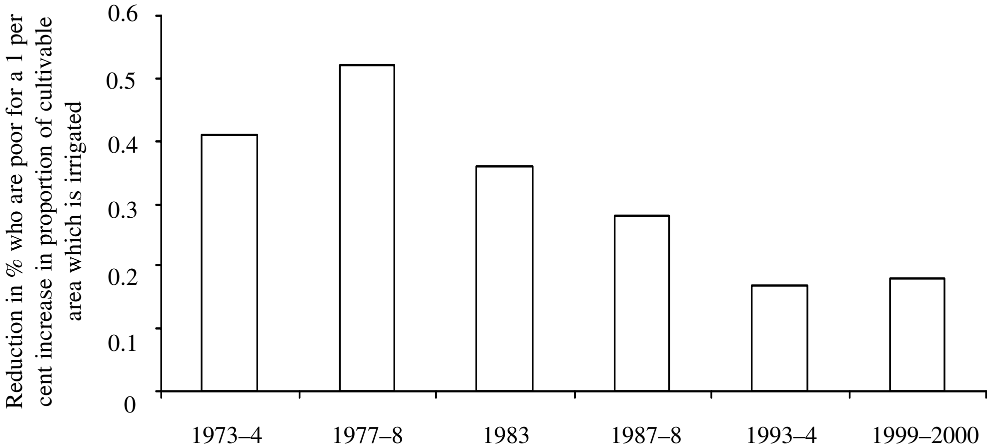

Figure 6.6: Declining Impact of Irrigation on Poverty Reduction in 14 Indian States

Source: Table 6.4b.

TABLE 6.4b: Decline in Rural Poverty with a 1 Per Cent Change in the Ratio of GIA/GCA

Period	% GIA/GCA	Rural population moving out of poverty with 1 per cent increase in the ratio of GIA/GCA (million)
1973–4	23.74	1.89
1977–8	26.64	2.64
1983	29.91	1.98
1987–8	32.94	1.69
1993–4	36.82	1.11*
1999–2000	39.22	1.34*

Note: * Although regression coefficients during these years were not significant, even then these numbers have been worked out to show the order of magnitude.

ments in other complementary infra- structure and policies need to be undertaken concurrently. Another possible explanation could be the relatively faster growth in non-agricultural rural employment (mainly in the services) and its impact on the earnings and poverty of the rural poor.

Apart from the impact that availability of irrigation has on rural poverty, as traditionally measured in terms of income or consumption norms and converted into head count ratio (HCR), availability of irrigation also affects non-income measures of poverty. As above, using the cross-section data of 14 states for selected years, we present in Table 6.5 correlation coefficients between extent of irrigation (measured as per centage of GIA to GCA) and some such identified variables on which data was available. The results show that availability of irrigation does significantly affect a number of non-consumption measures of poverty—housing conditions as measured by per cent of rural people living in a *pucca* house, per cent of households having access to safe drinking water, per cent of households having electricity connection, and per cent of households having access to all—electricity, safe drinking water, and toilet facilities.

TABLE 6.5: Correlation Coefficients between GIA to GCA (%) with Selected Variables

Variable	Year	Corr Coeff	N
Per cent of households with *pucca* houses	1981	0.48***	14
	1993–4	0.60**	14
	2001	0.56**	14
Per cent of households with access to safe drinking water	1981	0.68*	14
	1991	0.60**	14
Per cent of houses with electricity connection	1981	0.60**	14
	1991	0.38	14
Per cent of households with access to electricity, safe drinking water, and toilet	1991	0.59**	14
Per cent of villages connected by road			
Population <1000	1991–2	0.51***	14
	1994–5	0.50***	14
Population 1000–1500	1991–2	0.24	14
	1994–5	0.18	14
Population >1500	1991–2	0.21	14
	1994–5	0.22	14
IMR (rural) per thousand	1981	0.13	14
	1991	–0.18	14

Note: *, **, and ***, respectively, denote significance at 1, 5, and 10 per cent level of significance.

Availability of irrigation also induces better rural road connectivity even in tiny villages with less than 1000 population. The availability of irrigation, in isolation, does not seem to have a significant impact on infant mortality rate.

IRRIGATION AND RURAL LITERACY

Evidence suggests that availability of irrigation is associated with higher rural literacy (Pritchett 2001). A simple linear regression of per cent rural literacy (as per 2001 census) as a function of per cent GIA/GCA at the state level for the 14 Indian states, however, do not reveal any significant relationship between the two although a closer examination of the available data at a more disaggregated level of district suggests that this lack of relationship between the two is not true under all conditions of irrigation availability. We therefore attempted to quantify the relationship between rural literacy and irrigation availability for different states using the district level data (Figure 6.7). We have first used per cent rural population literate as the dependent variable and then used per cent male literate and per cent female literate as the dependent variable. In all the three cases per cent of GIA to GCA has been used as the independent variable. For brevity we present in Table 6.6 the results in respect of only those states where literacy variable in either of the three specifications has been significant. In the case of all other states the literacy variable turns out to be non-significant.

The analysis reveals some interesting results. Literacy (in at least one of the three alternative specifications discussed above) bears a significant relationship with availability of irrigation in eight of the fourteen states. While in six of these eight states the coefficient has the expected positive sign, in the case of the remaining two states, namely, Punjab and Haryana, the results show a negative relationship. A more careful examination of these relationships would suggest that literacy and irrigation are negatively associated in high irrigation states (Punjab and Haryana), positively and significantly associated in medium irrigation states (Andhra Pradesh, Bihar, Gujarat, Orissa, Rajasthan, Tamil Nadu, and Uttar Pradesh), and not significantly related in states with low irrigation coverage (Karnataka, Kerala, Madhya Pradesh, Maharashtra, and West Bengal). Another important message from the results is that while the association between male literacy and irrigation coverage is significant in all the eight states, that between female literacy and irrigation coverage holds true in five of the eight states.

Water Resources Development and Sharing of Economic Benefits

Investments in large water-resources projects providing multiple benefits including irrigation, hydropower, water supply, and flood control, generate a vast array of economic impacts both in

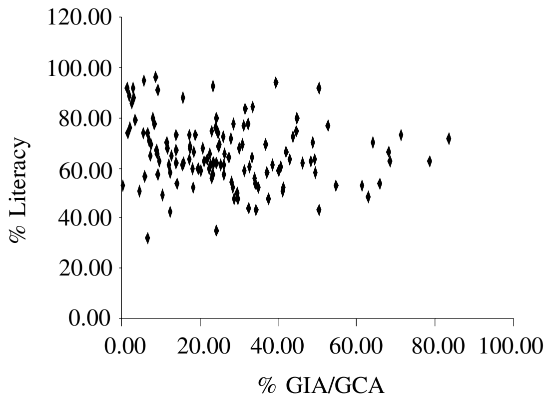

Figure 6.7a: Irrigation and Total Literacy—Low Irrigation States, 2001

Source: GOI (2001) and www.censusindia.net

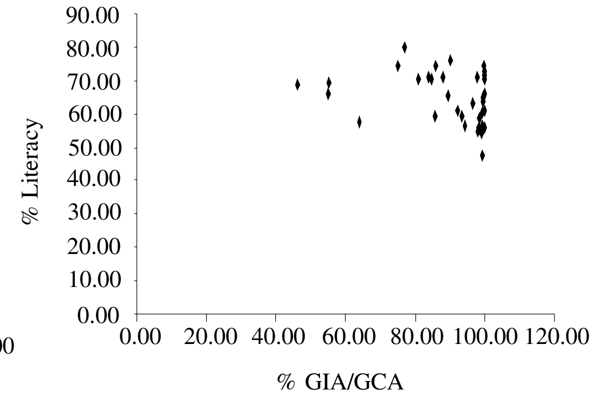

Figure 6.7b: Irrigation and Total Literacy—High Irrigation States, 2001

Source: Same as Figure 6.7a.

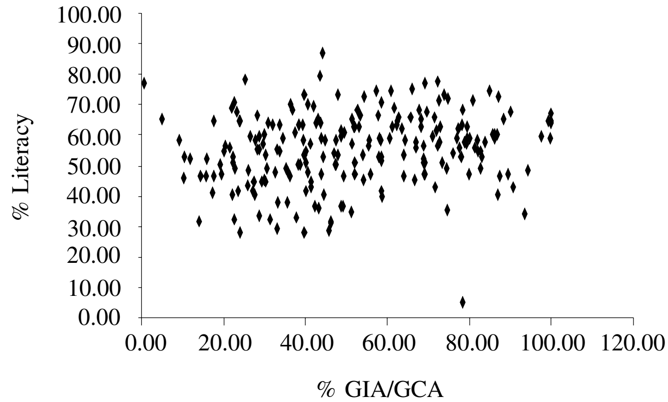

Figure 6.7c: Irrigation and Total Literacy—Medium Irrigation States, 2001

Source: Same as Figure 6.7a.

TABLE 6.6: Impact of Irrigation (% GIA/GCA) on Literacy, 2001

State	Irrigat. Status	Constant	Regression Coefficient	R Bar Square
		Dependent Variable: Per Cent Persons Literate		
Punjab	High	140.58(27.61)	–0.79**(0.29)	0.29
Haryana	High	74.24(6.84)	–0.12 (0.08)	0.06
Uttar Pradesh	Med.	44.84(3.63)	0.14**(0.05)	0.08
Andhra Pradesh	Med.	44.89(3.33)	0.21*(0.07)	0.31
Bihar	Med.	32.04(5.59)	0.20**(0.10)	0.09
Gujarat	Med.	54.23(4.60)	0.20(0.12)	0.12
Orissa	Med.	38.94 (7.44)	0.47*(0.17)	0.21
Rajasthan	Med.	48.56(2.69)	0.20* (0.07)	0.20
		Dependent Variable: Per Cent Male Literate		
Punjab	High	148.77(25.83)	–0.81**(0.27)	0.33
Haryana	High	90.32(6.58)	–0.16**(0.08)	017
Uttar Pradesh	Med.	57.44(4.14)	0.16*(0.06)	0.08
Andhra Pradesh	Med.	59.68(2.81)	0.13**(0.05)	0.18
Bihar	Med.	38.36(3.96)	0.36*(0.07)	0.44
Gujarat	Med.	65.79(4.81)	0.23***(0.13)	0.14
Orissa	Med.	52.69(7.32)	0.45**(0.16)	0.20
Rajasthan	Med.	66.81(2.36)	0.16**(0.06)	0.17
		Dependent Variable: Per Cent Female Literate		
Punjab	High	132.87(30.15)	–0.79**(0.31)	0.25
Haryana	High	56.33(8.39)	–0.07(0.10)	0.03
Uttar Pradesh	Med.	35.29(4.76)	0.07(0.07)	0.01
Andhra Pradesh	Med.	29.62(4.17)	0.30*(0.08)	0.36
Bihar	Med.	16.04(3.27)	0.26*(0.06)	0.37
Gujarat	Med.	49.28(10.32)	0.19(0.27)	0.04
Orissa	Med.	23.06(7.60)	0.53*(0.17)	0.25
Rajasthan	Med.	29.83(3.21)	0.22**(0.08)	0.16

Note: *, **, *** denote significance of regression coefficient at 1, 5, and 10 per cent level of significance, respectively. High irrigation status, medium irrigation status, and low irrigation status, respectively, denote states where per cent GIA/GCA is >75, between 30–75 and <30, respectively. Karnataka, Kerala, Madhya Pradesh, Maharashtra, and West Bengal fall in low irrigation status states.

the region where they are located, and at an inter-regional, national, and even global level. These impacts include both direct and indirect or multiplier impacts. In general, ex-post and ex-ante evaluation of these projects often value only the direct impacts such as irrigation, hydropower, water supply, fish production, flood control, and recreational benefits.

In such evaluations, however, indirect or multiplier impacts of such projects are generally not taken into account. Ignoring these indirect impacts result in underestimation of the total impacts of a project on regional and inter-regional economies. Indirect and induced impacts are those that stem from the linkage between the direct consequences of a dam project with the rest of the economy. Indirect impacts of dams comprise (i) inter-industry linkage impacts, both backward and forward linkages, resulting in increase in the demand for outputs of other sectors; and (ii) consumption-induced impacts arising out of increases in income and wages generated by the direct outputs of the dam.

While the direct impacts of these projects have been well understood and analysed, the indirect impacts of these water resources projects have often neither been explicitly and fully understood and appreciated nor have generally been quantified. To that extent the quantification of the economic impacts of these projects have been incomplete and therefore inferences drawn about the benefits emanating from these projects and how these benefits have been shared by different sections of the society have been partial, flawed, and, possibly, sometimes prejudiced. The empirical evidence on the magnitude of indirect impacts of such projects and how the direct and indirect benefits of these projects are distributed is, however, scarce. Limited empirical evidence available from Brazil (Cavalcanti and da Costa 1988), India (Hazell and Ramasamy 1991), Malaysia (Bell et al. 1982), and the USA (Ortolano and Cushing 2002), however, show large indirect benefits of such projects. Hazell and Haggblade (1990) estimated that in India, a 100-rupee increase in agricultural incomes generates an average of Rs 64 of rural non-farm income, Rs 39 in rural areas, and Rs 25 in rural towns. The multiplier was found to be more in developed states because of higher consumption linkage and input intensity. In a recent study Bhattarai et al. (2004) reported an irrigation impact multiplier value for India ranging from 3 to 4.5.

A recently conducted multi-country World Bank study on multiplier effects and income distribution impacts of dams, using multi-sector economy-wide models, conclusively demonstrate that irrigation and hydropower-induced inter-sectoral and consumption induced effects of the large water storage structures produce large economic gains and that these gains do not leave the poor out (Bhatia et al. 2006a). The multiplier value, denoting the summary measure that reflects the total effects—direct and indirect—of a project in relation to its direct effect, in Brazil, India, and Egypt ranged between 1.4 and 2.0, implying that for every one dollar of value-added generated directly by the project, another 40 cents to 1 dollar were generated in the form of indirect or downstream effects.

Combining an analytical framework of optimizing models with a SAM-based fixed price multiplier model, the Indian study attempted to quantify the direct and indirect aggregate income impacts of the Bhakra dam and also to quantify how these gains have been shared by different categories of households—land owning as well as workers including urban households (Bhatia and Malik 2004). The results obtained show that indirect impacts form a significant proportion of the total benefits emanating from the project. The multiplier value of 1.90 estimated for the project implies that for every rupee of direct benefit derived from the project another Rs 0.90 is produced in the form of indirect or downstream benefits. The estimated results show that the average incomes of households rise by 29 per cent. The benefits are shared by all categories of households, including the urban households, albeit to varying extent. The most significant finding from the analysis shows that the per cent income gains of agricultural labour households are much higher than the agricultural land-owning households (Table 6.7 and Figure 6.8). Thus while the income of landed households increased by about 42 per cent that of agricultural labour increased by 65 per cent. The project benefited urban households also whose average incomes increased by about 17 per cent. These income gains when seen in conjunction with lower foodgrain prices, made possible by the increased foodgrain production as a result of the project, and availability of these foodgrains through the fair price shops throughout the country, raises the real income of such households still further. Further the increased economic activity generated by the dam encouraged several thousands of workers year after year to migrate to Punjab and Haryana from such far off and poverty-ridden places as Bihar and eastern Uttar Pradesh to look for employment opportunities. The remittances, which were estimated to be of the order of Rs 3548 million (US$75 million) in 1995–6, were sent back to their native places by the workers and helped their families come out of poverty and improve the living conditions in such far off places. Some of these impacts on the poor in the other regions have not, however, been captured by the multiplier analysis. Incorporation of such multiplier impacts would raise the value of project benefit multiplier still further.

That investment in water infrastructure have resulted in major gains for all sections of the society, including the poor and landless, is also demonstrated by some of the other evidence available on the subject. An OED review of the irrigation sector, based largely on the retrospective evaluation of over two hundred World Bank-financed irrigation projects over a four decades period, concluded that the benefits of most irrigation investment have reached the poor (World Bank 1994). The study reports that the

TABLE 6.7: Differences in Incomes of Agricultural Labour and Other Rural Households—With and Without Bhakra Dam

(Rs million)

Category of Households	With Project	Without Project	Difference	Per Cent Difference
Self-employed rural households	12505	8825	3680	41.7
Agriculture labour	4005	2425	1580	65.2
Rural non-agriculture	1125	627	498	79.5
Rural—Others	8413	6988	1425	20.4
Urban households	16331	14014	2317	16.5
Total	42379	32878	9501	28.9

Source: Bhatia and Malik (2004).

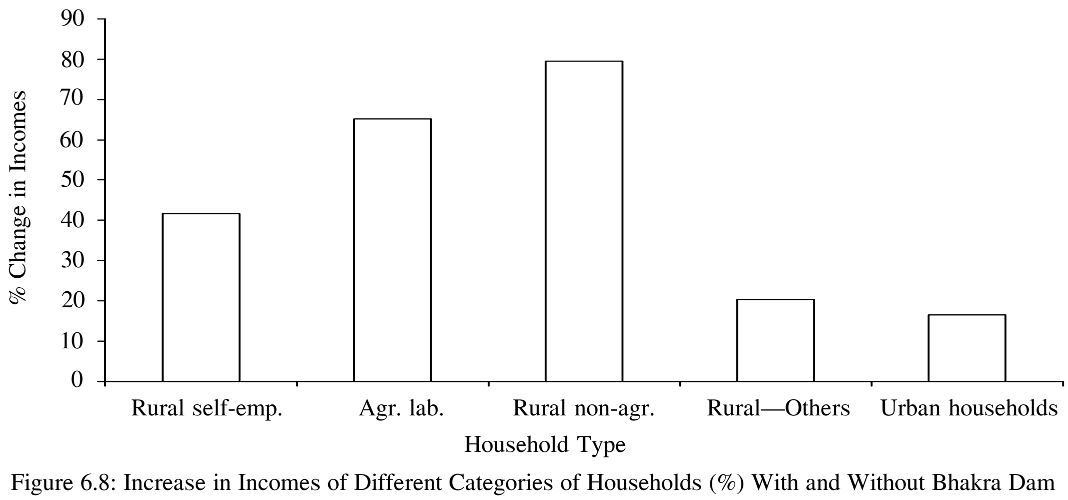

Figure 6.8: Increase in Incomes of Different Categories of Households (%) With and Without Bhakra Dam

Source: Table 6.7.

median farm size of beneficiaries per project is two hectares. The average project served 76,000 farm families, ranging from an average of 1,72,000 in India to 5000 in sub-Saharan Africa. Water infrastructure has also evened out the seasonal demand for labour, resulting in major gains for the poor (Chambers et al 1989).

In another study on evaluating the distribution of direct gains amongst different categories of households, emanating from a large irrigation project—Nagarjuna Sagar Dam in Andhra Pradesh, it has been reported that the direct gains emanating from the project have been shared by all classes of households—both landed and non-landed (CESS 1989). As a result of the project the incomes of small farming households increased as much as those of medium farming households and only marginally less than the gains occurring to large farmers. Even the labour households and other households gained substantially, though somewhat lower than the landed households. However, in terms of per capita change in incomes, the gains to small farmers and agricultural labour has been higher than even the large farmers (Table 6.8 and Figure 6.9). As a result the incidence of poverty in all the categories of households is lower in the command area of the project as compared to non-command area (Table 6.9 and Figure 6.10).

TABLE 6.8: Impact of Irrigation on Household Income and Per Capita Income—Nagarjuna Sagar Project

Category	Household Annual Income (Rs)			Per Capita Annual Income (Rs)		
	Command	Non-command	% Increase	Command	Non-command	% Increase
Large farmers	33233	19841	67.5	3901	2751	41.8
Medium farmers	18926	11821	60.1	2788	1644	69.6
Small farmers	11162	6942	60.8	1998	1377	45.1
Marginal farmers	6869	4982	37.9	1382	1012	36.6
Agr. labours	5172	4158	24.4	1115	775	43.9
Others	6012	5110	17.7	1284	1074	19.6
Overall	11003	7601	44.8	1995	1378	44.8

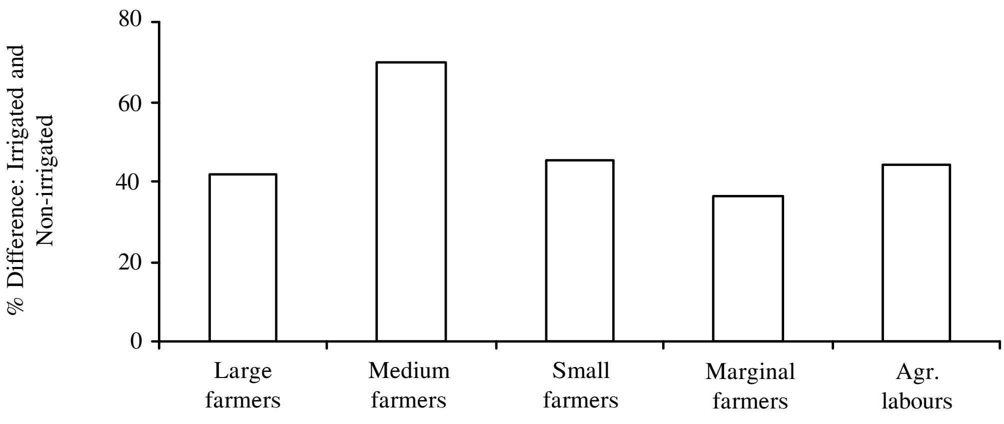

Figure 6.9: Effect of Nagarjunasagar Irrigation on Per Capita Income

Source: Table 6.8.

TABLE 6.9: Incidence of Poverty (%) in Command and Non-command—Nagarjuna Sagar Project

Size Class	Incidence at Rs 1200 Per Capita Per Annum		Incidence at Rs 1400 Per Capita Per Annum	
	Command	Non-command	Command	Non-command
Large Farmers	3.7	10.5	5.6	15.8
Medium Farmers	2.0	14.3	5.1	42.9
Small farmers	23.4	41.7	30.7	50.0
Marginal Farmers	50.3	60.5	63.9	76.3
Agr Labours	53.6	87.9	72.0	93.9
Others	51.7	59.5	62.1	67.6
Overall	35.4	51.7	45.7	62.8

Source: CESS(1989)

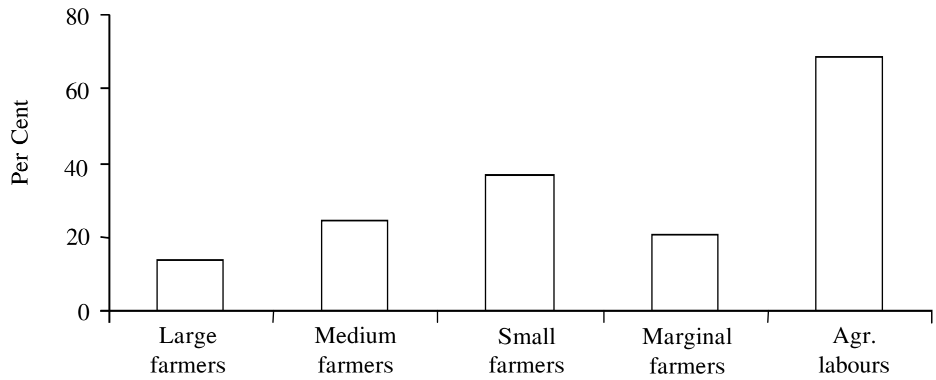

Figure 6.10: Nagarjunasagar: Decline in Poverty of Each Class as a Result of Irrigation

Source: Table 6.9.

WATER MANAGEMENT POLICIES AND POVERTY

It is not only the investments in water resource infrastructure per se that leads to a fairly widespread distribution of gains, the changes in the policies governing water use and allocation, in isolation or in conjunction with investments in water resources, can similarly have substantial impacts on the economic growth and on the poor. The empirical evidence linking the two again is, however, scarce. In 1992 Mexico passed a new water law that introduced radical changes in the way water is managed. Most important was giving users much greater say and introducing tradable water rights. In some areas the effects of these changes have been dramatic with substantial reductions in the (unsustainable) pumping of aquifers, and with water moving from low-value crops to new high-value crops. Each drop of water now generates a direct demand for more than twice as much agricultural labour (and therefore opportunities for poor people) (World Bank 1999).

In a recent study attempting to quantify the economic implications of changes in water use policies on the pattern of economic growth and impact on the poor in the state of Tamil Nadu in India, it has been shown that significant economic and distributional gains are possible from adopting a flexible policy of water allocation amongst various sectors (Bhatia et al. 2006b). Adoption of a flexible policy of water allocation

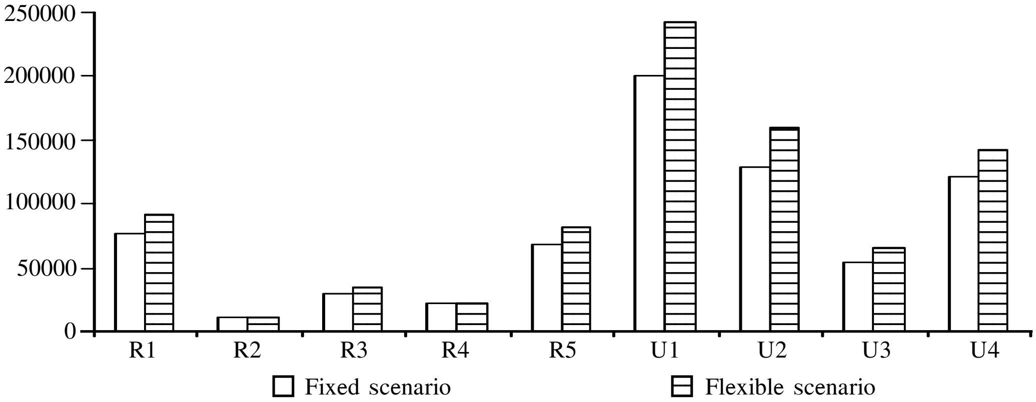

Figure 6.11: Per Capita Income of Different Groups under Fixed Allocation and Flexible Allocation, 2020

Note: The different groups represent the following occupational classification as in the survey done in 1997: R1—Rural self employed in non-agriculture; R2—Rural agriculture labour; R3—Rural other labour; R4—Rural self-employed in agr; R5—Rural other households; U1—Urban self-employed; U2—Urban regular wage salary; U3—Urban casual labour; U4–Urban other households.
Source: Bhatia et al (2006)

amongst various sectors, whereby water is allocated to various sectors on the basis of its economic value in each sector rather than on the basis of fixed allocation made on the basis of current state policy of giving priority of water allocation to agriculture over industry, results in an increase in aggregate gross value of output by 40 per cent in the year 2020. Under flexible water allocation, all groups of households (except agricultural labour households) receive higher incomes as compared to a fixed water allocation scenario. On an average, rural population gains by 14 per cent while non-agricultural labour and other households gain by around 20 per cent each (Figure 6.11).

The evidence presented above thus clearly and unequivocally demonstrates that the benefits of investments in development of water resources have not been inequitable and that these investments have made a significant impact on poverty reduction. Benefits of investments in development and management of water infrastructure do not leave the poor out—in fact the non-land holding and poor households at times tend to gain relatively more from such investments than the landed households. The impact of growth does not thus necessarily flow through only the 'trickle down' route but by 'a rising tide lifts all boats' route as well.

Type II: Impact of Targeted Water Resource Interventions on Poverty

Targeted interventions and policies that affect the development and management of water resources and land–water interface, both in the command and in the catchments, provide many opportunities for simultaneously improving resource management and the lives of poor people. There is a growing evidence to suggest that communities living in vulnerable land–water environments (such as eroded mountains, salinized plains, and flood plains) can benefit greatly from the improved opportunities that arise when local land and water resources are managed more effectively. Accordingly, there has been a surge in projects that focus on land and water management activities. They increase the livelihoods of rural people (who constitute a large proportion of the population in these degraded environments) and improve the quality of land and water resources.

These interventions, generally in the nature of watershed development projects in India, have been undertaken on a large scale as a means of raising land productivity, cropping intensity, in-situ moisture conservation, rain water harvesting, safeguard on the measures for prevention of silt deposition in the reservoirs, bio-mass production, and overall economic and social upgradation in the rainfed/watershed areas on a sustainable basis. Though not officially classified as a poverty-reduction programme or employment-generating programme per se, since poverty is both a cause and effect of over exploitation of natural resources, it is believed that successful watershed development would result in sustainable reduction in poverty.

A large number of evaluation studies carried out to analyse the impact of watershed development projects on the intended beneficiaries, employing a variety of methodologies, under differing initial conditions and using different time frames, provide a somewhat mixed experience. While there have been a number of instances where watersheds have proved to be successful in providing the intended benefits, failure stories also abound (see amongst others Reddy 2000, Deshpande and Reddy 1991, Chopra et al. 1989, Deshpande and Rajasekharan 1995, Reddy and Reddy 2002).

An impact evaluation study to examine the initial experience of some of the better performing WDPs in Gujarat (Shah 2001), on the basis of a survey of 120 households from four micro watershed reported that as a result of project intervention, the net returns per household increased between 42 to 99 per cent (Table 6.10).

In another study on watershed evaluation in Gujarat, it has been shown that after four years of watershed, the irrigated area almost doubled, cropping intensity increased and average crop yields increased. The total net returns from all crops increased by 63 per cent. Between 87 to 100 per cent of farmers reported that the project created direct benefits in terms of drinking water facility. The majority of landless households (71

TABLE 6.10: Per Cent Change in Net Returns per Household—Before 1996 and After (1999)

Activity	Districts				
	Rajkot	Surendra Nagar	Amreli	Bharuch	All
Checkdams and other activities	110.45	86.67	48.91	–	73.56
Field bunds alone	86.07	49.66	34.41	75.86	49.42
Total	99.12	67.68	42.25	75.86	63.21

Source: Shah(2001)

TABLE 6.11: Income Position of Beneficiaries and Non-Beneficiaries

Items	Scarcity Zone		Transition Zone	
	B	NB	B	NB
Income (Rs/hectare)				
– From agricultural products	4625	3126	7530	5610
– From by products	625	497	616	627
Income (Rs/Household)				
– From agricultural products	15418	10891	1325	11161
– From by-products	2082	1731	1074	1248

Note: B—beneficiaries; NB—non-beneficiaries.
Source: Shah and Memon (1999)

per cent) also reported increase in the availability of employment mainly on the project activities (Shah and Memon 1999).

Another study in Maharashtra analysed and compared the impact of watershed development in rainfall scarce areas and in transition areas (Deshpande and Rajasekharan 1997). Besides impacts on increases in irrigated area, changes in cropping pattern, etc., this study also reported an increase in gross income of the households by between 17 to 42 per cent (Table 6.11). The changes in the per hectare income from agriculture of the beneficiaries, compared with non-beneficiaries also showed substantial increase of about 34 to 47 per cent as the incremental income.

In a comprehensive evaluation of performance of watersheds and their management institutions, Arya and Samra (2001) undertook a survey of 27 villages having 2070 families in the Haryana Shivaliks region. Out of 27 villages, the Hill Resource Management Societies (HRMS) were formed in only 14 villages of which only 10 were functional at the time of survey. Their study indicates that as much as 83 per cent of the women and 51 per cent of the men were not even aware of the joint resource management concept. Of the 53 water-harvesting structures surveyed in these villages, only 13 were providing goods and services. About 38 per cent of the structures failed immediately after implementation. As against the 2519 hectares proposed command area of these 53 structures, the actual command area at the time of survey was only 16 per cent. The authors, however, opine that despite these failures, conflicts, and excessive governmental indulgence, the experience of successful sub-group of watersheds from this group was encouraging. Their experience shows that with community planning and a bit of restraint and commitment, the economy of any village can be turned around.

It has been opined that the favourable picture depicted by most of the studies may in part be also due to selection bias: in reality in some of the states the success rate can be as low as 25 per cent (Springate-Baginki et al. n.d.). Further, while the success stories get disseminated by researchers and policy-makers as well as by the media, unsuccessful or failed events are generally not highlighted. There has, however, been an increasing realization that while there is nothing wrong with the approach per se, one of the important reasons for the apparent failure/unsustainability of a number of these projects to deliver has been the lack of an institutional arrangement for the proper and just distribution of the benefits derived from the project. This has resulted in iniquitous and skewed distribution of these benefits in favour of land-owning households leading to conflicts within the communities and ultimately to the failure of the project (Adolph 1997, GOI 1994, Deshpande and Rajasekaran 1995, World Bank 1990b).

An empirical evaluation of dryland watershed development projects in Maharashtra and Andhra Pradesh lend support to the hypothesis that more participatory projects perform better than their more technocratic, top-down counterparts, and that a combination of participation and sound technical input may perform the best of all (Kerr et al. 2000). Evidence about the role of economic conditions and infrastructure in successful projects is more limited. Despite rhetoric to the contrary, successful participatory projects remain few in number so their impact is limited. In the study of the rainfed areas of Maharashtra's Pune and Ahmednagar districts, for example, it was found that the innovative projects operated in only 40 out of over 1000 villages. Also, the most successful projects enjoyed special treatment that is difficult to replicate on a large scale and therefore spreading participatory watershed development throughout the country will not be easy. The same study also found that one continuing challenge for almost all projects is in designing interventions and organizing communities so that benefits are distributed more evenly to landless people, shepherds, and women. These are the least influential community members and their needs and interests require special attention. Otherwise watershed projects can actually make them worse off than before by restricting their access to resources that contribute to their livelihoods (Kerr et al. 2000).

The above concerns about unequal distribution of gains are also shared by the results of another study in Maharashtra. An evaluation of Vaiju Bahhulgaon Watershed, undertaken under the Indo-German Watershed Development Programme in Maharashtra found that though the overall impact of the project on the livelihood of the people of the project area has been remarkable, there have been significant differences in the benefits accruing between marginal farmers and the landless (Srigiri et al. 2003).

While the core thrust of the argument of increased community participation remains valid as a necessary pre-condition for success of any watershed project, it is not necessarily true that land-owning households only derive benefits from the water made available from the project. The difference lies in the perception of what constitutes these benefits, how these benefits are measured and quantified, and how these benefits are shared by different categories of people.

The availability of water to the targeted population in relatively backwards areas, where such watersheds have often been built, apart from providing direct benefits to the targeted population in the form of increased agricultural production, increased livestock activity, increased fishing activity and increased availability of drinking water also provide a number of indirect benefits not only to the land and non-land-owning population in the targeted area but also to the population in the neighbourhood areas. Increased agricultural and livestock production activities made possible by availability of water cause 'ripple' effects throughout the local economy. These activities place greater demand on supply of inputs such as seeds, fertilizers, etc. Increased output has implications for increased marketing, transportation, and processing services for these products. All these effects increase the demand for employment of labour. Greater incomes of the population in the targeted area have implications for increased consumption expenditure with its own forward and backward linkages. Consideration of such full impacts comprising of both direct and indirect economic benefits and how these benefits are shared by different sections of the population would enable a more objective assessment of the benefits derived from the watershed, their allocation between different groups of beneficiaries and resultant impact on their poverty.

Estimating the direct and indirect economic benefits and understanding the sharing of these benefits amongst different sections of the affected population is beset with methodological problems. In perhaps the only attempt to quantify such direct and indirect benefits of a watershed project and to understand how these benefits are shared by various stakeholders, Malik and Bhatia (2004) attempted to quantify the direct and multiplier benefits for a typical watershed—Bunga in Shivalik Hills region of Haryana. The results obtained confirm significant economic gains from watershed with indirect benefits constituting a significant component of total benefits of the project. The estimated multiplier value of 1.41 implies that for every one rupee of additional value directly added by the project in the agricultural sector, another Rs 0.41 is generated in the form of downstream or in the nature of indirect effects.

The results on income distribution impacts of investment in such watersheds show that all categories of households benefit albeit to varying extent. On an average the incomes of households increase by about 49 per cent with different categories of land-owning households gaining between 43 and 59 per cent and non-land-owning households gaining an increase of 23 per cent in their incomes (Table 6.12 and Figure 6.12). Workers relatively do not benefit as much from the watershed since the demand for hired labour does not increase in proportion to the total increase in demand for labour since farm households, most of whom are themselves marginal and small farmers, have enough surplus family labour to gainfully employ them on their own farms. A further break-up of sources of increase in incomes suggest that between 67 to 77 per cent of income gains for farm households came from the agricultural sector and about one-quarter of the benefits came from indirect effects of the dam. In the case

TABLE 6.12: Differences in Income Levels of Various Household Categories—'With Project' and 'Without Project' Situations

(Income in rupees)

Category of Households	With Project 2001–2	Without Project 2001–2	Percentage Difference
Marginal farmers (< 1 ha)	1206	803	50.1
Small farmers (1–2 ha)	3015	1891	59.4
Medium farmers (2–3 ha)	2636	1715	53.7
Large farmers (> 3 ha)	2516	1762	42.8
Workers	1038	842	23.3
Total	10411	7013	48.5

Source: Malik and Bhatia (2004).

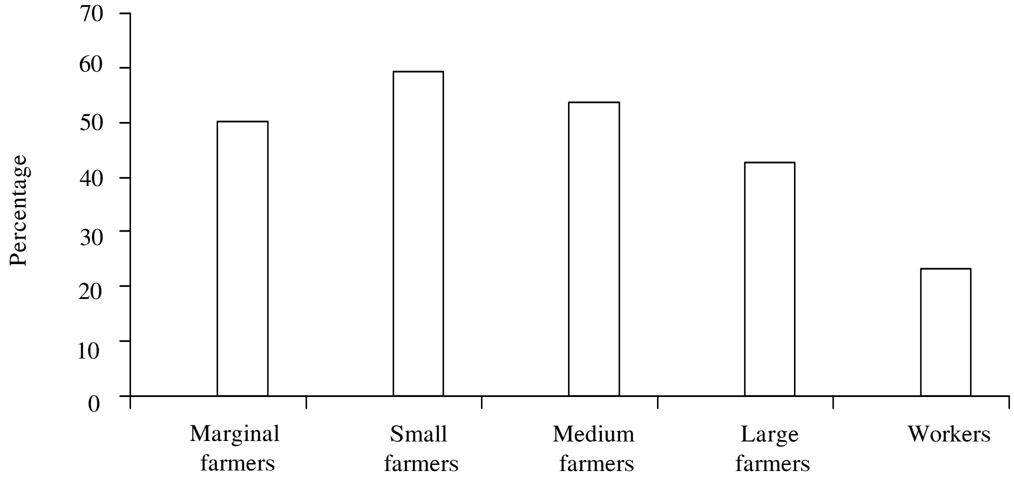

Figure 6.12: Increase in Incomes of Households (%)

Source: Table 6.12.

of non-land-owning households, on the other hand, about 40 per cent of the increases in income came from the direct impact in the agricultural sector while the remaining 60 per cent came as indirect impact from other sectors (Figure 6.13).

The relationship between watershed development, rural livelihoods, and poverty has been examined in another recent study conducted in Andhra Pradesh (Reddy and Reddy n.d.). The results obtained show that while landless and landed poor benefit in the short run (from increased employment and higher wages during the construction phase), the landed households benefit in the medium and long run. However, many of the labour who have worked continuously for five to seven years in the watershed programme have improved their living standards. The other impacts of the watershed development on the poor have been a decline in migration, increase in literacy levels, and increase in non-farm employment of educated youth and an improvement in their status of health and nutrition.

Apart from the direct and indirect economic benefits, watersheds have played an important role in groundwater recharge and thereby in checking partial or complete failure of irrigation wells. The

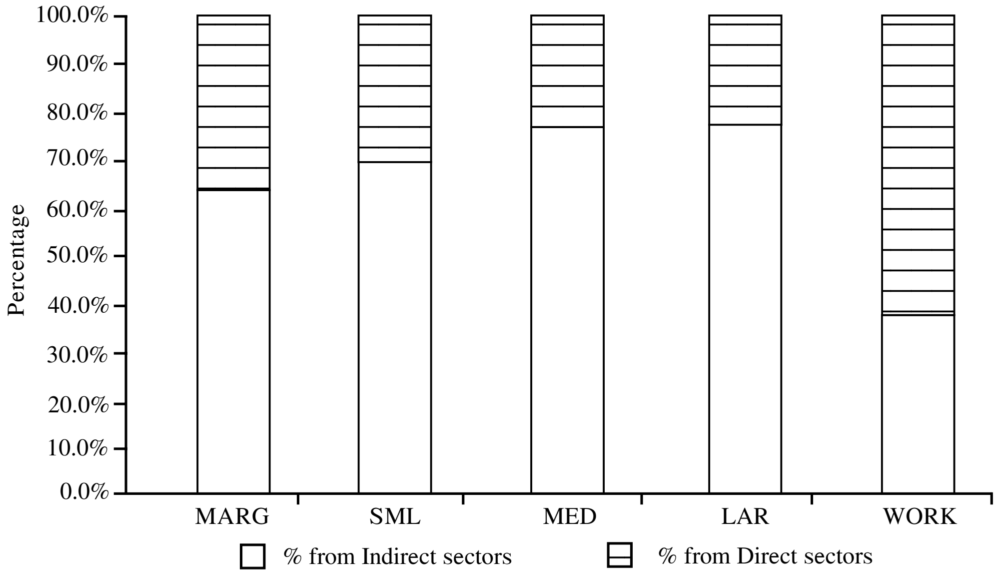

Figure 6.13: Income Gains from Bunga dam

Source: Malik and Bhatia (2004).

watersheds have contributed richly to physical and economic access to groundwater resource for irrigation by increasing groundwater recharge, reducing the cost of irrigation and increasing the net returns per acre of gross irrigated area (GIA). This has also helped to reduce the gap between the small and large farmers in respect to physical access to groundwater resource. In a study on assessing the impact of watershed development on groundwater augmentation in Basavapura watershed in Karnataka, it has been shown that not only the groundwater recharge increased, the life of dug wells, bore wells, dug cum bore wells, and filter point wells increased by four, five, three, and six years, respectively. As a result of availability of larger quantity of groundwater, the area under water intensive crops like paddy and sugarcane increased by 245 per cent (from 33 acres before the watershed was built to 114 acres, six years after the watershed had been built). Due to changes in the cropping pattern and the reduced cost of groundwater extraction, while the net returns per acre of groundwater used on small and large farmers increased by 3 per cent and 43 per cent, respectively, the net returns per acre of GIA increased by 44 per cent and 121 per cent, respectively on the small and large farms (Table 6.13) (Chandrakanth et al. 2004). Similarly, in Andhra Pradesh, according to an evaluation conducted by the state Water Conservation Mission between 1998–9, out of nearly 2000 watersheds evaluated, in as many as 90 per cent of the watersheds water levels have increased to varying levels despite a decline in rainfall by 28 per cent; nearly 1.7 lakh hectares of additional area has been brought under irrigation; and as a result migration of labour declined by between 10 and 40 per cent in different watersheds (Rao 2000).

As a result of improved water availability the watersheds have also been reported to be successful in mitigating the impact of drought. In a recent study on the impact of watershed development in eight drought-prone districts of Gujarat during 2000, a year of severe drought, it has been shown that the incidence of drought—in terms of such variables as access to drinking water, area under crops in kharif and rabi seasons, yields of main crops, fodder and animal husbandry, milk yield, local employment, migration, and

TABLE 6.13: Impact of WDP in Basavapura, 2000

Particulars	Before WDP (1994)			After WDP (2000)			% Change
	Small Farmers	Large Farmers	Overall	Small Farmers	Large Farmers	Overall	
GIA (Acres)	5.8	11.4	8.8	7.5	15.1	11.7	33
C.I.(%)	192	146	156	216	164	175	19
Groundwater used per acre-inch of GIA (acre-inch)	5.95	5.96	5.96	8.3	9.21	8.96	50
Irrigation cost per acre-inch of water used (Rs)	180	164	168	105	81	87	–48
Net returns per acre of GIA (Rs)	7298	6181	6508	10,505	13,678	12,758	96
No. of farmers	18	22	40	18	22	40	

Source: Chandrakanth et al. (2004).

food security—is much less severe in watershed villages when compared to the adjoining non-watershed or 'control' villages (Shah 2000).

The World Bank-funded Shivalik Hills Watershed Management Project attempted to scale up the lessons from many pilot watershed management projects undertaken by several agencies. The findings from the Implementation Completion Report (ICR) of the project indicate that the project has been successful—besides economic outcomes it has led to social transformation of the project areas. Apart from increased agricultural production, increased levels of incomes, and increased levels of employment it has led to improvement in living conditions, improved sanitation facilities and improved health conditions. In addition, there were significant improvements in livestock activity—breed improvement, improved animal health, improved feeding practices. While exact data of these improvements on milk production is not known, the milk production is estimated to have increased by at least 50 to 100 per cent. There is extensive anecdotal evidence from the inhabitants of village communities throughout the project that water tables have risen. The data in the Table 6.14 provides details on changes in groundwater levels in four sub-watersheds in Punjab. The successful

TABLE 6.14: Changes in Groundwater Levels in Punjab

(Metres below surface)

Sub-watershed	Village	1990 June	1990 Oct	1997 June	1997 Oct	1998 June
Dasuya	Malewal	7.68	7.38	4.49	3.95	3.30
Dasuya	Bhanowal	16.64	16.24	9.44	8.94	8.90
Dasuya	Mastiwal	14.69	14.49	7.79	6.49	5.90
Arniala	Baghpur	4.54	3.22	3.63	2.79	2.50
Arniala	Arniala	25.55	24.10	18.55	19.50	18.20
Arniala	Mustafapur	35.40	32.11	24.60	24.45	24.30

Source: World Bank (1999).

completion of the watershed project led the World Bank to initiate the second phase of the project in Shivalik Hills and also take up the Uttaranchal Decentralized Watershed Development Project (2004).

Apart from watershed development programmes, another evidence of the effectiveness of targeted approach of water-related investments in contributing towards poverty alleviation is provided by the Sodic Lands Reclamation Project I undertaken by the World Bank in the state of Uttar Pradesh. The project aimed at improving agricultural production through large-scale reclamation of sodic lands and thereby to contribute to poverty alleviation of the families concerned. Actions were targeted on the below poverty line (BPL) group of the rural population in ten districts of Uttar Pradesh worst affected by sodic lands. About 95 per cent of the land owners in sodic areas were small and marginal farmers with an average holding of 0.4 ha and more than 50 per cent of project beneficiaries were originally landless labourers and share croppers. Apart from achieving the objective of land reclamation, the project contributed significantly to poverty reduction. The project was able to raise both the living standards of the affected population as well as the level of social development. The positive impact of the project intervention on household poverty included raise in local wage employment, incomes, consumption, savings, reduction in labour migration and disguised unemployment. The project also has had some impact in forging larger economic integration of the project area with outside world and increased school enrolment of children. The Implementation Completion Report (ICR) estimated that the average per capita incomes increased by 87 per cent and that the marginal and small farmers benefited more than the large farmers. The average incomes of previously marginal farmer families increased by 109 per cent that of small-scale farmers by 90 per cent while income of large farmers increased by 59 per cent. The family savings and household wealth also increased substantially (Figure 6.14). A notable feature of the project is that while the men in the farmers cooperative failed to manage the important credit component, women's micro-credit groups have filled the vacuum and constitute an indispensable element in the overall success of the project. Encouraged by the success of the project, specially the poverty reduction

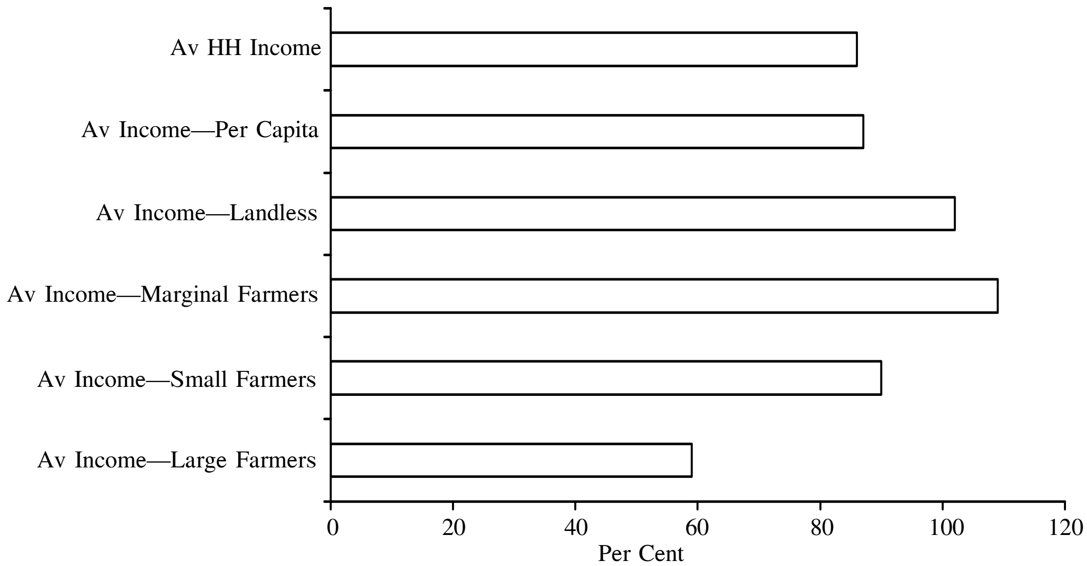

Figure 6.14: Increase in Incomes (%)—UP Sodic Land Project
Source: World Bank (2001).

impacts, the World Bank is funding Phase II of the project.

There are many opportunities for simultaneously improving resource management and the lives of the poor people through targeted approaches and if such opportunities are properly identified, carefully explored, successfully implemented and efficiently managed, these have the potential of contributing positively, significantly and sustainably to reduction in poverty.

TYPE III: INTERVENTIONS: BROAD POLICIES AND INVESTMENTS THAT AFFECT THE DEVELOPMENT AND MANAGEMENT OF WATER SERVICES

Water harnessing, regulating, and delivery services in India are typically top-down government controlled. These government agencies/ departments, by whatever name they are called in different states—irrigation departments, municipal bodies, water boards, etc.—not only administer, allocate, and distribute water but also fix and collect fee, have a say in crop pattern, and undertake O&M activities. These gigantic bureaucratic institutions, both in the irrigation and water supply sectors, have over the years failed to effectively perform the complex job of water management. They have been unable to properly upkeep the huge distribution networks created, extend their networks to reach out to hitherto unserved areas, in ensuring transparency in their operations, and thereby in ensuring an adequate, efficient and equitable distribution of water. While these inefficiencies have affected all sections of the society, it is the poor and the women who have suffered excessively. There is a growing evidence to show that poor people bear a disproportionate share of the impact of inefficient water and sanitation services. Fewer poor people are connected to a network. When they do have access, the installation has to be shared among many more people. And the prices they pay are amongst the highest, generally more than the more affluent households connected to the piped system. The poor still have to pay for water 10 to 20 times more than their richer neighbours (WSP 1999, ADB n.d. http://beyondboundaries.adb.org/ ch2/) (World Bank 2004, Briscoe 1992).[9]

It thus follows that improvement in water services management institutions and policies can contribute towards ensuring more judicious and equitious allocation and efficient use of the available water amongst different users, substantially benefiting the poor in the process.

Irrigation Water Management

The irrigation departments in developing countries, including India, are responsible for ensuring equitable and more efficient distribution of irrigation water. These departments have however failed miserably on both counts. The irrigation sector under public management is plagued with a three fold crisis: financial crisis, technical crisis, and public image crisis (Mollinga 1999). It has also been widely understood that reforms in the public sector irrigation agencies alone are unlikely to bring in any significant improvement in either service delivery or system performance. Several alternative pilot initiatives, with the objective of bringing about some improvements in the irrigation management, have been attempted with varying degree of success under different underlying conditions. On the basis of experience gained from some of these pilots, it is being increasingly realized that some form of joint management between irrigation departments and water users is likely to be more successful in moving towards the goal of better and more efficient irrigation service delivery. Accordingly

[9] An incidental assumption is that poor are concentrated in the tail ends and therefore a reduction in head tail inequities in water use would reduce water scarcity and contribute to poverty reduction. 'Small farm size is related to location in the tail. This makes the relationship between farm size and income stronger and farm size more valid as a proxy. Head—tail inequities in water delivery are not just a general scheme problem but they are a problem that affects poor farmers more than larger farmers. As a consequence, in the WUAs of both the states (Andhra Pradesh and Gujarat) IMT that leads to better provision of canal water to the tails would be 'pro-poor' in itself as it disproportionately benefits small farmers.'(Van Koppen et al. 2002, Report 61, IWMI).

involvement of users in management of irrigation water is being increasingly advocated as the centerpiece of any alternative management strategy.

The concept of user involvement in management of irrigation water is, however, not a new one. It dates back to generations. Involvement of users in irrigation water management through different formats of Participatory Irrigation Management (PIM), Water Users Associations (WUAs) or through Irrigation Management Transfers (IMT) has been tried in several countries of the world with varying degree of success. A 1989 World Bank review of 21 impact evaluations of irrigation projects found cost recovery to be excellent in those projects in which water management and operation and maintenance had been entrusted to water users (World Bank 1990a) though it is not known if these initial trends could be sustained subsequently. The overall experience with these transfers can at best be described as a mix of positive and negative results. While on balance most sources report positive results, especially in operation and finance, although the cost of irrigation to farmers often rises (Vermillion 1997, Groenfeldt and Svendsen 2000). While IMTs in countries like Turkey, Mexico, the USA, and New Zealand are considered as successful examples, in most of the developing country transfers the position is relatively less clear (Shah et al. 2002).

Over the past three decades or so numerous efforts have been made in India to introduce PIM. The National Water Policy of 1987 and subsequent version of 2002 also recognized the concept of participation of farmers in irrigation management. The National Water Policy of 2002 states 'Water Users Associations and the local bodies such as municipalities and gram panchayats should particularly be involved in the operation, maintenance and management of water infrastructure/facilities at appropriate levels progressively, with a view to eventually transfer the management of such facilities to the user groups/local bodies' (GOI 2002). Isolated efforts made by Command Area Development Authority (CADA), several NGOs, and local community organizations did succeed to varying extent in formation of WUAs in some of the canal systems, but not much progress could be made in scaling them up. The evidence available from some of these formal and informal pilot efforts in several states shows encouraging results (Oblitas and Peter 1999) although it is not clear if such positive outcomes could be sustained after all the external support—financial, consultant, NGO—had been withdrawn from the projects.

Nevertheless, policies to increase farmer participation in irrigation represent a significant shift in the approach to irrigation service delivery in India. Several researchers in India have attempted to evaluate different components of the performance of WUAs located in different states of the country using a variety of methods for data collection and employing varying analytical techniques and circumstantial evidence to assess the impact.

An evaluation of the impact of PIM in Maharashtra shows that the transferred sites showed far better maintenance performance than the non-transferred sites (Brewer and Sakthivadivel 2000). However, since most of the resources to the transferred sites till date (of evaluation) had been supplied by the government, either through the maintenance grants or special repairs grants, it remains to be seen if the farmers would be willing and able to provide the additional resources for the maintenance once the government support is withdrawn. In another evaluation of WUAs undertaken three years after the transfer in Maharashtra, it has been reported that WUAs have been able to increase the irrigated area using less water. Even in such WUAs where more water has been used after IMT the per unit water use (water use efficiency) is found to be higher after IMT. Recovery of water charges have considerably improved. At the same time WUAs have been charging much higher amount from the users and majority of the WUAs have been running in profit. Initially this profit may have been on account of management subsidy they were getting. However, even such organizations, which have been working

TABLE 6.15: Comparison of WUA Management Performance

WUA	Devising Rules	Water Distribution	Rule Enforcement Maintenances	Fee Collection	Conflict Resolution	Overall Performances
Mohini	High	Low	Low	Low	Low	Low
Anlolav	Low	Low	Low	Low	Low	Low
Datta	High	High	High	Medium	High	High
Shevare	High	High	High	High	High	High
Ozar	High	Medium	Medium	High	High	High
LBP	Low	High	Low	Low	Medium	Low
PAAP	Low	Medium	Low	Low	Medium	Low
PVP	Low	Medium	Low	Low	Medium	Low
Salipperi	High	Medium	High	High	High	High
NK	High	High	Medium	High	High	High
Pingot	Medium	High	Low	Medium	Medium	Medium
Baldeva	Medium	Low	Low	Medium	Medium	Medium

Source: Brewer(2000).

for over three years and where management subsidy has ceased to exist, are running in profit. Although the assessment in this study is not the result of a widespread database, the picture does show WUAs in a favourable light (Pant 2000).

A comprehensive two-year study carried out by International Irrigation Management Institute, Colombo and Indian Institute of Management, Ahmedabad during 1994–6 undertook to survey policies and activities on IMT being carried out in different parts of the country. The study was carried out in six states—Bihar, Haryana, Gujarat, Maharashtra, Kerala, and Tamil Nadu. The results on overall evaluation of management performance based on a sample of 12 IMTs in large-scale canal systems in these state have been summarized in Table 6.15 (Brewer 2000).

The comparison in Table 6.15 suggests that five of the 12 canal WUAs have been high performers. These include the three canal WUAs in Maharashtra (Shevare, Ozar, Datta) and two canal WUAs in Tamil Nadu (NK and Salipperi). Two Gujarat WUAs (Mohini and Anklav) and three Tamil Nadu WUAs (PAP, PVP and LBP) were rated poor. Two Gujarat WUAs (PIngot and Baldeva) were rated average. The study also reported results on financial performance of seven sample WUAs (Table 6.16). The results on financial performance show that all except Mohini were able to make profit in at least half of the years analysed. All WUAs except Salipperi charge their farmers more for water than the state charges the WUAs. This, however, does not mean that the WUAs actually collected all the fees. In all cases maintenance costs were higher than the maintenance grants provided by the states. Although total expenditures varied greatly, in every WUA total expenditure make up less than 5 per cent of the net incomes from high value crops cultivated in the WUA commands.

Another evaluation of 13 WUAs spread over Bihar, Maharashtra, Tamil Nadu, and Gujarat suggests an increase in area under irrigation, increase in per cent of farmers receiving irrigation, increase in per cent of households having access to adequate and timely irrigation, diversification in cropping pattern, increased crop yields, and an improvement in the physical condition of distribution/filed channels (Prasad 2001). Some of the other evidence available about the impact of these WUAs also suggest that these associations have been able to economize on the use of water,

TABLE 6.16: Financial Performance of Seven Sample WUAs

	Mohini	Datta	Shevare	Banganga (Ozar)	Jay-Yogeshwar (Ozar)	M.Phule (Ozar)	Salipperi
# of years analysed	5 (90–1 to 94–5)	5 (90–1 to 94–5)	3 (92–3 to 94–5)	2 (93–4 to 94–5)	3 (92–3 to 94–5)	3 (92–3 to 94–5)	5 (90–1 to 94–5)
# of years with profit	2	4	3	1	2	2	3
Mean share of WC* in total income (%)	90	71	76	82	67	63	NA
Mean state WC* to WC* charged to members (%)	69	46	71	59	62	54	NA
Mean share of state WC* in total expenditure (%)	63	45	66	36	41	29	NA
Mean maintenance exp/ha (Rs)	56.3	57.0	35.1	97.0	40.3	36.7	77.4
Mean transaction exp/ha (Rs)	256.0	170.2	151.7	134.0	75.7	89.3	
Mean total exp/ha (Rs)	856.2	407.5	546.4	355.0	198.7	177.3	77.4

Note: *WC = water charges. Transaction expenditure include expenditure on all items except depreciation, interest on loans, maintenance, and water charges paid to the state. Total expenditure represents the sum of transaction expenditure, maintenance expenditure, depreciation, interest on loans, and water charges paid to the state.
Source: Same as Table 6.15.

increase productivity and create a sense of reliability and assurance to all farmers in getting the water on time and in adequate quantity for various crops (INCID 2003).

It is, however, difficult to make broad generalizations about the impacts of WUAs based on such studies, because of varying underlying conditions prior to transfer, the nature of user involvement, the extent and nature of IMT, the process of transfer, the legal framework governing these transfers, the sharing of costs between irrigation departments and the users, the outside support in group formation and management, the time elapsed between the time of transfer and impact evaluation studies carried out, the methodology adopted in data collection and impact evaluation and above all the personal biases of the researchers undertaking the evaluation.

A significant push to the process of IMT in India has been made by the multilateral funding agencies. The World Bank assisted Water Resources Consolidation Projects (WRCPs) and Water Sector Restructuring Projects (WSRPs) in several states—Orissa, Tamil Nadu, Haryana, Uttar Pradesh, and Rajasthan—have been emphasizing the involvement of users in management of water at the minor level. Since most of these projects are ongoing their precise impact is still unknown. An evaluation of the Haryana WRCP, which has since closed, was carried out by the OED. The OED concluded that the net effect of rehabilitation, modernization, and improved O&M of the canal and drainage systems and improvement of water courses and their turnover to WUAs show that water courses activities improved incomes and equity with a modest impact on diversification to high value crops (World Bank 2002). A total of 1280 WUAs had been formed of which 'turnover' of watercourses had been made in the case of 754 WUAs. Two impact evaluation studies on PIM were conducted by Haryana State Minor Irrigation Tubewell Corporation (HSMITC) —one for 66 watercourses and the other for 125 watercourses. The results indicate a reduction of time to reach water at the tail end by 30 minutes to 3 hours, average increase in irrigated area by 15 to 25 per cent and overall increase in farm incomes by 15 to 25 per cent (ICR of HWRCP).

WUAs in Andhra Pradesh

In the first ambitious state-wide programme of reform in the irrigation sector in the country, the state of Andhra Pradesh, supported by the World Bank through the Third Andhra Pradesh Irrigation Project, in 1997 transferred irrigation management to farmers by forming over 10,000 WUAs in one go covering the entire surface irrigated area of 4.8 m.ha. This was supported by an enabling legislation—the Andhra Pradesh Farmers' Management of Irrigation Systems (APFMIS) Act 1997—and actions to restore the sector's financial viability. The WUAs have been created with clearly specified mandate, responsibilities, and powers. Results from a few quick impact evaluation studies, mostly undertaken two to four years after the reforms, of the IMT in Andhra Pradesh, are available. A preliminary evaluation of the reforms undertaken by the OED in 1999, two years after the formation of WUAs, indicated encouraging initial impacts (Oblitas and Peter 1999). The study reported an improvement in irrigated area, improved equity in water distribution, and savings on maintenance and rehabilitation works, etc. Van Koppen et al. (2002) report improved access to water and marginal extension of irrigated areas though no significant changes in cropping patterns, crop yields or incomes occurred. Several other studies analysing the impact of transfer of management to WUAs in Andhra Pradesh also suggest initial positive impacts of WUAs in terms of bringing about improvement in the irrigation system, increase in land values, increase in the irrigated area, increase in equity in distribution of water, in making water available to tail-end areas and increase in crop yields, reduced disputes and conflicts in water allocation and improved transparency (Tables 6.17, 6.18, 6.19, 6.20) (Rao et al. 2002, Raj 2002, Pangare 2002).

TABLE 6.17: Benefits Derived after Switching Over to WUAs

Benefits	Irrigation Projects	
	Major/ Medium (%)	Minor (%)
Improvement in the irrigation system	81	100
Increase in the irrigated area	54	31
Availability of irrigation to tail-end areas	46	37
Increase in crop yields	48	37

Source: Rao et al. (2002). Based on a survey of 37 major/ medium projects and 32 minor projects from nine districts of Andhra Pradesh.

TABLE 6.18: Increase in Kharif Irrigated Area—Before and After Reforms: Sriramsagar Project

(Area in acres)

Year	Total Command	Area Irrigated Wet	Irrigated Dry	Actual Command Irrigated
1995	30860	3020	3498	6518
1996	30860	6907	2863	9770
1997	30860	9280	5350	14637
1998	30860	13147	5402	18549
1999	30860	18366	6003	24369
2000	30860	18505	6003	24508

Source: Pangare (2002).

TABLE 6.19: Average Land Value Before and After Formation of WUAs: Andhra Pradesh

(in Rs)

WUA No.	Irrigated			Irrigated Dry		
	Before	After	Increase	Before	After	Increase
WUA–192	75002	85203	10201	52506	76251	23745
WUA–59	80166	87741	7575	–	–	–
Total (Average)	77584	66472	8888	52506	76251	23745

Source: Raj (2002).

TABLE 6.20: Crop Yields Before and After Formation of WUAs: Andhra Pradesh

Time	Rice (bags per acre)	Cotton (kgs per acre)	Chillies (kgs per acre)	Groundnut (kgs per acre)	Mango (tonnes per acre)
Before WUA	32	10	120	9	3
After WUA	35	12	110	11	4
Increase	3	2	10	2	1

Source: Same as Table 6.19.

Jairath (2002) makes a critical assessment of the claims of all-round benefits, as reported in government figures and some researchers, achieved after switching over to PIM in Andhra Pradesh. For example, on the claims of improvement in irrigated area under some of the projects, the author cautions that such improvements in increased irrigated area could actually be at the cost of quality of irrigation—in that the irrigated area may now be receiving inadequate water. Further, even if there was some actual increase in irrigated area, the rate of increase so realized cannot be sustained indefinitely. On the claims of increases in crop yields, the author argues that changes in crop yields are a function of several interacting variables and it is not correct to ascribe the observed changes to PIM. In fact her own field data from two canal sites do not indicate any trend of increase in rice yields. The author reports that PIM resulting in greater control over water use and increasing the equity of distribution is not validated from the field investigations. Whatever increase in irrigation has come about is a result of reduced wastage due to the revamping of the supply network of irrigation channels. While WUAs have performed very successfully as institutions for executing activities for improved maintenance and repair of the channels by accessing funds from the government, as regulatory institutions in charge of water distribution on equitable basis, their performance has been quite weak and ineffective. This bears adversely on their ability to generate resources through collection of water cess. In the coming years this would seriously constrain the reproduction of WUAs as viable organizations.

Urban Water Utility Management

Available research studies confirm that public spending on social services does not always translate into outcomes because the delivery of public services, which is the vehicle for translating policies into the desired outcome, is often weak and highly inefficient (Devrajan et al. 2002, Devrajan and Re inikka 2002, Saigal 2002). The poor has suffered inexplicably in the process, despite huge amounts of subsidies having been provided to these utilities to make the services available to the poor. Many of the poor, in city after city, are not even connected to the networks.

While some cities have tried to introduce low connection charges for the poor, the fact is that poorly developed tertiary networks and the existence of corruption prevent many poor people from becoming customers of the utility (WSP, PPIAF, WBI 2002). Often the poor have a substantial willingness to pay for water supply as shown by what they pay a private water vendor, yet a large number of such households lack access to decent water supplies (World Bank 1992). There has been pressure to improve the efficiency of delivery services and ensure universal coverage of these services. Since the urban poor usually do not live in a specific cluster—they may be spread over a number of geographically scattered clusters or may be living on the roadside—it is difficult to provide them these services through targeted water supply schemes. Their supply needs to be integrated with the municipal systems. These compulsions combined with the greater consumer awareness, technological change, regulatory innovations, and pressures from international organizations has led many of the developing countries to initiate institutional reforms, including seeking private sector participation—in different formats—in building the infrastructure and running these utilities.

Several initial proposals to involve the private sector in water supply and sanitation in the past have been shot down in their infancy stage due to lack of confidence in the capacity and incentives of the private sector. Fears have also often been raised that under such a scenario the poor will be priced out through higher tariff and higher connection fees or overlooked because they live in hard-to-reach poorly planned areas. The poor have been considered as high risk–low return consumers. As a result while there have been some attempts at initiating some institutional reforms in the sector, including small scale private sector involvement, there have been to date very few instances of large scale formal private sector participation in the developing world; wherever they exist they are mostly in the nature of service contracts or management contracts. In between the period 1984–2002 the private sector

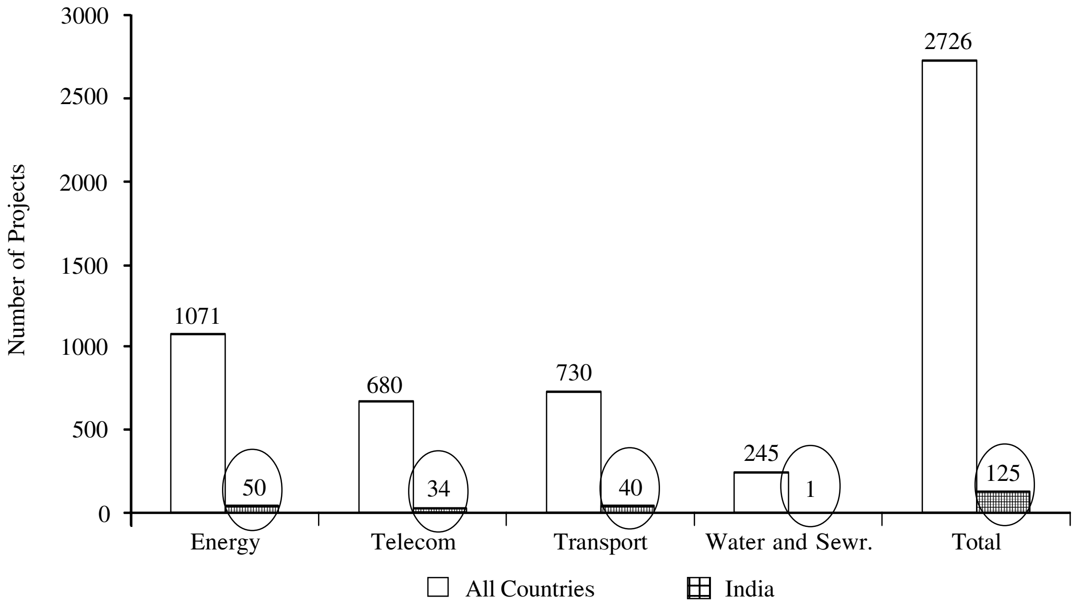

Figure 6.15: Private Sector Participation in Infrastructure (Low- and Middle-Income)—Number of Projects, 1984–2002

Source: World Bank Data Base.

participated in 2726 infrastructure projects in low and middle-income countries of which 125 projects were in India. Of the different infrastructure sectors, the lowest private sector participation was in water and sewerage. Of the 245 projects in this sector in all the low- and middle-income countries there was just one such project in India (Figure 6.15).

Evidence available from some countries, where efforts at privatizing water services have been made, suggest that it is possible, with innovation and effective partnerships, careful planning, and carefully designed tariff and subsidy structures, to not only benefit but disproportionately benefit the poor.

In India, as already indicated, private sector participation in provision of water and sanitation services has so far generally been limited to sub-contracting of certain services such as O&M of pumping stations, design and construction of new facilities, billing and collection etc. There are possibly no cities with large private sector distribution but there have been several instances of moving towards some form of management contracts with private operators such as in Bangalore, Mumbai, Kolkata, Delhi, etc. Since most of these contracts are either in the preparation stage or have been of recent origin and cover only a specified management/functional area, it is difficult to evaluate their effectiveness in overall system management. There have, however, been several isolated instances where innovative community participation and/or private sector participation have helped in improved working of the system and in enabling poor gain access to piped water.

The experience of contracting out the O&M of a new water supply scheme from Bilaspur dam for Ajmer in Rajasthan suggest that it is possible to improve the quality of service and increase consumer satisfaction by facilitating private sector participation (WSP 1999). All the four stakeholders—the consumers, the private contractors, the state government, and the PHED (Public Health Engineering Department)—have benefited from this contracting out. Consumers face shorter periods of disrupted water supply after a leak or burst with average time taken to repair leak and bursts in the pipeline coming down from 60–72 hours earlier to 24–30 hours now.

Under its PPP initiatives, the ADB provided funding for the Karnataka Urban Infrastructure Development Project under which a 12 mld bulk water system was built to benefit 120,000 residents of the towns of Ramanagaram and Channapatna in Karnataka. The Karnataka Water Supply and Drainage Board, the owner of the scheme, appointed a private operator for O&M which has resulted in remarkable improvement in supply of water (Jergensen n.d.).

Madras Metro Water Supply and Sanitation Board has contracted out a variety of services including the O&M of sewage pumping of stations. In Hyderabad also the water treatment plants and sewage treatment plants have been contracted out. In Delhi also the French MNC Degremont has recently built Sonia Vihar Water Treatment Plant which it will operate as well. In Bangalore, where about 20 per cent of the population lives in slums which coexist with well-developed areas, during the period 2000–2 BWSSB-AusAID Master Plan Project was implemented in which the Community Development Component worked on examining and testing the options for improved services to the urban poor. The success in these pilot projects in three slums provided BWSSB an opportunity to replicate these experiences. Residents in slums are being motivated to avail the opportunity to legally connect to BWSSB water supply system and are actively discouraged from resorting to illegal means. BWSSB has offered a rationalized reduction in the connection charges depending on the size of the house. The slum dwellers are allowed to pay connection charges in two installments and procedures for taking a water connection have been simplified. The services being offered include individual household connection and shared meter connection. Public taps are not an option. The work is being carried out with the help of NGOs and CBOs.

A somewhat 'large'-scale private financing in the water supply sector has probably been limited to the city of Vishakhapatnam in Andhra Pradesh and Tirupur town in southern Tamil Nadu. Tirupur is to get piped water for its industry by a private consortium of three companies. Under the scheme the knitwear industry will get 115 mld of water. Tirupur municipality, which includes 60,000 slum dwellers will get 26 mld while 792 rural settlements in its neighbourhood will share the remaining 36 mld. The project is to integrate water supply, waste management, and effluent treatment system. The project has been built on a Build-Own-Operate-and-Transfer (BOOT) basis with a 30-year time stipulation at the end of which it is to be transferred to the government. Water will be brought through a 55 km pipeline from Bhavani river. Since the project is in its infancy stage, its impact is still not known.

Earlier several isolated attempts made at involving private sector in water distribution were withdrawn either before they could commence their operation or shortly thereafter. For example, in 1998, the Pune Municipal Corporation attempted to implement an urban environmental infrastructure project through construction and management contracts with a private sector firm. The project was an integral part of a 25-year strategic plan that aimed to gradually extend to the population, a 24-hour water supply and sewerage service. In March 1997, the government of Maharashtra approved proposals to invite competitive tenders from the private sector. However, two weeks before tenders were due to be opened and the contract awarded, the Pune Water Supply and Sewerage Project was unexpectedly cancelled.

Similarly, in the state of Chhattisgarh, water supply from a 23.6 km stretch of the semi-perennial Sheonath river was handed over to local entrepreneur Kailash Soni in 1998 on a 22-year (renewable) concession to supply about 30 mld water to Chhattisagrh State Industrial Development Corporation (CSIDC) which has bulk buyers in distilleries, sponge iron units, and thermal power plants. However, under public pressure, the state government had to cancel the project.

There is thus no single 'one size fits all' solution or model of community and/or private sector participation in management that can be universally applied. Location specific solutions will need to be developed depending upon prevailing socio-economic, cultural, and institutional conditions and after gauging people's perception to change.

Type IV: Poverty Targeted Policies and Investments that Affect the Development and Management of Water Services

The people who are exluded from formal coverage of water and sanitation services almost always happen to be the people who are also poor. A large amount of emperical evidence clearly demonstrate the access to formal water and sanitation services have a larger social pay off. Based on evaluation results of 15 free-standing water and sanitation projects funded by the World Bank in different countries, OED concluded that the programme of providing access to clean water as a means of improving the lives of the poor has had positive impacts on the lives of the rural poor: large percentages of the target populations gained access to safe water they did not have before. The programme also produced significant benefits for women—the time saved in collecting water gave women more time to spend on economic activities, education, and other beneficial activities (Parker and Skytta 2000). Similarly, several studies on determinants of child mortality suggest a strong inverse correlation between access to water and/or sewerage connection on the one hand and child mortality on the other (Feachem 1981, Schultz 1980, WHO 1978, Puffer and Serrano 1973, Patel 1981). Several studies in India also arrive at broadly similar findings. In India it has been estimated that 1.5 million child deaths per year are due to diarrhoea and other diseases related to unsafe water (Jalan and Ravallion 2001, Parikh et al. 1999). Using the 1998–9 NFHS data Guillot and Gupta (n.d.) found that in states where both water and sanitary conditions are poor, safe drinking water seems to be a more important predictor of child survival than sanitation. In another study Klaauw and Wang (2004) report that providing electricity and sanitation facilities can reduce under-five-years mortality rates significantly. They also conclude that access to safe drinking water is a slightly cheaper policy (per under- five-years death averted) than providing clean cooking fuels. Some of the other evidence also show positive health impacts of safe water use. For example, in villages of rural panchayat of Putencruz, where about 17 per cent of the rural population was afflicted with water-borne diseases in 1992, the percentage of the afflicted population came down to almost 9 per cent in 1996 following use of safe drinking water for 3 to 4 years. Thus between 1992 to 1996 the incidence of disease declined at a rate of 15 per cent in the project area. Also when the project panchayats in Puthencruz are compared with their district, the district data do not show a declining trend, while the project area data do (World Bank 1998, OED of Kerala water supply and sanitation project, Report No 17922).

In India, the central government, concerned by the low population coverage with safe drinking water within a reasonable distance from their habitation and poor sanitation coverage of rural population, has been providing assistance to state governments for accelerating the pace of provision of these services. The approach generally followed in provisioning of these services has been the traditional top down-supply-driven approach. Most of the schemes have been built, owned, and operated by the government departments. The first batch of RWS projects in Maharashtra funded by the World Bank also, in practice, followed the supply-driven, department-implemented approach. From a national perspective, until recently, the involvement of communities in planning, building, running, or maintaining any of these large-scale schemes has been either absent or negligible. According to GOI (1994), no water supply programme prior to 1994 was seen to offer a viable community participation model. There have been isolated schemes, mainly in the form of pilots, where voluntary agencies, community groups, donors, and the private sector have been involved and their participation has been carefully built into the programme. Although these models have met with varying degrees of success they could not be scaled up.

In a joint NGO–community effort, more than 200 villages in the acute water-scarce semi-arid districts of Churu, Hanumangarh, and Jhunjhunu in Rajasthan have been receiving drinking water under the *Aapni Yojana* scheme, a novel water supply sanitation and health education project implemented by a consortium of five NGOs with extensive community participation with German KW bank financing about three-quarters of the total cost of Rs 800 crores (Shah 2003). The far flung villages now boast a network that supplies the water of Indira Gandhi Canal to hundreds of public standposts where taps have been installed and water flows round the clock. *Aapni Yojana* has not only adopted an innovative approach by dispensing with administrative boundaries and the established implementation and operation practices, but has also changed the social dynamics of villages. Equal access to water at public taps and maintenance of the scheme at the local level and payment for the services has created a sense of ownership, belonging, and awareness. The water and health committee in each village, which is independent of the panchayat, is responsible for payment of metered consumption. The women's self-help groups finance sanitation units through the saving-and-loan schemes and link up with the rural banks.

In another model of government built and community operating, a very successful example of village communities operating and maintaining an economically viable multi-village piped water scheme over a long period of time is provided by the four villages of Shirol taluka of Kolhapur district in Maharashtra. This scheme has been working for over twenty years with joint water management body (mandal) of Lat, Latwadi, Shivnakwadi and Shiradwad villages operating and maintaining the scheme with huge total revenue surplus. The multi village piped water scheme was built in 1980 by the Government of

Maharashtra and later taken over by this village group. The scheme started with 419 households and over the 19 years has extended to cover 1723 households (WSP 1999).

In yet another model of NGO–government–community participation, The Sri Sathya Sai Water Supply Project (SSSWSP) was launched by Sri Sathya Sai Central Trust, a non-government organization (HSMI n.d.). Under the project, safe drinking water has been supplied to 731 villages covering a population of over 1 million in the Ananthapur District of Andhra Pradesh. These villages had been facing drought conditions for the last several years and prior to the implementation of the project, the availability of drinking water was meagre and the quality of water was not good. The whole district was deprived of groundwater due to frequent failure of the monsoon and groundwater levels had been going down. Excess fluoride along with bacteriological problem contaminating the drinking water persisted. The villagers suffered severe health problems due to water borne diseases. After the construction of the project by the Trust, it has been handed over to the state government. There are no water tariffs imposed. Only the O&M costs have been set for the efficient maintenance of the system. These costs were to be borne by the government of Andhra Pradesh and the Board in the ratio of 70:30 pending creation of corpus fund. The government has been releasing every year, the 70 per cent of the maintenance cost and the Board is required to raise the 30 per cent cost from the water users by prescribing appropriate charges. In order to meet the 30 per cent gap in the O&M maintenance, the Board has been pursuing the gram panchayats to collect funds from the community. These amounts could not be raised at all due to the poor financial conditions of the gram panchayats as well as the inability of the village inhabitants to contribute. This has raised doubts about the long-run sustainability of the project. An impact evaluation study indicates that as a result of this project the villagers have been able to get safe drinking water. The study also revealed that due to the availability of soft water, the chronic health problems, particularly those due to excess fluorides, have been resolved. Diseases like malaria, diarrhoea, fluorisis, etc. have not been repeated in the last five years. The people are extremely happy with the water made available under the project, which ensured them a decent standard of health and improved quality of life.

There have been numerous other examples of varying degrees of community involvement, with or without government support, in rural water-supply programmes in different parts of India and other developing countries (see amongst others Briscoe and de Ferranti 1988, World Bank 1991a and 1987, Narayan 1995).

There has of late been an increasing realization that these efforts have not succeeded in providing adequate, efficient, affordable, equitable, and sustainable services to the poor. The need for improved management of water services to better serve the interests of the poor has been strongly advocated time and again. There is a growing awareness that in order for these services to be effective, these services should be designed, executed, and maintained in accordance with the needs and demands of the consumers. In order for such services to be effective there has to be a shift away from a supply-driven approach towards a demand-driven approach which provides users with the services they want and are willing to pay for. Alternative models of service delivery, including the involvement of beneficiary users in the management of rural water supply and sanitation schemes, is being seen as having the potential of improving O&M of the rural water schemes and in ensuring more equitable distribution of water and access to sanitation services. In order for the assets and services to be sustainable, there should also be a transfer of ultimate ownership and responsibilities to users and their communities.

Several new initiatives, based on the principle of local community participation, control, and authority, are under way. The large-scale demand-driven approach to rural water supply and formation of integrated community-based management structures was operationalized in the

World Bank-financed Karnataka Water Supply and Environmental Sanitation Project and Uttar Pradesh and Uttaranchal Rural Water Supply and Environmental Sanitation Project (SWAJAL). The experience with these experiments suggest that such an approach has led to transparency, improved quality of service delivery and more efficient distribution of water and accessibility to sanitation services (ICR of KWSES and ICR and OED Review of SWAJAL). Women now participate in other valuable activities such as self-help groups, child rearing, community support, and O&M of water supply systems and utilize the time saved in gainful employment (OED and ICR of SWAJAL Project). Swajal also led to improvement in water handling practices (such as water storage, cleanliness of utensils used for storage, etc.) improved health and hygiene practices (use of latrines, hand washing before meals, hand washing after defecation, and proper disposal of infant faeces), improved knowledge about diarrhoea and its control and a reduction in incidence, duration, and severity of diarrhoea (Table 6.21) (World Bank 2002, Srivastava and Mohan 2002).

The success of the SWAJAL and other similar pilot projects based on similar demand-driven approach in provisioning of drinking water, environmental sanitation, and hygiene behaviour in rural areas in India and the experience gained from similar experiences in other countries has led the GOI, through the Rajiv Gandhi Drinking Water Mission, to adopt it with necessary modifications, as a model approach in its efforts to make safe drinking water available to rural areas in a more sustainable way.

TABLE 6.21: Key Development Objective Indicators: SWAJAL

Indicator	Baseline (%)	Achievement in Uttaranchal (%)	Achievement in UP (%)
% persons washing hands before eating	54	85	82
% HH using safe water for drinking and cooking purposes	45	90	80
% mothers with infant children who practice safe disposal of infant excreta	32	44	71
% children suffering from diarrhoea during the last two weeks	13.9	3.6	5.5
% HH using latrine (latrine coverage in completed village)	12	63	31
% schemes with potable water quality	NA	100	100
Average time saved per HH as a result of scheme	NA	3.5 hrs	NA
% villages where community contribution to capital cost fully received	NA	100	100
% schemes in operation after three years	NA	97	99
% schemes where O&M collection is more than O&M expenses after one year	NA	100	100
% completed schemes where more than 90% of O&M expenses are being collected after three years	NA	45	60

Source: World bank (2002) and Srivastava and Mohan (2002).

A similar targeted approach of giving small holders access to improved and appropriate irrigation technology can also lead to improved conditions of poor people (WSP 2000). Some attempts were made to introduce the treadle pump technology, with discharge of 1 to 2 litres per second, for marginal and small farmers in the states of Uttar Pradesh, Bihar, Orissa, and Assam. In a study to assess the comparative performance of the treadle pump vis-à-vis other available water-lifting options such as the diesel engine, the treadle pump was found to be effective to operate a command area of about one acre and therefore more suited for marginal and small farmers (Srinivas and Jalajakshi 2004).

WATER–ENERGY–POVERTY NEXUS

Water and energy are interlinked. Water and power are both crucial for macroeconomic growth and stability. Given the similarities in the two sectors vis-à-vis their impact on the poor, and the close association between water and poverty on the one hand, and water and energy on the other, it follows that the water and energy policies and programmes can provide synergy for accelerated reduction in poverty. As in the case of water–poverty interactions, the direct empirical evidence linking energy to poverty reduction is also scarce. However, unlike in the case of water, where water–poverty relationships are better understood, the energy–poverty interrelationships are less understood and much less articulated. In general, while there is a broad agreement, supported by anecdotal evidence, on the direction of links between energy and poverty alleviation, hard data on the absolute or relative magnitude of the welfare impacts of different kinds of sectoral interventions are in very short supply (Waddams 2000).

Electricity Impacts on Poverty

There is a large body of evidence from India and other parts of the world that suggests that electricity improves living standards, supports development and job opportunities and improves health. Some studies also suggest a statistical significant association between electricity connection and lower child mortality (quoted in World Bank 2002a–b). Klaauw and Wang (2004) also report that providing access to electricity and sanitation facilities can reduce under-five-years mortality rates significantly. These benefits are widely recognized by the households and they attach significant importance to electricity access and use.

Water–Energy–Poverty Interactions: Agricultural Sector

While water–energy interactions are important in all sectors, in India these interactions are relatively more prominent in the agricultural sector. The agriculture sector accounts for more than 80 per cent of water use and more than one-fourth of electricity consumption in the country is used for pumping irrigation water. This has been made possible by extension of electricity availability to rural areas. More than 86 per cent of villages have so far been electrified with a number of states reporting 100 per cent village electrification. The increased electrification of villages has facilitated widespread adoption of tubewell technology for irrigation. The net result of increased electrification of villages and growth of tubewell technology has been a reduction in rural poverty. Using two points of time data in respect of 14 major states, we present in Table 6.22 the correlation coefficient between per cent of villages electrified and per cent rural poverty on the one hand, and number of electric tubewell per thousand hectares of GCA and per cent rural poverty on the

TABLE 6.22: Correlation Coefficients between Village Electrification and Rural Poverty

Variables	1993–4	1999–2000
% Villages electrified and % rural poverty	–0.77*	–0.84*
Number of electric tubewells per 1000 ha of GCA and % rural poverty	–0.46**	–0.48**

Note: * and **, respectively, denote significance at 1 and 5 per cent level of significance.

other. In both the cases and at both the points of time all the correlations are significant.

While provision of electricity in rural areas is often a necessary pre-requisite for adoption of tubewell technology by the farmers, other complementary policies such as provision of subsidized credit for installation of tubewells and provision of electricity at highly subsidized rates to farmers, that too charged on an annual fee basis, has played an equally important role in accelerating the growth of tubewells in rural India. However, as a result of low electricity tariffs coupled with poor recovery of even these low tariffs, the subsidies on account of electricity supply to agricultural sector have risen sharply: during 2000–1 these subsidies were of the order of Rs 264 billion. These subsidies during the year accounted for 48 per cent of combined revenue deficit and 26 per cent of combined gross fiscal deficit (GFD) of all states. Although the relative magnitudes differ from state to state, in the state of Madhya Pradesh, for instance, electricity subsidies to agricultural sector accounted for 84 per cent of the GFD, while for Haryana and Gujarat the figures were 79 per cent and 55 per cent, respectively. Thus in a number of states in India if subsidies on account of electricity supply to agricultural sector alone could be reduced substantially, some of the states could cut their fiscal deficit to a large extent.

While these power subsidies have ostensibly been justified on grounds of making electricity affordable for the poor, small, and marginal farmers, these subsidies have disproportionately helped relatively well-off medium and large farmers at the cost of marginal and small farmers (Figure 6.16). For large farmers the subsidized flat rate per pump represents a manageable portion of their gross income, and makes it possible for them to irrigate a larger area at lower per unit cost. But small farmers pay the same tariff per pump as the large farmers to irrigate a much smaller area. As a result, for example, in Haryana, electricity tariffs represent 13 per cent of the gross farm income of marginal farmers in contrast to 6 per cent for large farmers. Moreover, electricity subsidies do not even reach the majority of small and marginal farmers who do not have access to electricity and rely mostly on rainfall to irrigate their fields (World Bank 2001). The marginal farmers who constitute 43 per cent of the farm population in the states of Maharashtra, Andhra Pradesh, West Bengal, Punjab, Himachal Pradesh, and Rajasthan own only 5 per cent of electric tubewells in these states (ESMAP 2001).

This is, however, not to undermine the

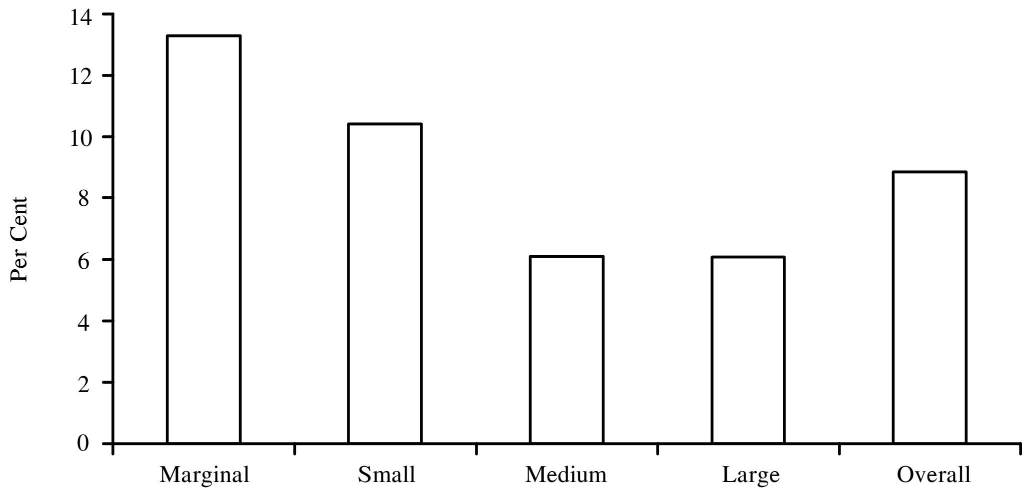

Figure 6.16: Share of Electricity Tariff in Gross Farm Income, Haryana, 2001

Source: World Bank (2002c).

contribution that the availability of electricity and/ or the low electricity tariffs have played in the proliferation of tubewell technology in rural India and thereby in increasing welfare of all including the poor through easy accessibility of groundwater for irrigation pumping even in those areas where surface water could not be made available. The use of subsidized electricity, specially its availability on a flat-rate tariff basis, has also encouraged farmers to install pumpsets that are of higher horse power than those required for their own use. This has resulted in most of the farmers selling a part of their water in the market. Small and marginal farmers, who could not have invested in their own tubewell, have benefited indirectly from electricity subsidies since they now get water at prices that are lower than those that would have prevailed in the absence of subsidies (Pant 1992, 2004; Shah 1993; Shah and Raju 1987). Although hard data on the poverty-reducing impacts of tubewells per se are difficult to get, the impacts are obvious when one looks at the contribution the availability of groundwater has made on diversification of cropping pattern, increased cropping intensity, increases in crop yields and the associated impacts on household level food security, employment generation, agricultural wages, and reduction in foodgrain prices. According to one estimate, electrification accounts for 2 per cent growth in aggregate output of irrigated agriculture (Ranganathan and Ramanayya 1998).

Reforms in the Power Sector and Implications for the Poor

As in the case of the water sector, the electricity sector is also undergoing significant reforms. Power sector reforms are expected to directly benefit the poor by reducing the cost of grid supply and enhancing the quality of service (World Bank 2002c).

Despite the relevance of energy provision for growth and poverty alleviation and despite the advances in energy generation technologies and financial innovations in providing energy to low income areas, in India about 14 per cent of the villages and a very large proportion of households in rural and urban areas, are as yet not connected to the main grid.

Given the high cost of energy transmission, decentralized energy generation and distribution may offer some hope for the rural and poor habitations. Small and medium- sized hydropower projects provide one such means for clean, renewable energy which can often generate development in lagging areas.

CONCLUSIONS

There has been a debate in India about the efficacy of alternative approaches to poverty reduction—a growth-led poverty reduction approach versus a strategy based on improved social services and programmes targeted at the poor. The main message from this debate on the relative efficacy of the alternative approaches to poverty reduction in India has been that there is no choice. If broad-based poverty reduction is to be achieved, all the approaches are required depending on the prevailing circumstances.

The evidence and observation presented in this chapter demonstrate that the poor-stand to gain through both broad based growth led as well as focused water development investments (Type I and III interventions). The evidence presented also confirm that it is not only water development per se that has a positive impact on the poor, reforms in the management of water resources and the policies governing the use of water, individually as also in conjunction with each other, offer equally important and juxtaposing avenues for poverty reduction (Type II and IV interventions). The development and management of water resources impact poverty through a multitude of direct and multiplier avenues and processes and it is important to recognize and take due cognizance of the multiplier impacts and inter-linkages of these interventions. Unlike many other measures aimed at poverty reduction, which are usually ad hoc in approach and transitory in nature, development and management of water resources provide a more systematic, broad based and sustainable approach to poverty reduction. Further, while other approaches to poverty reduction usually aim at increasing income/consumption levels of the poor, investments in water, as demonstrated, helps reduce both the income as well as non-income incidence of poverty. Development of water resources also often form the basis of overall regional development enthusing investment in complementary sectors and infrastructure which interact with each other to induce still larger impacts on poverty reduction.

The strong interlinkages between water, growth, and poverty on the one hand, and water, energy, and growth on the other, translate into mutually reinforcing and much stronger and forceful interlinkages between water, energy, growth, and poverty. Like investment in development and management of water offer important avenues for poverty reduction so do the investment in development and management of power. Investing in development of hydropower can help tap this synergy between water and power in accelerating poverty reduction, more so in poor dominated and otherwise lagging areas.

To sum up, investments in development of water resources of all kinds–broad based or targeted, large or small, single purpose or multipurpose–positively and significantly impact the poor and therefore such investments need to be speeded up. To enable provision of affordable, efficient, and equitable water services and thereby not only accelerate but sustain the poverty-reducing gains of such investments, selective, careful and vigilant reforms in institutions and policies governing the allocation, management, and use of water are called for.

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7

Water and Environmental Sustainability

GEORGE C. VARUGHESE

Quantitative and Qualitative Limits to Water Use

Water Availability in India

The two main sources of water in India are rainfall and the snowmelt of glaciers in the Himalayas. Although reliable data on snow cover in India are not available, it is estimated that some 5000 glaciers cover about 43,000 km^2 in the Himalayas with a total volume of locked water estimated at 3870 km^3. Considering that about 10,000 km^2 are located in Indian territory, the total water yield from snowmelt contributing to the river runoff in India may be of the order of 200 km^3/year (*1 cubic kilometre or 1 BCM per year*).

India receives an average annual precipitation of approximately 4000 BCM in the form of rainfall and snowmelt. After accounting for percolation, evaporation, and other losses, less than 50 per cent (1869 BCM) is the total surface flow, including regenerating flow from groundwater and the flow from neighbouring countries. In view of the constraints of topography, uneven distribution over space and time, water storage technologies, and interstate issues, the total utilizable quantity of water is estimated to be 1122 BCM/year of which 690 BCM and 430 BCM are utilizable surface and groundwater, respectively.

Current and Future Water Requirements

In 1990, the total water withdrawal was estimated at 552 BCM—30 percent of the country's renewable water resources of 1869 BCM. The contribution from surface water was 362 BCM, while the groundwater withdrawal was estimated at 190 BCM. Approximately 460 BCM was used for irrigation while 25 BCM was used for domestic needs (Table 7.1). About 19 and 15 BCM were used for energy and industrial purposes, respectively.

TABLE 7.1: Present and Future Water Requirements

Purpose	Water Demand (BCM)		
	1990	2000	2025
Domestic use	25	35	52
Irrigation	460	630	770
Energy	19	27	71
Industrial use	15	30	120
Others	33	30	37
Total	552	750	1050

Source: GOI (1999).

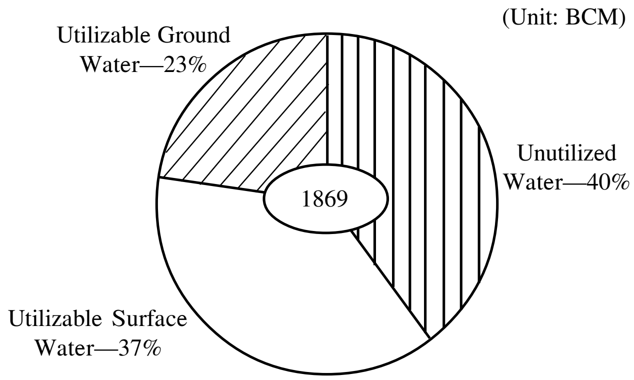

Figure 7.1: Water Availability in India

Source: Central Water Commission.

Currently more than 80 per cent of the 750 BCM water used in India is for irrigation. The balance 20 per cent is used to meet domestic, energy, industrial, and other requirements.

With the rapidly growing population and industrial and urbanization activities, the demand for water is expected to increase even faster. Estimates indicate that by the year 2025, the total water demand of 1050 BCM will be very close to the total utilizable water resources of 1122 BCM in the country. Though projections are not available beyond 2025, it is evident that the

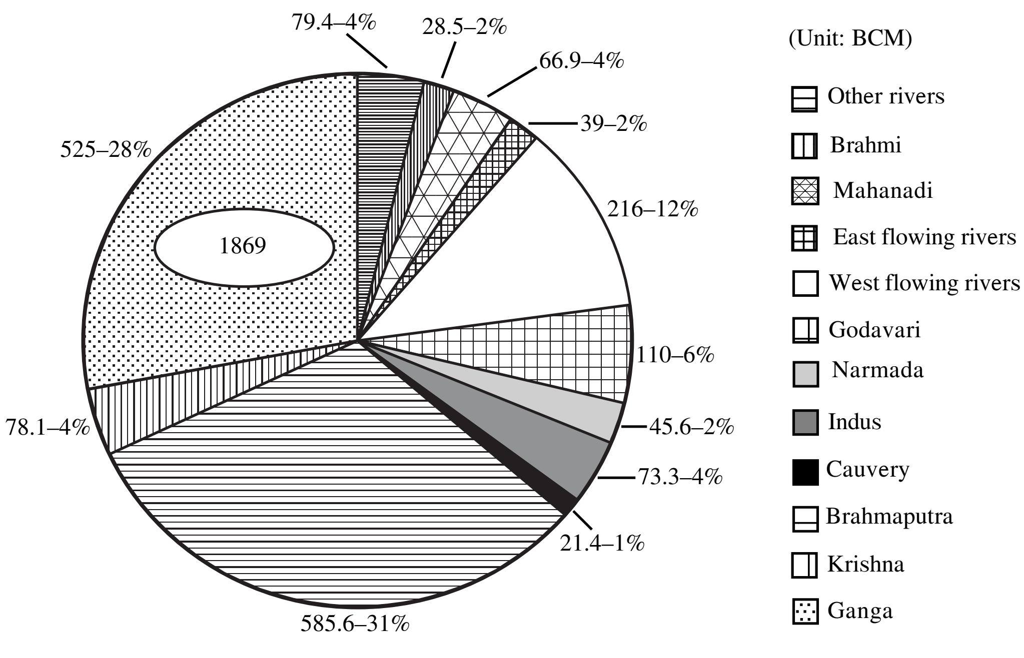

Figure 7.2: Basin-wise Water Resource Potential

Source: Same as Figure 7.1.

Box 7.1: Water Needs of Ecosystems

The water needs of ecosystems are not always recognized, because many people do not regard water for ecosystems as a social and economic use. Yet access to fresh water is an undisputable need for the maintenance and functioning of valuable ecosystems and landscapes in which human activities are an integral part. Ecosystems are also important in securing human health, because they provide services fundamental to our life support system—such as control of pests and detoxification and decomposition of waste. They contribute to the production of food (crops and fish), medicines, and other goods. They provide water treatment, recreation, and waterway transport. And terrestrial ecosystems help balance rainwater infiltration, groundwater recharge, and river flow regimes.

Accelerating population growth and unsustainable consumption and production patterns have increased the demand of water. In the greater competition for water that results, ecosystems—and biodiversity—tend to be the losers. But people are the losers too. Activities that reduce biodiversity jeopardize economic development and human health through losses of useful materials, genetic stocks, and potential medicines. As ecosystems and biodiversity are degraded, their ability to lend resilience to the biosphere declines, and communities and human health suffer. The decline in the quantity and quality of water flows has reduced the productivity of many terrestrial, aquatic, and coastal zone ecosystems and led to losses of biodiversity. In remote areas this degradation of ecosystems has devastated fishing, agriculture, and grazing and undermined the survival potential of rural communities relying on these activities.

Source: World Water Council and Earthscan.

country can face an acute water crisis unless clear and strategic measures are taken now.

It is pertinent to note that more attention is also required to scientifically assess the water requirements for ecosystems security. Today approximately 40 per cent (748 BCM) of available water resources is considered to be unutilizable due to a variety of factors. Probably this is a blessing in disguise since water must be catering to the requirements of the ecosystem integrity.

Temporal Challenge

Almost 80 per cent of rainfall occurs in the four monsoon months of June to September. In peninsular rivers, where there is no contribution from snowmelt, monsoon flow accounts for more than 90 per cent of the annual flow.

In this context retention and storage of water becomes imperative. Even more important is the scale at which retention or storage activities are undertaken. Large dams have their fair share of adverse social and environmental impacts. The country is, on the other hand, endowed with large numbers of traditional water harvesting structures. Unfortunately, most of them are dilapidated, silted, or encroached due to breakdown of the traditional community-based management systems and neglect by the state water engineering departments. Revival of these traditional water harvesting structures coupled with contemporary watershed management systems (including large scale afforestation and regeneration of degraded lands (nearly 30 per cent of the country), small structures like check dams, gully plugs, and other systems) can significantly enhance the surface water retention and storage capacity and also recharge groundwater aquifers of the country.

Spatial Challenge

Precipitation in India is not uniformly distributed and varies from less than 100 millimetres per annum in Rajasthan to more than 2500 millimetres in Assam.

Brahmaputra and Barak basin with 7.3 percent of geographical area and 4.2 percent of the country's population have 31 percent of the annual water resources. Against a national per capita annual availability of 2208 m^3 of water, the average availability in Brahmaputra and Barak is as high as 16,589 m^3 while it is as low as 360 m^3 in the Sabarmati basin (Table 7.2). The per capita annual water availability for rest of the country, excluding Brahmaputra and Barak basin, works out to about 1583 m^3.

Water availability of less than 1000 m^3 per capita is considered by international agencies as scarcity conditions. The Cauvery, Pennar, Sabarmati, east-flowing rivers, and west-flowing rivers are some of the basins with scarcity conditions.

In majority of the river basins, present utilization is significantly high and is in the range

TABLE 7.2: Basin-wise Per Capita Availability of Water

River Basin	Catchment Area (million hectares)	Average Annual Surface Water Availability	Replenishable Groundwater Resources	Per Capita Available Surface Water (cubic metres)	Per Capita Surface and Groundwater (cubic metres)
Indus	32.13	73.31	26.55	1749	2383
Ganga–Brahmaputra–Meghna System (includes Ganga & Brahmaputra & Barak)	109.76	1110.62	206.07	18,061	3358
Ganga	86.15	525.02	171.00	1471	1950
Brahmaputra & Barak	23.61	585.60	35.07	16,589	17,612
Godavari	31.28	110.54	40.60	2048	2799
Krishna	25.89	78.12	26.40	1285	1719
Cauvery	8.12	21.36	12.3	728	1147
Subermarekha	2.92	12.37	1.80	1307	1497
Brahmani–Baitami	5.18	28.48	4.05	2915	3329
Mahanadi	14.16	66.88	16.50	2,513	3134
Pennar	5.52	6.32	4.93	651	1159
Mahi	3.48	11.02		1052	1051
Sabarmati	2.17	3.81		360	360
Narmada	9.88	45.64	10.80	3109	3839
Tapi	6.51	14.88	8.27	1007	1564
West-flowing rivers			28.90		
Tapi to Tadri	5.59	87.41		3383	3387
Tadri to Kanyakumari	5.62	113.53		3480	3482
Kutch and Saurashtra including Luni	32.19	15.10		683	683
East-flowing rivers			18.20		
Mahanadi to Godavari	8.66	22.52		953	954
Pennar to Kanyakumari	10.01	16.46		366	964
Area of inland drainage in Rajasthan	6.00				
Minor rivers draining into Bangladesh and Myanmar	3.63	31.00		14,623	

Source: Central Water Commission.

of 50–95 per cent of utilizable surface resources. But in the rivers such as Narmada and Mahanadi percentage utilization is only 23 and 34 per cent, respectively. In several basins there is also an overdrawal of groundwater leading to lowering of groundwater tables and also salt water intensions.

If the national per capita average of 2000 m^3 is to be maintained, given the bourgeoning population, the only river in north India with significant surplus water to meet future needs of the country is the Brahmaputra. Since Bangladesh also draws water from this river, it may not be easily possible to tap its full potential. In peninsular India, the Godavari, Brahmani, Mahanadi, and Narmada, besides regions of Tapti and Tadri, may have surplus water. Interlinking of rivers has been proposed to address the spatial challenge of water availability. Besides its questionable techno-economic feasibility, the associated ecological damages of river linking may be irreversible.

MANAGEMENT OF WATER RESOURCES—ENVIRONMENTAL IMPACTS

Most human activities—whether domestic, agricultural, industrial, or other services—have an impact on water and the ecosystems. World Health Organization statistics indicate that half of India's morbidity is water related. Water-borne diseases can to a large extent be controlled by managing human consumption and production patterns. It is therefore pertinent to have an understanding of human activities, including water management initiatives, and its impacts on water and the environment.

Impact of Key Human Activities on Water and the Environment

Domestic Activities

Unsustainable consumption patterns of the rich in India are increasingly moving towards generating larger quantities of more toxic substances. Waste management systems have not been able to keep pace with the huge volumes of organic and non-biodegradable wastes generated daily. As a consequence, garbage in most parts of India is unscientifically disposed and ultimately increases the pollutant load of surface and groundwater courses.

On the other hand, the large population of the poor in India has not much choice but to live off the natural resource base and pollute the environment. They deforest for food, fuel, fodder, and fibre, and pollute water source on which they depend, since they cannot afford access to sanitation services.

Domestic water use today, though a small fraction of the total water requirements, is underpriced for political reasons. This leads to considerable waste of the precious resource and inadequate revenues for O&M. Low revenues result in deterioration of the supply infrastructure and further loss of the resource due to system inefficiencies.

In most parts of the country, waste water from domestic sources is hardly treated due to inadequate sanitation facilities. This waste water containing highly organic pollutant loads finds its way into surface- and groundwater courses, often very close to dense pockets of human habitation from where further water is drawn for use. Considerable investments will be required to ensure treatment systems in at least the 500 major cities and towns of the country. Coupled with investment requirements are the difficulties of mobilizing consumers to pay for centralized systems. Estimates indicate that it is viable to set up decentralized treatment systems for clusters of approximately 100 to 200 households where it is more possible to convince users to pay for efficient services. Incentives like soft loans may be provided to these initiatives.

Industrial Activities

The Industrial sector contributing to about 20 per cent of the national income accounts for about 8 per cent of the current water use. With rapid industrialization and urbanization, the water requirement for energy and industrial use is estimated to increase to about 18 per cent (191 BCM) of the total requirements in 2025.

Poor environmental management systems especially from industries such as thermal power stations, chemicals, metals and minerals, leather processing, and sugar mills have led to discharge of highly toxic and organic waste water. This has resulted in pollution of the surface- and groundwater sources from which water is also drawn for irrigation and domestic use. The enforcement of regulation on discharge of industrial waste water and limits to extraction of groundwater need to be considerably strengthened, while more incentives are required for waste water reuse and recycling.

Agricultural Activities

Indian agriculture, employing about 75 per cent of the labour force, is still a 'gamble on the monsoon' with frequent droughts and floods. Two-thirds of India's farm production comes from one-third of its land which is irrigated. The rest is from rainfed areas which employ large populations. In order to meet the increasing demand for food and farm employment, India has to increase the area under irrigation and enhance productivity in both irrigated and rainfed areas.

For the agricultural sector, water and electricity for irrigation is subsidized for political reasons. This leads to wasteful flood irrigation rather than more optimal practices such as sprinkler and drip irrigation. Cropping patterns and farming practices also do not necessarily encourage the judicious use of water. Conservative estimates indicate that the same irrigation water used today can irrigate double the current area with optimized irrigation and farming practices.

With limited revenues and budgetary support, the state engineering departments are unable to operate and maintain the irrigation systems efficiently, leading to increasing deterioration of the structures and systems over time. Consequently there are further losses of the water due to breaches and seepage resulting in waterlogging and salinity. Water quality is further affected due to overuse of chemical fertilizers and pesticides.

Impact of Water Resources Management Activities on Water and the Environment

Water resources development and management activities are undertaken essentially at the sub-basin and basin levels—with their positive and negative impacts on the environment.

Sub-basin Level Activities

Activities at the sub-basin level include watershed development and a range of other interventions including surface structures such as tanks and canals, and groundwater withdrawal structures like tubewells and handpumps.

Watershed Development Programmes: Watershed development programmes typically attempt at improving the water regime through engineering and vegetative measures to maximize the potential of natural resources and increase the income of inhabitants. While supply side measures include engineering interventions such as soil and water conservation measures, check dams, bunding, and other structures together with forestry practices which regulate or even increase water flows, demand side measures include improved farming practices to reduce the requirements of water.

Watershed development programmes check soil erosion, optimize rain water utilization, and promote land use patterns, cropping, and agronomic practices that augment the productivity of land. Besides catering to agricultural requirements, watershed development programmes often cater to domestic and sometimes industrial requirements.

Of late, the need for involving local communities in watershed development programmes to maximize its impacts has been recognized. Consequently, recent programmes have increasingly tended to focus on participatory management practices that are socially inclusive and institutionally sustainable.

The negative impacts of watershed development programmes are marginal and are far outweighed by its benefits. Given the ecological

BOX 7.2: IMPACTS OF WATERSHEDS

Amita Shah and Gani Memon in a quick review of watershed development projects (WDPs) being implemented since1995–6 in Gujarat examine their initial impact at the household level based on a primary survey covering 120 households in four micro watersheds selected from Rajkot, Surendranagar, Amreli, and Bharuch. Even though the project had barely completed four years of its implementation, irrigated area almost doubled since the project intervention. Since increased irrigation has been used mostly for growing cotton during kharif which gets extended up to rabi season, there is, in effect, an increase in cropping intensity. Increased irrigation has led to a substantial rise in average yield of productivity per hectare from all crops combined. Thus the total net returns from all crops increased by 63 per cent. As many as 87 per cent of the households reported that the project created direct benefit in terms of drinking water facility, such proportion being nearly 100 per cent in Surendranagar and Bharuch. The majority of landless households (71 per cent) reported increase in the availability of employment mainly on the project activities, even though it has not yet led to reduction in migration.

In Andhra Pradesh, the area where watershed development work has been done for five years accounts for about 10 per cent of the problem area designated for DPAP. According to an evaluation by the state Water Conservation Mission, between October–November 1998 and October–November 1999, out of nearly 2000 watersheds evaluated, in as many as 90 per cent of the watersheds water levels are increased to varying levels despite a decline in rainfall by 28 per cent. The overall impact of the programme is very positive. 1.7 lakh hectares of additional area has been brought under irrigation; and, as a result, migration of labour declined from 10 per cent to 40 per cent in different watersheds. It is pointed out further that none of the villages experiencing acute drinking water shortage during summer this year belonged to any of the watersheds under the programme.

Source: C.H. Hanumantha Rao, 'Watershed Development in India: Recent Experience and Emerging Issues', *Economic and Political Weekly*, 4 November 2000.

importance of watersheds and the extent of human dependence on the services provided by them, participatory watershed development programmes need to be strongly promoted.

Other Sub-basin Programmes: India is endowed with a diverse range of traditional water harvesting structures which have over centuries catered to community requirements. Their positive socio-economic and environmental impacts are evident with hardly any negative implications.

BOX 7.3: WATER HARVESTING STRUCTURES

Farmers in very dry areas have developed—and are developing—a number of systems for conserving soil and water which enable them to make the most of limited and unpredictable rainfall. These systems are often highly effective, well adapted to local ecological and social conditions, and often outperform methods based on modern agronomic knowledge. Some of the indigenous practices and recent initiatives are documented here.

- In the western and central Himalayas, diversion channels called *kuhls* or *guhls* were built to draw water from hill streams or springs. The length of these channels varied from 1–15 km, and carried a discharge of 15–100 litres per second.
- In Meghalaya, a 200-year-old system of tapping stream and spring water for irrigating plants by using bamboo pipes is prevalent. About 18–20 litres of water enters the bamboo pipe system, gets transported over hundreds of metres, and finally reduces to 20–80 drops per minute at the site of the plant, like a modern drip irrigation system.
- The *zabo* system of cultivation practised in Kikruma village of Nagaland is a combination of forestry, agriculture, and animal care with soil erosion control.
- The *ahar-pyne* system of irrigation is found in south Bihar. *Ahars* are rectangular catchment basins, and pynes are channels constructed to utilise the water flowing through hilly rivers.
- *Kunds,* found in the Thar Desert, are covered underground tanks with an artifically prepared

(Contd ...)

Box 7.3 (contd ...)

catchment area to increase runoff. It was developed to supply drinking water.

- Karnataka has been a forerunner in managing traditional water harvesting structures, like *arakere, volakere, devikere, katte, kunte,* and *Kola.* The maximum number were tanks—40,000 tanks still exist today.
- Khatri is a unique way of water storage in various parts of Himachal Pradesh. These are hand-hewn caves located on both sides of the road beneath huge rocks. Once these khatris are carved out they are provided with an iron gate and locked. The water seeps into these reservoirs from the rocks and is collected inside and is sufficient for daily use. Two types of khatris are found: in one rainwater is collected from house roofs in tins and stored in reservoirs. In the second type, only seeping water is collected and is used as drinking water.
- A special water harvesting structure in Kasaragod district of northern Malabar is called *surangam,* a tunnel dug through a laterite hillock from the periphery of which water or moisture seeps out.
- One-third of the irrigated area of Tamil Nadu is watered by ancient tanks called *eris,* which have played an important role in maintaining ecological harmony—flood-control, preventing soil erosion, reducing wastage of runoff, and recharging groundwater.
- Some tribals of Nicobar Island make extensive use of split bamboos in their water harvesting systems. The split bamboos are placed along a slope with the lower end leading into a shallow pit. These serve as conduits for rainwater which is collected, drop by drop, in pits called jackwells.

Source: Development Alternatives, Community based Water Management Systems—An Overview, 1992.

Minor irrigation departments in state governments have been constructing both lined and unlined minor canals. Though these have been constructed as farm feeders, most of them do not function effectively due to breaches by upstream farmers and lack of maintenance. Consequently, there are instances where these minor canals have also contributed to waterlogging and salinity. On the other hand, these minor canals have more often contributed positively to recharging the groundwater regime. Hence the negative consequences of minor distribution canals are easily avoidable through more pragmatic O&M systems that involve the farmers and the service providers.

Groundwater caters to about 50 per cent of the irrigation and 80 per cent of domestic requirements of the country, in addition to meeting a substantial portion of the industrial requirements. While tubewells are used for irrigation, domestic requirements are met from open wells, handpumps, and also tubewells.

While these structures are meeting essential requirements, in most parts of the country there is overdrawal of groundwater which is assuming unsustainable proportions. Recharge of the groundwater regime through afforestation, watershed, and other practices is absolutely essential and urgent in order to reverse the situation. On the other hand, administrative measures to regulate groundwater drawal like those tested in Gujarat and pricing of energy and water can considerably optimize consumption and reduce demand.

River Basin Level Programmes

River basin level programmes are often multipurpose initiatives with key structures such as dams, canals, and flood control works.

Dams: Dams have been a source of water storage and conservation over several centuries. However, the scale at which these dams have to be constructed has become a source of controversy throughout the world with equally strong arguments on either side. With over 5000 minor, medium, and major dams already operational in India, a host of both positive and negative impacts from their construction, operation, and maintenance have been witnessed.

Indian agriculture has been a major beneficiary of dams of all scales. Estimates indicate that large and medium dams (which account for approximately 40 per cent of the irrigated area) have contributed to approximately 25 per cent increase in agricultural production. Small dams scattered

Box 7.4: Large Dams in India

Period	Number of Large Dams >15 m high	10–15 m high	Total
Up to 1900	28	14	42
1901–1950	118	133	251
1951–1970	418	277	695
1971–1989	1187	1069	2256
1990 and beyond	56	60	116
Details not available	74	162	236
Under construction	461	234	695
Total	2342	1949	4291

As per the International Commission On Large Dams standards, dams having a height of more than 15 metres are designated as Large Dams. The CWC has formalised the following classification of dams:

Size classification
(Based on storage and height)

Category	Storage in Hectare Metres	Height in Metres
Minor	<125 and >6	<12 and >8
Medium	>125 and <6250	>12 and <30
Major	>6250	>30

Taking into account only those dams with height >15 metres, India has 2342 large dams.

Source: Central Water Commission, 1994.

Box 7.5: Contribution of Large and Medium Irrigation Projects to Agricultural Production

In 1993–4 irrigated agriculture accounted for about 60 per cent of foodgrains production. This too was not due solely to dam-based irrigation strategy. Irrigation projects in India are classified under three categories: major (CCA > 10, 000 ha), medium (CCA = 2 000–10, 000 ha), and minor (CCA < 2000 ha). Minor irrigation projects include both surface and groundwater as their source, while major and medium projects exploit surface water resources alone. At the end of 1996–7, the irrigation potential created was 91.8 m.ha. as against 22.6 m.ha. in 1951 and of this major and medium irrigation contributed 33.8 m.ha. or just 36.8 per cent. Assuming that all major and medium irrigation projects include large dams, at the most 21.9 per cent (59.52 × 36.8) of total production foodgrains in 1993–4 may have come from irrigation based on large dams. The actual figure will be still less since not all major and medium projects include large dams.

Source: Roy, 1999—www.dams.org.

all over the country have contributed to about 15 per cent increase in agricultural production.

Multipurpose river valley projects have also contributed to about 20 per cent of the power generated in the country, besides flood control, recreation, and water supply for domestic and industrial needs.

The benefits of dams have been often overshadowed by the scale and variety of adverse socio-economic and environmental impacts. Some of the salient negative impacts include:

Disruption and displacement of affected communities

Various estimates put the number of people displaced by big dams in a range of 20–50 million people, with most of them being from the agricultural sector.

In India, one large dam on an average affects about a million people, displacing almost half of them. In addition these lead to:

- tremendous upheaval in the lives of local communities—often tribal settlements;
- displacement of people and their livestock, loss of livelihoods;
- loss of agricultural land estimated to the tune of 9.1 m.ha. in the last 20 years by the World Commission on Dams;
- submergence of villages and towns; monuments of religious, historical, or cultural importance; loss of heritage; and
- spread of disease vectors like malaria,

filaria, schistosomiasis, and other public health impacts.

Disturbance of ecosystems and loss of biodiversity

With projects in remote and pristine areas, it has been virtually impossible to estimate the disturbances caused by large dams to various natural ecosystems.

Box 7.6: Impacts of Dams on Ecosystems

To investigate all the impacts of dams on ecosystems a wide spectrum of data are required, relating to both the abiotic and the biotic components of ecosystems. To evaluate fully the impact of a dam on ecosystems, pre and post-impoundment information is required on: the hydrology of the river (both at the site of the dam and downstream); hydraulic characteristics of the river; water quality; geomorphological characteristics (that is, sediment transport); aquatic biota and their habitat requirements; riparian vegetation and associated fauna; the direct use of the river and its associated resources by local people. To date, most studies conducted have investigated the impact of one dam or a few dams on specific components of ecosystems. Very often these studies are focused on the abiotic, primarily first-order impacts. There have been relatively few studies of second and third order impacts, possibly because of the longer time frame required before new equilibrium states are attained and total change becomes apparent. At higher tropic levels (for example, impact on terrestrial animals), there are very limited amounts of data relating to long-term change caused by dam construction although there is often a lot of conjecture about possible impacts prior to dam construction (Nilsson and Dynesius 1994). To date most studies of the environmental impacts of dams have been conducted in temperate climates. Little is known of the possible impacts in tropical climates, where biological processes often proceed faster and so ecological changes become apparent more quickly (Bardach and Dussart 1973). It is probable, though largely unproven because the data are unavailable, that the flooding of large areas in the tropics is especially likely to cause global species extinction, simply

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Box 7.6 (contd ...)

because of the high biodiversity of the areas flooded. Anthropogenic influences within a catchment can significantly alter the impact of a dam on ecosystems. Consequently, to fully ascertain the impacts on ecosystems it is necessary to gather both environmental and socio-economic data. Of course combined data are also essential to ascertain the impact of a dam on people.

Source: Ecosystem Impacts of Large Dams, Background Paper Nr. 2 Prepared for IUCN/ UNEP/ WCD by M.P. McCartney, C. Sullivan and M.C. Acreman.

Some of the impacts include:

- loss of forests and wildlife habitat—danger to wildlife, movement routes disrupted, interrelated species split, food-chains broken, disappearance of some species;
- loss or endangering of flora species—herbs and medicinal plants of local or wider importance;
- disturbance of aquatic and riparian life—movement impeded, spawning hindered; loss of aquatic biodiversity upstream and downstream;
- changes in river morphology and water quality—silt load, temperature stratification, variations in nutrient content, and dissolved oxygen at different levels; and
- changes in groundwater regime.

Box 7.7: Dams—Modern Management

In the past, great trust has been placed on technological solutions. Dams became the symbols of development the world over. So far, 3000 large and medium reservoirs have been constructed across India. In 1950–1, irrigation was available for only 2.26 crore hectares of land. By 1993–4, this has increased to 8.50 crore hectares. Even foodgrain production has increased. However, this has not been without a cost. Twenty million people were displaced over four decades since India's independence as hundreds of dams came up all over the country. Of

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Box 7.7 (contd ...)

these only around 25 per cent were ever resettled. The environmental and social costs of these dams and the disparity between losers and beneficiaries were realized in the face of increasing population pressure on the land. Resentment against the big dams, in particular, have led to agitations in Maharashtra in the 1960s and 1970s. Similar agitations seized the projects in other parts of the country. But these agitations were project specific, and it was only in the late 1980s that resentment against big dams became a worldwide issue and attention was focused on Silent Valley, Narmada, and Tehri projects in India.

Dams are responsible for inundating ecologically important lands and the numerous species, while destroying the lands and livelihoods of millions of people. In India, the World Bank is currently financing 21 projects, mostly in the irrigation and power sectors, involving the forced displacement of over 800,000 people, mostly tribal and rural people. It is said that mega irrigation has increased crop yields by over 200 per cent and is responsible for one-third of the world's total crop production. But it is increasingly becoming costly, inefficient, and low performing. Water prices in the irrigation sector are artificially low and promote wastage.

Apart from displacement, ecological and project costs, dams have been the end points for siltation caused by deforestation and soil erosion in the catchment areas of the rivers. Siltation also brings up the question of sustainability from the capacity standpoint. Most of the reservoirs have lost their storage capacity by a minimum of 25 per cent due to siltation.

Thus, the sustainability factor of the dams is increasingly being questioned. Even project maintenance is not properly financed, as the experience with the Kadem reservoir shows.

Source: Water Policy Briefing, IWMI, 2002

While most adverse impacts of large dams cannot be completely avoided, they can be minimized through careful and sensitive planning and execution. Since the scale is large, it will also involve diverse experts and stakeholders, especially the potential project affected persons.

Canals: A large part of India has witnessed irrigation through long canals traversing several states. These canals have helped to improve the foodgrain production, as several water deficient areas have been provided water throughout the year. A prime example of this is the 800 km long Rajasthan Canal with 2 m.ha. of command area. It was primarily conceived in 1947 to utilize the surplus water of the eastern rivers of the Indus Basin, namely the Sutlej, the Ravi, and the Beas, to irrigate the parched lands in the extreme arid districts of the Rajasthan Desert.

The reliable water supply from canals brings about a range of direct and indirect effects in the command and surrounding areas. These impacts are usually on all fronts: social, economic, and environmental.

Canal irrigation has brought about extensive benefits to the country through its contribution towards increased agricultural production and productivity. In the command areas in Rajasthan, wind erosion and deforestation have been minimized to some extent and afforestation became possible. In other parts of India, multiple cropping has been adopted. The rural economy in states like Punjab, Haryana, and Uttar Pradesh has benefited immensely riding on the agricultural boom due to canal irrigation.

Canals also have had their share of adverse impacts. For example, in the case of the Rajasthan Canal, it has resulted in waterlogging and subsequent salinity in 40 per cent of the command area, leading to loss of productivity. Rich soils in Punjab and Haryana have been robbed of their use because of waterlogging.

Due to availability of water, changes in traditional cropping patterns have also been witnessed with farmers switching over to cash crops for better returns. Even though it is a positive fallout of the canals, it has also resulted in traditional staple crops getting abandoned and greater focus being put on water-intensive crops even in arid regions. Another adverse impact of the canals has been livestock congregation and subsequent over-grazing in the command areas. Cases of malaria due to increased mosquito breeding and water-borne diseases have also been reported. Most negative impacts of canals are avoidable with more effective management systems.

Measures to Address Environmental Challenges

Water problems and water management options are as much a product of the social, economic, and institutional context as they are of the technical factors governing local hydrological conditions. In addition, many of the most important water-related challenges have to do with socio-economic distribution of access.

The environmental challenges of water resource development and management in India are expected to manifest themselves more explicitly and rapidly in the coming years. These environmental challenges may be addressed through four broad approaches:

- improving efficiencies and minimizing losses;
- recharging groundwater aquifers;
- abatement and treatment of pollution; and
- reuse and recycling of waste water.

Due to the complexity and urgency of the environmental challenges, these approaches need to be simultaneously pursued. However, it is evident that an essential pre-requisite for water and human security is ecological security. Hence, water resource planning in India has to urgently estimate the requirements of water for ecosystems security.

In each of these approaches appropriate policy, institutional, technological, and economic interventions and/or instruments may be adopted. Most of these instruments have fortunately been tried or tested at least on a pilot scale in India. The challenge is to institutionalize systems for these interventions and instruments to work on a large scale.

Improving Efficiencies and Minimizing Losses

A major bane of the water resource infrastructure in India is the inefficiencies and losses in the system. This characteristic is pervasive in water systems for agriculture, industry, domestic, or other requirements. Crude estimates indicate that improvements in efficiency can reduce up to 40 per cent of current losses. Unfortunately, efficiency is still more an exception rather than a norm.

System inefficiencies result in high rates of unaccounted-for-water (UFW) which has two components: (a) physical losses due to leakages and (b) administrative losses due to illegal tapping and under-registration. Both components contribute roughly equally to UFW. The percentage of physical losses is influenced not only by the deterioration of the network, but also by the total amount of water used, system discharge, and the degree of supply continuity. The percentage of administrative losses depends on the degree of effort exerted in identifying illegal connections and metering.

Reasons for poor services and high levels of UFW range from inappropriate technology and lack of spare parts; poor organizational structures; lack of trained staff; absence of career opportunities and motivation; insufficient funds, tariff and collection systems; and lack of policy frameworks; and non-involvement of the users. The approach for reducing UFW includes improved operation and maintenance and sound management practices—not confined to the technology aspects but also priority causes such as institutional and financial constraints, and negative political interference.

The main financial constraints in reducing UFW are (a) very low water charges—requiring continual subsidization of O&M by state governments—and (b) 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.

Proper metering and pricing of water will be a first step in inducing greater conservation of water by both agricultural and domestic users. It is often claimed that the poorest cannot afford to pay, so prices need to be a lot lower. But there are two powerful arguments against this. First, in many

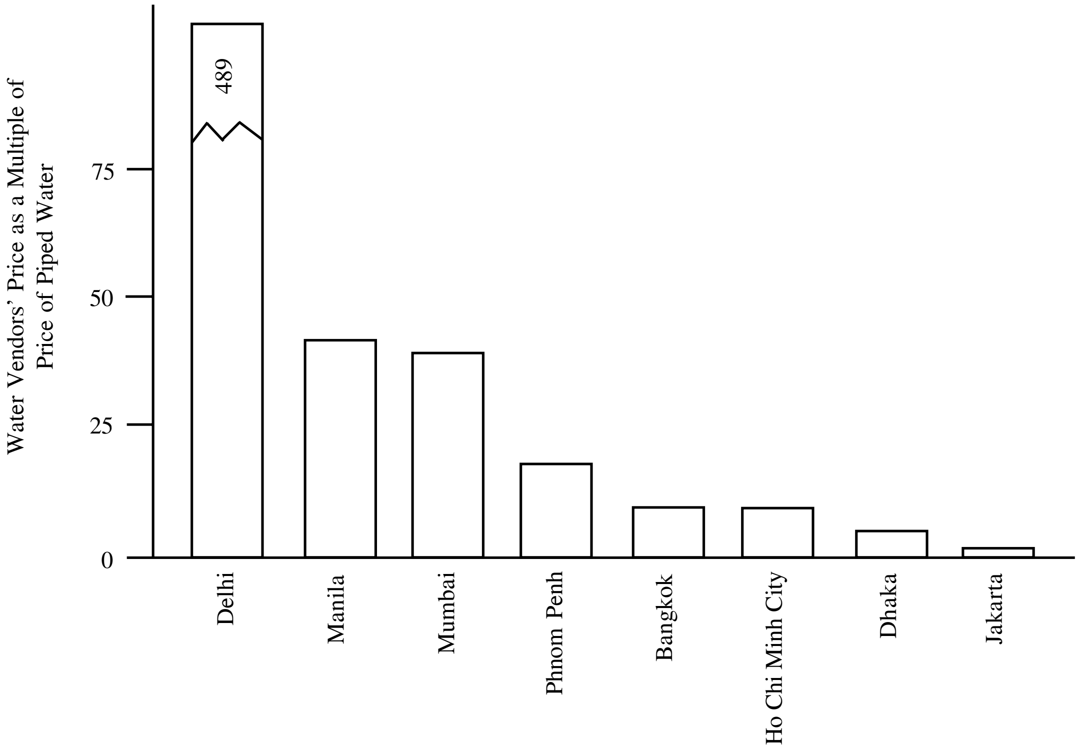

Figure 7.3: The Poor Pay More

Source: UN; Asian Development Bank.

developing countries, the main beneficiaries of low water prices are not the poorest but the middle classes, because it is the middle classes who have access to piped water. The poorest often pay far more to private water vendors (see Figure 7.3). Second, setting prices too low removes the incentive to use water wisely.

Some of the other possible interventions and instruments include:

- increasing agricultural power tariffs to establish incentives for groundwater and power conservation;
- enabling transfer and reuse of water between sectors through economic incentives and legislations;
- contracting out operations of water supply systems, maintenance of irrigation canals, and collection of water fees to community-based organizations, ngos, private sector, or a combination of these; and
- promotion of water conservation methods such as sprinkler and drip irrigation equipment, on-farm works, and other land-improvement investments.

Recharging Groundwater Aquifers

Rainfall in India occurs during short spells of high intensity (most of the rain falls in just 100 hours out of 8760 hours in a year). Because of such short duration of heavy rain, most of the rain water tends to flow away rapidly, leaving very little for recharge of groundwater. Measures to recharge groundwater aquifers include:

- promotion of watershed management practices which have proved to be an effective means of recharging groundwater, improving soil fertility, and enhancing productivity;

- repair and revival of traditional water harvesting and conveyance structures and community-based management systems;
- incentives, like subsidy on property tax, may be provided to individuals who adopt water harvesting practices in their premises;
- modified baselines (including environmental parametres), monitoring systems and the associated metrics, tools and techniques for integrated planning and management of groundwater; and
- creation of water markets that encourage water trading among and within sectors. This would mean that the users have an incentive to invest adequate resources and efforts to maintain the value of the water resources they own to maximize benefits over longer time horizon, thus promoting groundwater recharge measures.

Estimates by the Centre for Science and Environment indicate that up to 300 BCM (approximately half of the current demand) can be captured through effective rainwater harvesting and watershed management. Even if this may be an overestimate, the fact remains that it is possible to harvest a significant quantum of requirements through this initiatives.

Abatement and Treatment of Pollution

Pollution abatement and treatment measures that may be adopted include:

- capacity building of farmers for improvement in application of water, fertilizers, and pesticides through better extension of irrigated agronomy know-how. This will help in greatly reducing contamination of water sources by agricultural chemicals;
- investments in canal lining to reduce seepage that results in waterlogging and salinity. Seepage holes may be designed as required to provide for basin recharge;
- reclamation of salinity affected lands;
- introduction of fiscal incentives for improving environmental quality through:
  * rebates on excise duty/customs duty/ sales tax on machinery and equipment used for pollution abatement or adoption of clean technologies;
  * accelerated depreciation allowances to encourage adoption of clean technologies; and
  * soft loans/subsidies for setting up common effluent treatment plants and recycling and conservation activities;
- application of 'polluter pays' principle through pollution taxes, penalties, and price structures; and
- support for innovations in development of pollution abatement and treatment technologies through setting up zero-pollution industrial estates.

BOX 7.8: POLLUTERS PAY PRINCIPLE—SUPREME COURT

A monitoring Committee on Hazardous Waste set up by the Supreme Court has looked into the allegation of pollution created by Coca Cola, which distributed its sludge to farmers at Plachimada, Palakkad, where the soft drink giant has a bottling unit. The committee came to the conclusion that Coca Cola will take quick measures to ensure water supplies to all the people in the vicinity of the plant. In order to reduce the withdrawal of groundwater, both the units are directed to install reverse osmosis systems to ensure that use of public water for effluent treatment is returned to its original condition for reuse. This recommendation has to be implemented within six months.

Source: http://www.domain-b.com/newsreview/200408aug/20040825newsb.html.

Reuse and Recycling of Waste Water

There are several examples across the country where waste water has been reused or recycled for applications like crop irrigation, industrial use, and groundwater recharge. Reclaimed water has been used in farming or diverted to irrigate forests. An additional advantage to these applications is the recharge of groundwater. Industrial and commercial activities such as cooling applications which do not require drinking water standards are also potential users of reclaimed water. Reclaimed water can be applied to aquifer recharge areas like retention ponds from where it can percolate into the soil.

To ensure that these practices are adopted, policy measures that are required include:

- zoning cum incentive scheme designed to encourage reuse and recycling of waste water from one industry for processes in another (internalize the externalities); and
- support for innovative technologies and capacity building of private sector for design and implementation of water recycling and reuse technologies.

The core water challenge is one of 'governance'. While infrastructure development needs to be pursued and cannot be neglected, the focus has to be on judicious use of available water resources at the local level with community participation and management. A prerequisite for this would be capacity building of all stakeholders including planners, designers, engineers, and civil society.

BOX 7.9: THE BANK'S 1993 OPERATIONAL POLICY 4.07—WATER RESOURCE MANAGEMENT

The Bank assists borrowers in the following areas:

- Developing a comprehensive framework for designing water resource investments, policies and institutions. Within this framework when the borrower develops and allocates water resources, it considers cross-sectoral impacts in a regional setting.
- Adopting pricing and incentive policies that achieve cost recovery, water conservation, and better allocation of water resources.
- Decentralizing water service delivery, involving users in planning and managing water projects, and encouraging stakeholder to contribute to policy formulation. The Bank recognizes that a variety of organizations—private firms, financially autonomous entities, and community organizations—may contribute to decentralizing water delivery functions. Thus it supports projects that introduce different forms of decentralized management, focusing on the division of responsibilities among the public and private entities involved.
- Restoring and preserving aquatic ecosystems and guiding against over-exploitation of groundwater resources, giving priority to the provision of adequate water and sanitation for the poor.
- Avoiding the waterlogging and salinity problems associated with irrigation investments by (i) monitoring the water tables and implementing drainage networks where necessary and (ii) adopting best management practices to control water pollution.
- Establishing strong legal and regulatory framework to ensure that social concerns are met, environment resources are protected, and monopoly pricing is prevented. The Bank requires legislation or appropriate arrangements to establish effective coordination and allocation procedures for inter-state water resources.

Source: World Bank.

APPROACH TO WORLD BANK COUNTRY WATER RESOURCES ASSISTANCE

India is the largest borrower from the World Bank, having received some 59 billion US$ over the years. The Bank has financed many of the nation's biggest dams, irrigation structures, and other mega projects. Approximately one-fifth of these investments have been in water and water-related operations and there is no reason to expect that this trend will be very different over the next few years.

In 2002, OED evaluated the Bank's water-sector strategy in India finding that 'approaches have been top-down, bureaucratic and fragmentary, rather than participatory, client-oriented and integrated'. Because of the systemic problems in the sector it found that 'the Bank's current operations have moved away from new construction and are focusing on making existing infrastructure work efficiently. This is most appropriate given the poverty alleviation mission of the Bank'. Although this echoed two previous reviews, the Bank adopted a new water strategy in March 2004.

The key messages of the Water Resources Strategy 2004 are:

- Water resources management and development are central to sustainable growth and poverty reduction and therefore of central importance to the mission of the World Bank.
- Most developing countries need to give active attention to both management and development of water resources infrastructure.
- The main management challenge is not a vision of integrated water resources management but a 'pragmatic but principled' approach.
- A major World Bank role should be to assist countries in developing and maintaining appropriate stocks of well-performing hydraulic infrastructure and in mobilizing public and private financing, while meeting environmental and social standards.
- The World Bank will re-engage with high-reward–high-risk hydraulic infrastructure, using a more effective business model.
- The Bank is perceived by many to have a major comparative advantage in the water sector, and there is, accordingly, a strong demand for Bank services and a strong demand that the Bank engage in it.
- The Bank's water assistance must be tailored to country circumstances and be consistent with the overarching Country Assistance Strategies and Poverty Reduction Strategy Papers.

As has already been discussed in Chapter 6, the strategy has also identified four broad types of interventions and their linkages with poverty reduction.

While there is a clear policy and strategic commitment to poverty reduction and environmental protection, the challenge is to operationalize these commitments in the new Country Water Resources Assistance Strategy.

Opportunities to Address Environmental Challenges

As a key institution in international development, the World Bank has some obvious comparative advantages even in a country like India where its investments may be only a relatively small fraction of the national development budget.

The environmental and other challenges of water resource development and management are too complex for any small group of individuals or institutions to address. In order to retain its credibility as a knowledge and investment partner, the World Bank can play a valuable role by consciously and proactively engaging with stakeholders who might have widely different and even opposing viewpoints.

The core challenge of water resource development and management in India is one of governance. With growing population and increasing economic activity, the pressures on this basic but increasingly scarce resource have grown much faster than the ability of communities and higher level jurisdictions to cope with them. The bulk of the day-to-day environmental and social problems of India's cities and villages emanate from this core challenge. The solution will lie in how quickly and how well these communities learn to decentralize their management systems and mobilize community ownership and participation in decision-making.

Operationally, the environmental challenges include:

- improving efficiencies and minimizing losses in the extraction, transport, and use of water;
- addressing the spatial and temporal variations of available rainfall and devising the means to optimize its availability, now and for the future;
- planning and designing water-related projects as environmental improvement opportunities to maximize the overall

benefits—not simply to minimize negative impacts;

- internalizing waste water minimization, reuse and recycling as an integral feature of all water related projects. Most projects have tended to increase supplies, without adequate attention to demand-side management; and

Box 7.10: Efficient Management of Supply and Demand

TATA Chemical Limited's Mithapur plant has not only produced potable water from seawater in this water-scarce area, it also recycles water to a zero-discharge sewage-treatment plant. Tata Salt, the largest-selling branded salt in India, is a by-product of Mithapur's water-management process. Refuse from bathrooms, toilets and kitchens is collected in centralised sewage-aggregation tanks and pumped into the treatment plant. The water is disinfected through chlorination and monitored for its quality. The solid remains of the treatment plant are rich in organic carbon, nitrogen and phosphorous. This waste is composted and used as substrates for horticulture. The treated water is routed back to the township's flush-pumping station and is also used to maintain the gardens and greenery on the campus.

Source: www.tatachemicals.net.

- ensuring adequate reserves for ecosystems requirements; supporting scientific assessments and incorporating the analysis into projects.

The World Bank understandably has had a bias towards infrastructure development projects. However, their reviews and current strategy indicate that they have learnt from global experiences the need to focus much more attention on resource efficiencies and long-term sustainability. Such efficiencies and sustainability often cannot be achieved through large centralized systems in countries like India. Decentralized systems to which local communities can relate and of which they take ownership are often far more effective.

Box 7.11: Estimating Ecosystem Requirements—Methods

1. Rapid Estimation Methods: Most of these methods are based on the establishment of an empirical relationship between the flow in a river or channel (as water volume per unit time), and the resulting structure and function of the associated aquatic ecosystem. One of the best-known rapid methodologies is the so-called 'Montana method' (Tennant 1976). A modified version was developed in South Africa recently (DWAF, 1999) based on experience from local studies, and has been extensively used for planning purposes.
2. Comprehensive Methods: Many of these methods use habitat-based endpoints: ecologists provide recommendations regarding the extent, distribution, and character of available habitat which is required to maintain or protect certain ecological functions or key species, and then determine, with the help of hydrologists, the necessary magnitude, frequency, duration, and timing of flows which will provide these habitats. The best-documented examples of more comprehensive methods are the Building Block Methodology (BBM: King, et al. 2000) which was developed and has been extensively applied in South Africa, the Instream Flow Incremental Methodology (IFIM) which is widely used in the USA, and the holistic approach which has been applied in Australia (for wetlands) (Tharme 1996).

Source: Heather Mackay, Water for Ecosystems, *thewaterpage.com*.

In this context, the opportunities and priorities must be to:

Promote integrated water resources management approach: The need for integrated water resources management is widely and frequently called for but rarely implemented due to differences in conceptual understanding and analysis, coupled with implementation hurdles in bringing together powerful agencies with strong domain expertise but with a tendency of protecting their 'turf' rather than working together. With its global experience and influential position, the World Bank can and must catalyse much better performance in this sector and help create far more integrated and better resource management practices in India. To do so, it will have to follow certain basic principles, such as:

- The water needs of the poor and underserved must be given the highest priority through the preparation of a comprehensive policy and regulatory framework aimed at integrated management systems that can ensure rational and equitable allocation of resources.
- The water requirements for ecosystem services and security need to be scientifically assessed and incorporated into the analysis of all water resources management projects.
- Industrial, agricultural, and municipal water systems should be designed to take full advantage of innovative approaches designed to maximize delivery and minimize waste such as Zero Emission systems, controlled irrigation and 24/7 drinking water supplies.
- Water resource management must go well beyond environmental impact assessment and minimize externalities to becoming integral components of national and local action to improve the environment and human security.
- The information base and analytical framework for integration of water resources

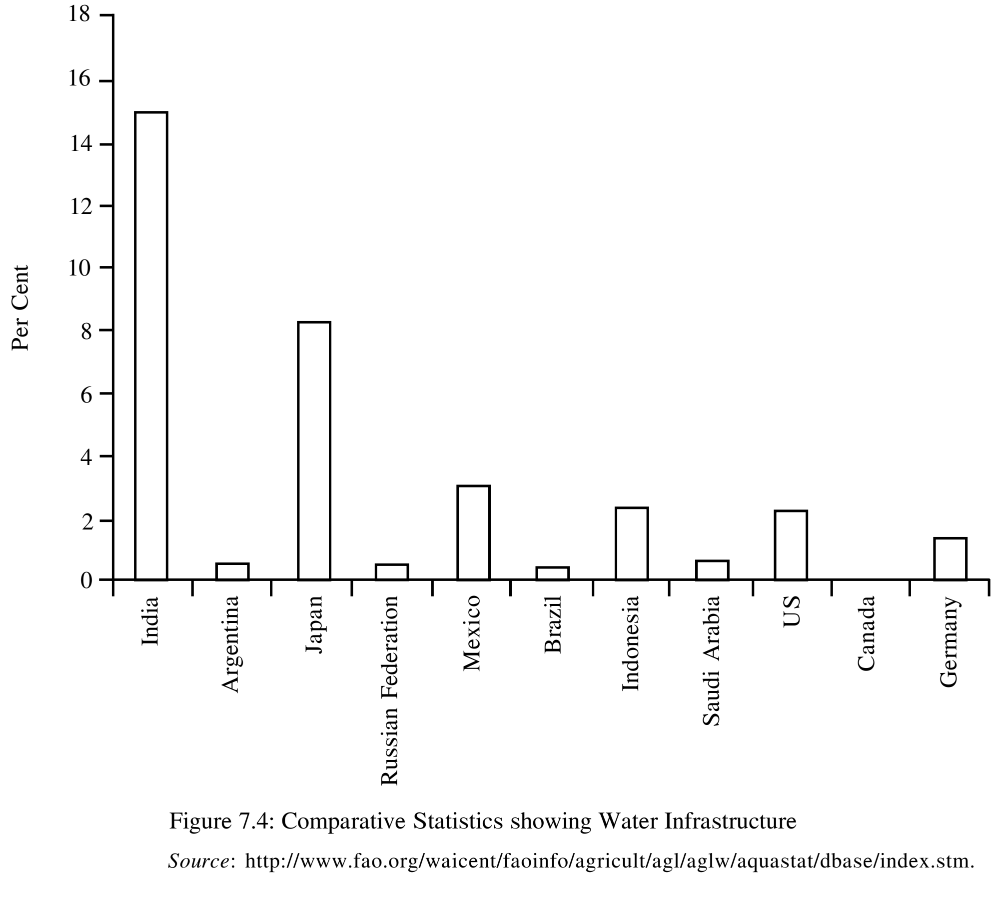

Figure 7.4: Comparative Statistics showing Water Infrastructure

Source: http://www.fao.org/waicent/faoinfo/agricult/agl/aglw/aquastat/dbase/index.stm.

management needs to be continually revised and updated in the light of experience and made widely available through intensive programmes for the education and training of planners, designers, engineers, and civil society.

- Integrated planning and action will also require modified baselines (including environmental parametres), monitoring systems, and and the associated metrics, tools, and techniques.

Vigorously pursue decentralization and community water management initiatives: India has built an extensive infrastructure over the past 50 years for managing the nation's water resources. One thing is clear, however: large-scale public sector operations are often not very accountable to the citizen or amenable to his or her sense of ownership. This has meant that they often suffer from neglect, leading to poor financial returns, inadequate income to cover the costs of upkeep and maintenance and misuse, inevitably resulting in inefficiencies, water losses, and environmental degradation.

Over a long period of India's history, water had been managed, very successfully, as a local resource. Unfortunately, the logic of the so-called economies of scale and the self-perpetuating momentum of the engineering sector had radically changed all this.

Fortunately, the Constitution of India recognizes water as a 'state subject'. This opens the possibility of bringing it back under the control of local communities which can ensure that it can be retained for as long as possible where it falls and used efficiently through local ownership and management. The World Bank through its investments can help accelerate the decentralizing process:

- The constitutional authority provided by the 73rd and 74th Amendments to the Constitution, which empowers Panchayats and urban local governments to manage their water resources must be used so as to create a sense of ownership among local communities and a culture of paying for the resource and its delivery.
- The issue of water ownership and rights will have to be revisited and options for transferring surface and groundwater rights defined. Mechanisms for transfer or reuse of water between sectors also need to be simplified.
- New guidelines and/or legislation are required for:
  * creating institutions for water sharing and allocation–including strengthening of regulatory powers; and
  * water resource development, distribution and revenue collection—including participation of the private sector, NGOs, and community-based organizations.
- Large-scale conservation measures like integrated watershed development need to be simplified and propagated widely to mobilize local ownership and promote food livelihood security. At the same time, smaller projects, such as traditional water harvesting and conveyance structures, and community-based management systems which are more in tune with local cultures and practices must be revived and popularized.

Foster local institutional development and capacity building: Robust local institutions are an essential pre-requisite for decentralized management of water resources. They must also have access to higher level information and institutional support to manage these resources in an integrated manner. The highly effective community-based institutions that used to exist in most parts of the country have today been replaced by the local offices of state-level engineering departments. In some places, there also exist NGOs and private sector initiatives, usually in the nature of experiments and pilot projects, attempting to create and build up local water management institutions.

No single type of institution can hope to manage the ever-growing complexities and challenges of water resource development and management. New types of multi-stakeholder institutional bodies will be required and innovative partnerships will have to be forged for this purpose. The task of building local institutions and their capacity across a country like India is immense. The World Bank with its Indian and global experience can play a significant role in this process:

- An aggressive, conscious effort is needed to define the roles of various participants in the multi-stakeholder processes associated with managing water resources:
  - governance—panchayati raj institutions, gram sabhas, or urban local bodies;
  - operations—community-based organizations, NGOs, private sector, government agencies, or a combination of these;
  - regulation—state or central government; community based; and
  - financing—all these stakeholders plus international agencies.
- The knowledge and skill base of these local institutions will have to be strengthened for:
  - integration of water resource management;
  - building of information and knowledge base;
  - internalizing cost recovery principles; and
  - monitoring and conflict resolution mechanisms.
- Operationally the local institutions will need support in design and implementation of projects including:
  - assessment of technological options and
  - management systems including unbundling of resource development, conveyance, distribution, and revenue collection where appropriate.

Promote economic instruments for efficient and sustainable water resources management: Though water is unquestionably a fundamental right of every human being, its growing scarcity severely jeopardizes the ability of citizens in many parts of India to exercise this right. Economic instruments are recognized as one essential component for efficient and sustainable management of the resource. However, economic instruments are very often politically difficult to implement. The World Bank with its global experience can play a critical role in promoting appropriate economic instruments for the various components of water resource management in India to:

- Evolve pricing mechanisms for irrigation, urban and rural water supply systems that include the full cost of providing it. These should include the costs not only of the infrastructure, operations and maintenance, capital servicing, and other financial costs, but also the broader economic, ecological and social costs incurred in the process of acquiring, transporting, and delivering it. At the same time, these pricing mechanisms have to be adjusted to ensure universal service provision, and especially to cater to the special needs of the poor and underserved.
- Demonstrate pilot projects in cooperative, enterprise, and other institutional modes, with community participation, for providing water services to communities.
- Provide time-bound subsidies for development, testing, and scaling up of tools and techniques (for example, drip irrigation) for efficient use of irrigation water with the aim of enabling such practices to become financially viable and widely adopted without continuing subsidies.
- Evolve fiscal incentives like rebates on excise, customs and other duties, or tax

exemptions for industrial operations that adopt pollution prevention and treatment measures, particularly for systems aimed at zero emission.

- Provide incentives to domestic water suppliers that integrate water reuse and recycling measures in their operations.
- Devise fiscal instruments such as taxes, penalties on industrial polluters for discharging effluents in water bodies based on the 'Polluter Pays' principle.
- Promote establishment of water markets that encourage water trading among farmers themselves and also with urban or industrial users.

Support innovative approaches to water resources management: The environmental and other challenges of water resources development and management in India require a whole range of innovative approaches. The World Bank can play a major role in promoting these technological, financial, institutional, and other innovations to cater to various scales of decentralizations. Once proof of concept is demonstrated, the Bank can also support design of scale up mechanisms. Some of the areas of innovation include:

- Technology packages for:
  * upgradation of traditional water harvesting and conveyance structures;
  * cost effective systems for conjunctive use of surface and groundwater;
  * improved agriculture and irrigation practices to achieve 'more crop per drop';
  * low cost water purification systems;
  * water reuse and recycling systems; and
  * zero emission industrial estates.
- Water resources planning and management:
  * scientific assessment of water requirements for ecosystem security;
  * development of knowledge base and analytical framework for integrated water resource development; and
  * institutional and financial mechanisms for decentralization of water resources management.

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8

Water and Energy Interactions[1]

RAMESH BHATIA

INTRODUCTION

Water and energy interactions have significant impact on economic growth, poverty reduction, and environment in India. Hydropower accounts for a quarter of the total power capacity in the country and contributes 14 per cent to energy output in the country. Water is an essential input for generation of thermal and nuclear power. About one-third of total electricity is used for pumping groundwater for irrigation as well as for domestic water supply in urban and rural areas. Thus, water and energy are interdependent sectors and both have to perform well to meet the objectives of growth, poverty reduction, and environmental sustainability.

The results of the ongoing reforms in the power sector have been mixed. The Electricity Act, 2003 has provided the directions for changes that will result in financial reforms in the power sector and, hopefully, will result in a commercially vibrant power sector. The setting up of the Central Electricity Regulatory Commission (CERC) and State Electricity Regulatory Commissions (SERCs) in all major states has provided the necessary institutional arrangements for setting of remunerative tariffs and competitive conditions in electricity supply. A number of SERCs have issued tariff orders since 2000. In some states, efforts towards metering of agricultural connections have been stepped up and there are pressures to raise electricity tariffs for agriculture and reduce cross-subsidies from other sectors. Although average tariff charged from the agricultural consumers has more than doubled from 21.2 paise/kWh in 1996–7 to 41.5 paise/kWh in 2001–2, it is still far below the cost of supply to agriculture. There have been some setbacks after recent elections since Andhra Pradesh, Tamil Nadu, Maharashtra have resorted to free electricity for farmers. Policy-makers at the highest levels have been advocating that populist measures such as providing free power and water to farmers should be avoided. Politicians in the states are realizing the problems of free power to farmers since the supply systems are overloaded and a large number of illegal connections have come up. Nevertheless, the institutional mechanisms for policy reforms in the power sector have been put in place.

In contrast with the power sector, there has not been much policy reform or institutional change

[1] The author is grateful to John Briscoe, Sunil Khosla, Pramod Deo, R.P.S.Malik and Meera Bhatia for their valuable help.

in the water sector (except the involvement of users' associations in irrigation). National water policy as well as water policies in some states define the priorities of allocation of water to drinking water, irrigation, hydropower, in that order. Irrigation departments in state governments own and operate multipurpose projects as irrigation projects with scant importance for the value of hydropower. Water allocation is determined by administrative notions of priorities with utter disregard for economic value of water in alternative uses. Water needs for hydro, industry, and thermal power generation are not given much importance in allocation of water supplies by the government agencies. Only in a few cases, institutional arrangements exist under which flexibility in the transfer of water from agriculture to urban areas has been possible (Briscoe 1997).

Hence, the time for the next generation of reforms has come. In view of these significant interactions between water and energy sectors, a 'systems perspective' is necessary in the management of these two critical resources so that the value of output and services is maximized subject to social and environmental considerations. This would require institutional developments in both the water and energy sectors that provide flexibility in the allocation of these resources among various users by taking into account the complementarities and trade-offs in the use of these resources.

The ongoing reforms in the power sector have to be extended to include the water sector so that synergy benefits of the use of these interdependent resources are maximized and negative externalities can be avoided. This would require regional water and power boards (RWPB) that will coordinate the activities of existing State Electricity Boards, Independent Power Producers, Management Boards for Multipurpose Projects (such as Bhakra Beas Management Board, Damodar Valley Authority, and Irrigation Departments of state governments). These RWPBs will operate on commercial principles based on a set of incentive structures that maximize the value of water and power for producers. For example, these water and power boards will determine price of hydro power to reflect its value to society in meeting the peak power requirements. This price incentive will maximize the output of hydropower during the peak requirements by conjunctive use of surface water and groundwater for irrigation. There will be enough flexibility in the system to allocate water according to its economic value in the use. Prices set for consumers by these Boards will be based on the advice of the regional ERCs and will reflect the economic cost of supply for electricity and water for each user group. If some users/consumers have to be provided water or power below its cost of supply, direct and transparent subsidies will be provided by the state governments to regional water and power boards.

The major issues regarding the policy and institutional aspects of water-energy interactions are:

- allocation of water for hydropower and this power, in turn, is used for pumping water for irrigation; and
- pricing of electricity used for water pumping for irrigation.

The issue of water allocation among other uses including irrigation and thermal power is considered as a part of the integrated management of water and energy resources. Pricing of electricity[2] for irrigation is considered important due to the issues of the level of subsidies and the implications of eliminating these subsidies for livelihoods and incomes of marginal and small farmers.

HYDROPOWER AND IRRIGATION

Hydroelectricity is a clean and renewable source of flexible power,[3] which can meet the country's

[2] Pricing of electricity for other users does not raise much controversy except in the case of cross-subsides from industry to agriculture.

[3] For a discussion of various issues involved in the development of hydropower, see Central Electricity Authority (2001), GOI (2002), Deo and Modak (2004), and World Bank (2004a,c).

substantial peaking shortfalls and which can reduce the dependence on thermal and nuclear generating plants, thereby reducing their adverse environmental impacts such as greenhouse gas emissions and local pollution from coal-based plants.

Value and Cost of Hydropower

One of the major advantages of hydropower is that it is a low-cost high-value source of power, particularly in the Indian situation where power and energy shortages have resulted in high-cost coping strategies. Hydropower can be used for meeting peak power requirements and has a high value to society in terms of avoided cost (cost of coping strategies or loss of output/service). Hydropower provides valuable support for economic power system operations, where coal and nuclear-based generating plants form the base supply, because inherently long periods (several hours) are required for start-up, shut-down, and changes in their supply capacities.

Although hydropower has high initial capital costs and long gestation periods, its cost of operation is relatively low. For example, the cost of power supply in Himachal Pradesh, that is totally dependent on hydroelectricity, was Rs 2.38 per kWh compared to an all-India average of Rs

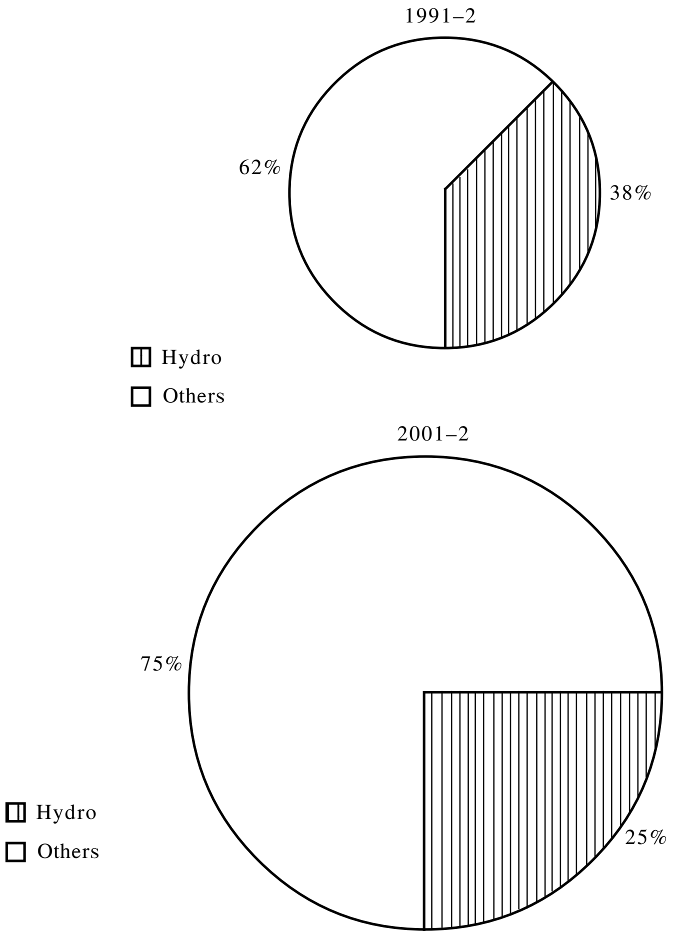

Figure 8.1: Share of Hydro Capacity in the Total Capacity, 1991–2 and 2001–2
Source: GOI (2002).

3.27 per kWh in 2000–1. Similarly, the cost of power supply in Meghalaya at Rs 2.36 per kWh was roughly three-fourths of the all-India average cost of power supply. In Orissa, hydropower accounts for about 40 per cent of total consumption, currently at an average price of approximately 60 paise/unit (Sinha 2002). In the case of the Bhakra system, that is more than 40 years old, electricity generation has operating costs of only 10 paise/kWh (World Bank 2004a).

Declining Share of Hydropower in India

India started development of hydro projects as multipurpose projects (Bhakra, Hirakud, and Srisailam are some examples). During 1980s and 1990s, the slow pace of hydro development in India has been due to the capital intensive nature of the projects, with long gestation periods and high initial risks (hydrology, geology, construction risks); water sharing disputes; and specifically in the case of storage projects, difficult resettlement and environmental issues. This led to increased emphasis on run-of-the-river hydro projects with only diurnal storage to meet peak shortages, where resettlement issues were minimal (World Bank 2004).

The all-India total installed power generating capacity under utilities, as on 31 March 2005, was 118,419 MW. Of this, hydro capacity was 31,136 MW or 26.3 per cent of the total. Hydro capacity in the country increased from 12,200 MW in 1981–2 to 31,136 MW in 2004–5. This shows about 7000 MW being added every decade. The share of hydro capacity in the total generating capacity in India, however, has declined over time from 38 per cent in 1981–2 to 26.3 per cent in 2004–5.

In 2004–5, gross generation (utilities) from hydro plants was 2715 kWh per kW of capacity compared with an average gross generation of

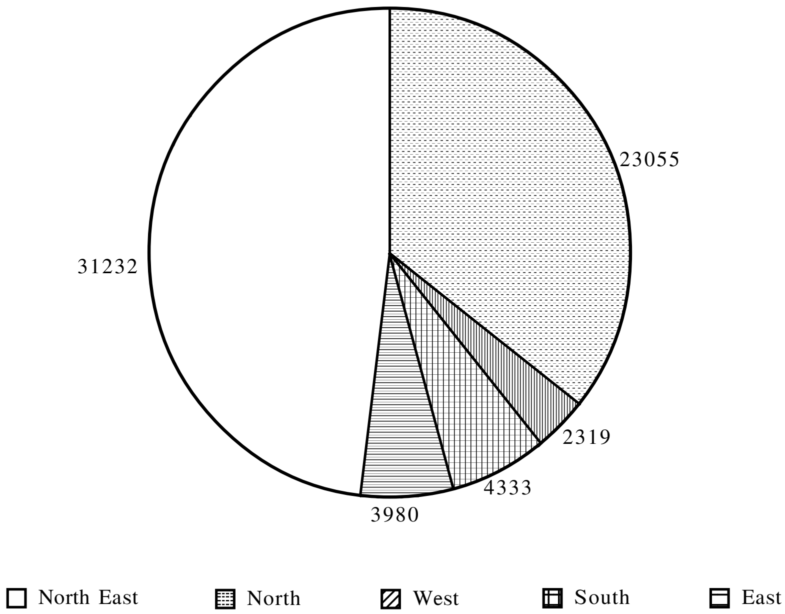

Figure 8.2: Hydropower Potential Remaining in Different Parts of India (MW)

5584 kWh per kW for thermal power plants. There has been a steady decline in gross generation (kWh per kW) of hydro capacity from 4065 in 1981–2 to 3790 in 1991–2 to 2715 in 2004–5. This shows the changes in the type of hydro capacity being added over time. As a result of this change, the share of hydro in total electricity generation in 2004–5 was 14.0 per cent even though its share in the total generating capacity was 26.3 per cent.

Potential for Hydropower Development

In 2001, the Central Electricity Authority (CEA) estimated hydro-electric potential (at 60 per cent load factor) to be 84,044 MW. Of this about 19,300 MW (at 60 per cent load factor) has already been developed or is under development. Of the remaining potential of 64,744 MW, about 36 per cent is in the north region and about 48 per cent is in the north east region. Thus, development of hydropower will also result in the development of states, particularly Uttaranchal, Himachal Pradesh, and Jammu and Kashmir and the north eastern states.

A vision paper prepared by Central Electricity Authority (CEA) in 2001 analyses the demand–supply scenario likely to prevail in the country based on Long term Perspective Plan Studies carried out by CEA and the Demand Forecasts available up to the end of 12th Plan (2016–17) as per 16th Electric Power Survey. Extrapolating from these, CEA estimates the demand for power by the year 2025–6 to be of the order of 353,000 MW with corresponding probable installed capacity of 463,000 MW. Hydro capacity additions have been planned so as to improve the share of the hydro in the system to about 32 per cent by 2025–6. This would mean an additional hydropower capacity of 120,000 MW over the next two decades.

The potential for small hydro (up to 25 MW) has been estimated at 15000 MW out of which 1500 MW has been achieved so far (CEA 2001). A number of state governments, irrigation departments, and private agencies are proposing small and micro hydropower stations including those on canal drops.

Policy and Institutional Arrangements in the Hydropower Sector

With the creation of National Hydropower Corporation (NHPC) in 1976, hydropower development, which was primarily the responsibility of the states, was elevated to a joint responsibility between the states and the central government. NHPC is a wholly owned government company with the mandate to build and operate hydropower. Two joint venture power corporations, namely, Nathpa Jhakri Power Corporation (NJPC) and Tehri Hydro Development Corporation (THDC) are responsible for the execution of the Nathpa Jhakri Power Project in Himachal Pradesh and projects of the Tehri Hydropower Complex in Uttaranchal respectively. Two statutory bodies, that is, the Damodar Valley Corporation (DVC) and the Bhakra Beas Management Board (BBMB) are also under the administrative control of the ministry of power.

The GOI has initiated several reform measures to create a favourable environment for addition of new generating capacity in the country. The Electricity Act (EA) 2003 has put in place a highly liberal framework for generation. There is no requirement of licensing for generation. The requirement of techno-economic clearance of CEA for thermal generation project is no longer there. For hydroelectric generation also, the limit of capital expenditure, above which concurrence of CEA is required, is being raised suitably. Proper implementation of the National Policy on Rehabilitation and Resettlement would be essential in this regard so as to ensure that the concerns of project-affected families are addressed adequately.

The investment policy for hydropower plants has been made more attractive from time to time and provides for

- debt–equity ratio up to 3:1;
- 100 per cent foreign equity participation;
- liberalized rates of depreciation in respect of assets;
- import of equipment for power projects at concessional customs duty;

- 14 per cent rate of return on equity; and
- generating companies can sell power on the basis of a suitably structured two- part tariff—one part to cover fixed costs and the other to cover variable costs at a prescribed level of performance.

As a part of the unbundling in the power sector, it has been suggested to have separate corporations for hydropower. For example, for Gujarat, one suggestion is to create a new company, HYGEN, by bundling together all the hydropower stations (Morris 2003). HYGEN would then develop as a specialist peak power player and lead the market developments in peaking power. During monsoons when runoff is available, HYGEN would have incentive to lower its price considerably. This would make coal-using base stations schedule their maintenance during this period. Further, in Gujarat, it is suggested that more efficient capacity utilization that is possible with a workable time of day tariff (leading to shifting of demand) is not feasible unless distribution and generation company staff have the requisite freedom to offer substantial discounts that depend upon the situation. The scope for shifting to off-peak hours is large in Gujarat given the fact that Gujarat has a large number of power-based industries and a substantial agricultural load that could use off-peak power effectively.

The enactment of the EA 2003 has done away with the previous licensing requirements for private investments in power generation projects and mandated an open access for supplies from these units to the distribution licensees, third party consumers and captive users. To that extent, just as with any of the other private sector power generation project, it also freed investments in renewable power technologies from these requirements.

Pricing of power for generators, transmitters, and consumers is a real issue in the continuation of the power sector reforms. In India, we now have the technical capacity to transmit thousands of megawatts of power from one end to the other using high voltage transmission lines. The institutional set-up to have a competitive power market also exists with regional power grids and power trading corporations (PTC), and transmission corporations in many states. But the pricing system has to be right and must provide the right signals to producers and consumers. Prices received by the producer, say a hydropower plant, should reflect what hydro plant contributes to the economy, that is, valuable low-cost power during peak periods almost instantly. If the prices are based on principles that ignore these aspects, no amount of 'incentives' is going to attract investors to hydropower, particularly when the rate of return on equity is fixed at 14 or 16 per cent[4] and there are restrictions on debt–equity ratio.

Pricing of Hydropower

As discussed earlier, hydropower can be used for meeting peak power requirements and has a high value to society in terms of avoided cost (cost of coping strategies or loss of output/service). However, to get maximum benefit from this advantage of hydropower in a multipurpose storage scheme, the following conditions must be satisfied:

- Appropriate pricing policies have to be put in place so that the price received by the producer of hydropower reflects its value to society. Invariably this significant benefit is not reflected in the tariff setting for power produced by hydro plants. This is true both for large and small/mini hydro plants.
- In order to get the maximum output of hydropower during peak periods, priority must be given to hydropower in allocation of water rather than to other uses.
- Price paid to the irrigation department for non-consumptive use of water for hydro generation should be based on the value of hydropower to society and not based on some arbitrary value of lease rentals or royalties for the use of water in multipurpose schemes.

[4] See CERC (2004).

As a part of the next generation power sector reforms, there is an urgent need for a debate on the methodology of tariff fixation for hydropower and other renewable (as well as for power generators in general). The CERC as well as state ERCs have to critically evaluate the 'Cost Plus' approach that is not in line with the philosophy of reforms. The 'Cost Plus' pricing system, with all the norms and incentive schemes, is not conducive to a competitive, efficient, and commercially vibrant power sector.

According to the CERC (2003a, 1999) 'the Commission is committed to the development of a fully competitive power sector. However, given the current realities of the sector (shortages, cross subsidies, long term PPAs, capacity allocation from CGS to state, etc.), the market development has to go through a number of intermediate phases ... competitive market will evolve gradually. During the intervening period, the regulation of generation tariff will have to be continued on cost of service approach ... In the cost plus approach, the Regulator has to go into the various components constituting tariff.' (CERC 2003).

There are serious disadvantages[5] in adopting the 'Cost Plus' approach for the determination of tariffs for each unit in the hydropower sector. These include, inter alia:

- underestimation of the value of hydropower;
- undervaluation of water used in hydro generation;
- disincentives for flow of funds in hydropower due to fixed rate of return on investment;
- incentives for 'gold plating' of capital costs; and
- disincentives for improving efficiency in generation and O&M.

Some of these issues are discussed below.

Underestimation of the Value of Hydropower

As mentioned earlier, prices received by the producer, say a hydropower plant, should reflect what hydro plant contributes to the economy, that is, valuable low cost power during peak periods almost instantly. The prices received by the hydropower producers should give appropriate signals reflecting the value to society of the output produced. Under conditions of shortages of power and energy, this would require that prices should reflect the savings in costs of coping strategies or loss of output. Under conditions where supply is almost equal to demand, the principle and practice of tariff setting for hydro producers should be based on avoided cost of supply.

The CERC has provided for a formula to separate the costs into fixed and energy charges. In this approach, the energy charge is equated to the lowest variable cost of thermal generation in that region, while the balance costs are recovered through the fixed charges. The energy charges are paid on the actual generation by the hydro station, hence there is an incentive to generate. However, this does not reflect the value of hydropower to the system (and, hence, to society). In order to reflect the advantage of hydro stations that are used as peaking stations, the CERC approach may be modified as follows:[6] As hydro stations are also used as peaking stations, it may be preferable to equate the energy charge of hydro stations during peak hours to the highest variable cost of thermal generation for such peak hour supply. This would make a substantial difference in the value of hydropower output as illustrated by data from Maharashtra (MERC 2004). For October 2001–March 2002, the merit order stack as proposed by MSEB showed that the lowest variable cost was 52.41 paise per kWh (from Korba thermal station). If hydropower produced in Maharashtra[7] is valued

[5] The distortions introduced by 'Cost Plus' pricing in the nitrogenous fertilizer industry are well known. This pricing approach resulted in high costs of fertilizer manufacturing and high prices in a protected market. These high costs in fertilizer production were shown as 'subsidies' given to farmers. For a detailed discussion, see Government of India (2000) and Alagh (2004).

[6] I am grateful to Pramod Deo for throwing light on this and other issues of pricing hydropower.

[7] Total hydropower capacity in Maharashtra is estimated at 2430 MW (or 25 per cent) out of a total capacity of

at this lowest variable cost, its value will be estimated as Rs 2.14 billion (4077 Mn kWh @ Rs 0.5241/kWh). However, if the hydropower is valued at the highest variable cost of 312.55 paise per kWh (from Kakrapar thermal station), this gives an estimated value of Rs 12.7 billion for hydro generation. This means that the value of hydrogeneration can be as high as six times the value estimated using the current practices.

This approach partly takes into account the benefit derived from hydropower in meeting peak requirements. However, to reflect the real value of peak power to society, it is necessary to estimate the costs of coping strategies adopted by industry or commercial establishments or households. This could be in terms of the avoided costs of diesel generation in the commercial or household sectors. Alternatively, one may use the generation in captive power plants that has been estimated at 317 paise per kWh.

The MERC tariff order (MERC 2004) has also increased the differential between tariff applicable for peak hour consumption by 20 paise per unit (compared with the average tariff of 320 paise/kWh for HT category). If the peak power tariff of 340 paise per unit is used for estimating the vale of hydropower, the total value of hydropower generated in Maharashtra will be Rs 13.9 billion (more than six times the value estimated by using the lowest variable cost of supply).

In Maharashtra, the MERC reviewed various methodologies while determining the tariffs for wind energy projects in Maharashtra. According to (MERC 2003), the avoided cost of generation could be derived by identifying the generation which is being replaced by the new generation project. This could be done by network analysis for various system conditions such as peak, off peak, and for seasonal and geographical variations of the demand. However, the MERC concluded 'While Long Run Marginal Cost and Avoided Cost of Generation are likely to give correct economic signals, it is not possible in today's context to arrive at the correct estimates for these numbers. The MERC has analyzed these options carefully and is inclined to use 'Cost Plus' methodology for determination of tariff of wind projects.' (MERC 2003).

However, in the case of large hydro projects, it should be possible to carry out a network analysis of power systems in which the hydro plant is contributing so as to estimate the 'avoided cost of generation' for peak and off-peak periods by each season.

Undervaluation of water used in hydro generation

In most of the cases[8] in India, hydropower stations are owned by the state irrigation departments. Power companies or state electricity boards pay a lease rent for the use of water for hydro generation. This lease rent is kept at a nominal level (based on some historical agreement) since it is considered that hydropower generation is a non-consumptive use of water and, hence, water is used for hydro generation without much cost to society.

This current practice gives rise to three types of distortions:

- it gives priority to the releases of water for irrigation and ignores the value of water use in hydropower;
- it undervalues the opportunity cost of water used as 'fuel' in the hydro generating plants; and
- it underestimates the 'real' costs of hydro generation and thus underestimates tariffs for electricity used in various sectors.

As an illustration, in the case of Maharashtra discussed above, the value of hydropower generated (4077 mn kWh) during 2003–4 was Rs 12.7 billion if the hydropower is valued at the highest variable cost (mainly fuel cost) of 312.55 paise per kWh (from Kakrapar thermal station). This means that by using water in the hydro plants, society was able to save fuel costs worth Rs 12.7

MSEB of 9738 MW. Net estimated generation in 2003–4 was 4077 mn kWh from hydro and 41906 mn kWh from thermal units (including gas). Thus, hydro generation was 9 per cent of the total net generation.

[8] These exclude power plants run by NHPC or BBMB or DVC.

billion in a year. This could be considered as the value of water used for hydropower during the year. As against this, the MSEB has projected expenditure on account of lease rentals[9] paid to the government of Maharashtra for the use of the dams for hydel generation at Rs 850 million. Hence, the price paid by MSEB for 'fuel' used in hydro plants is only 7 per cent of its value to MSEB. If the full price of water used in hydro plants is paid to the irrigation department, the government can use this revenue for meeting about one-third of the subsidy given to farmers (Rs 33 billion) for the use of electricity in agriculture.[10]

Pricing Disincentives for Optimum Management of Reservoirs

In the current system of reservoir operation, there is no incentive for maximizing the value of output from a given supply of water from a reservoir. In fact, the current system of tariff setting by the state ERCs acts as a disincentive for flexibility in the operation of the reservoir for maximizing the output of hydro during peak periods.

The state ERCs currently have a Fuel Cost Adjustment (FCA) Formula,[11] which enables the SEBs to recover the difference in the per unit pooled cost of power through the FCA formula. So, if and when there is a shortfall in hydro generation, the SEBs will buy more and recover the difference in cost per unit (between approved and actual levels) through the FCA Formula. This formula acts as a disincentive for the SEBs to show their interest in maximizing hydro output in dealing with the operation of the multipurpose reservoirs. Since they are not penalized for the shortfall of a low-cost source of energy in their purchase basket, they accept the priorities set by the irrigation department in operating reservoirs. This is illustrated by the case of Gujarat below.

In the current system of operation of multi-purpose schemes, priority is given to release water as per irrigation requirements. For example in Gujarat, as noted by the GERC, the policy of the Gujarat Electricity Board (GEB) is stated as follows: 'hydel generation is not assured and depends both on the monsoons and on irrigation needs. In other words, even if the reservoirs have water, it is released not in accordance with the needs of power generation but based on water requirements for irrigation purposes.' (GERC Tariff order 292 June 2003). Hence the GEB has asked the GERC to provide for the adjustment on account of reduced generation from hydel sources because 'as far as the hydro generation is concerned, it depends upon the availability of water in the respective dams after the irrigation requirements are met. GEB has no control on this factor'.

This practice is a manifestation of a broader distortion in water allocation policies which stipulates that priority must be given to agriculture even when the value of water (and power) for other uses is much higher. As has been shown in a study of Tamil Nadu, a flexible approach to water allocation has significant economic, social, and environmental benefits (Bhatia et al. 2006).

In the case of GEB, it has been recognized that variations in hydel generation will result in corresponding variations in the quantum of purchase of power from other sources.[12] The shortfall in hydro generation is expected to be

[9] The MSEB has submitted that the GoM has already appointed a Committee to decide the scientific basis for fixing the lease rent in respect of various hydropower stations already handed over and to be handed over to the MSEB.(See *MERC Tariff Order for MSEB—FY 2003-04*: *Commission's Analysis and Decision on MSEB's Proposal* 185.)

[10] According to available estimates, in 2003–4, electricity consumption in agriculture was 865 mn kWh by metered tariff users and 6893 mn kWh by users of flat rate tariff.

[11] This formula has been approved by MERC and GERC.

[12] In Gujarat, the bulk of the GEB's generation is based on coal and gas (3750 MW and net generation of 20,000 mn kWh per year). Hydropower plants (Ukai and Kadana and Panam) have a combined capacity of 547 MW or 13 per cent of the total of 4300 MW (estimates for 2003-04). However, their plant load factor is only 31 per cent and 11 per cent respectively. And their gross generation of 1088 mn KWh is only 5 per cent of the total net generation of 21178 mn kWh in Gujarat Electricity Board.

met from contingency power purchase from a non-firm source like Power Trading Corporation (PTC). As the cost of hydel generation at present is minimal, the procurements to match the hydel shortfall have been built into the formula. The GEB under this component proposed (to the GERC) compensation for additional power purchase, which will become necessary, in the event of a shortfall in hydel generation (measured by the difference in million kWh between the hydel generation approved by the Commission in its order and the actual generation, say in any year). GEB wants to be compensated for this shortfall at a rate equivalent per unit to the highest variable cost it incurred in the base year (GERC 2004). The GEB's logic is that such power procurement will be of a contingent character (unlike long term contracts) and should be charged at the highest variable cost of the previous control period (say, for example, previous financial year). For the year 2001–2, variation on account of power purchase cost increase due to reduced hydel generation was of the order of Rs 2.5 billion (equal to about one-fourth of the subsidy provided by the government to the GEB for subsidizing agriculture).

Pricing of Small Hydropower in Andhra Pradesh[13]

Although there have been attempts by Andhra Pradesh Electricity Regulatory Commission (APERC) and MERC to tackle the issue of pricing of small hydro, the complexities of institutional arrangements and methodology of costing of small hydro are such that the pricing issues have yet to be resolved. This sub-section presents tariff setting and related policy issues for small hydro (less than 25 MW) and mini hydro plants in Andhra Pradesh while the policy issues of small hydro in Maharashtra are discussed in the next sub-section.

During 2003, the APERC fixed the tariff for power produced from different non-conventional energy technologies. The APERC used the 'cost plus' formula. In the case of hydel power plants, the plant load factor (PLF) which depends largely on the intensity of monsoon, rainfall in the catchment area, and the changes in hydrology factor, and so on besides the plant size, are critical factors in the determination of tariff. Hence, APERC decided on a two tier tariff, distinguishing the plants operating at up to 35 per cent PLF and those above 35 per cent PLF. After taking into account the technical and financial parameters, the tariff for mini-hydel power plants was estimated as follows: Rs 2.6/kWh in the first year declining to Rs 1.88/kWh in the tenth year of operation.

Further, in the case of small hydro also, the APERC has been consistent in its approach against captive generation and third party sales in general, since in its view, these would adversely affect SEBs. APERC has enjoined all generators of non-conventional energy to supply power to APTRANSCO only with effect from the billing month of August 2002. In the context of EA, 2003, as pointed out by MERC (2003) in the context of their hydropower policy, this view point cannot be sustained.

The APERC noted that the water rates charged by the Irrigation and Command Area Development Department for non-consumptive use of water for hydel power generation were not conducive to promotion of power generation from the mini-hydel plants. It advised Government of Andhra Pradesh (GoAP) to re-look into this aspect and rationalize water rates for non-consumptive use by mini-hydel plants.

Policy Issues in the Development of Small Hydropower in Maharashtra

The irrigation department of Maharashtra government approached MERC in January 2002 for the formulation of hydropower policy to promote the private sector participation in the development of hydroelectric projects of sizes up to 3 MW. While reviewing this request, MERC observed that the department's approach in restricting investments in these projects only to captive generation units (defined as 100 per cent self-use) was questionable, as it negated the basic

[13] These sections are based on chapters from Deo and Modak and from the Tariff Orders of APERC and MERC.

role that the hydroelectric power units are primarily designed to play in the management of load variations in the power system. For that reason, it was surprising that the policy should have been prohibitory in developing these projects for power supply to the MSEB's grid, especially, in the light of the gross hydro–thermal imbalance in its system.

Further, in the context of the Electricity Act (EA) 2003, the policy prohibiting sale of power to the third parties, seen from the current perspective, went against the provision in section 10 (2) which stipulates that 'a generating company can, subject to conditions laid down under subsection (2) of section 42, supply electricity to any consumer.' In fact, this prohibitive approach, which has been the hallmark of the MSEB's policies (other SEBs in the country as well) towards the renewable energy-based power projects, is now outdated and no longer holds.

Another policy aberration in this case was with respect to the tariff. The energy generated at the hydropower plant though recorded on the time of day (TOD) metering, was credited on the ascending basis of tariff for its supplies to the MSEB's grid; the credit for the total generated energy being given by progressively allocating units upwards from the lowest tariff slab, until all units were accounted for. This ignores the basic principle behind hydroelectric power generation.

Lastly, the fact that the mini hydroelectric power projects are treated as offshoots of irrigation projects (power is generated as and when the irrigation department releases water, and the promoter is given no control over the timing of supply) deserves attention, if investments in water resources are to be optimally employed. Exorbitant royalty on non-consumptive use of water is another barrier.

Benefits from Integrated Management of Water and Power

According to the National Water Policy (2002), water resource development projects should as far as possible be planned and developed as multipurpose projects. Provision for drinking water should be a primary consideration. In the planning and operation of systems, water allocation priorities should be broadly as follows:

- drinking water;
- irrigation;
- hydropower;
- navigation; and
- industrial and other uses.

However, the policy statement says that these priorities might be modified if necessary in particular regions with reference to area specific considerations. Some of the state water policy statements also specify the same order of priority for drinking water, irrigation, and then hydropower and industry. Although the importance of allocation of water for drinking purposes is accepted, this administrative prioritization of water allocation among uses/users eliminates the flexibility in the operation of the system. Such prioritization results in less than optimum utilization of scarce water resources between hydropower and irrigation.

There are a number of experiences and studies that show the advantages of integrated operation and management of water and power sectors. Examples include the experience of Tennessee Valley Authority (TVA) in U.S.A. and the management experience of Bhakra Beas Management Board (BBMB) and Damodar Valley Corporation (DVC) in India. A set of these studies, summarized below, shows the benefits from integrated management of hydropower, surface irrigation, and groundwater use in the Bhakra-Beas system.

Benefits from Integrated Management of Hydropower, Surface Irrigation, and Groundwater Use

Benefits from the integrated management of hydro power and irrigation have been analyzed in a few studies on the Bhakra system and the integrated operation of the Beas-Sutlej system (Minhas, Parikh, and Srinivasan 1972; Rao and Ramaseshan 1985; Rao and Ramaseshan 1985a). In the Bhakra system, (the then) planned levels of power generation vary widely between 766 MW from December through April to 1697 MW in September. Conjunctive utilization models have been developed for integrated management of surface and groundwater irrigation. A linear programming model of the system is developed (Rao and Ramaseshan 1985a) that maximizes the level of firm power. Irrigation demands are to be satisfied in each of the sub periods. The power required to lift groundwater is over and above the firm power that is to be supplied. This integrated framework leads to a better understanding the interactions between the irrigation and firm power objectives. The results showed[14] that conjunctive utilization can increase firm power at least by 36 MW (over and above a firm power of 797 MW). The results also indicate, contrary to the then practice, groundwater use generally between May and November and not from December to April. The firm power level reached in a dry year is 200 MW (that is, 20 per cent) less than that reached in a dependable year. The levels of irrigation and power planned for a dependable year from the reservoirs of Beas-Sutlej system can be attained even in a dry year by conjunctive utilization of surface and groundwaters.

Institutional Arrangements for Integrated Management of Water and Power

The current institutional arrangements in India do not provide incentives for the optimum use of water and energy resources in the country. In order to get the benefits of integrated operations and management of multipurpose reservoirs along with thermal units and power purchase possibilities, it is necessary to have institutional arrangements as well as incentives for integrated management. At the institutional level, there are already experiences of Bhakra Beas Management Board (BBMB) and Damodar Valley Corporation (DVC). DVC operates on the same principles as the TVA but there is a need to make the process more transparent and participatory. This may require explicit objectives of maximization of revenues from the operations and constraints such as priority of water allocation to a particular sector (for example, irrigation or domestic needs) should not be imposed. If certain uses are considered important for meeting social objectives such uses should be paid for by the state governments directly to the river basin authority.

The ongoing reforms in the power sector have to be extended to include the water sector so that synergy benefits of the use of these interdependent resources are maximized and negative externalities can be avoided. This would require regional water and power boards (RWPB) that will coordinate the activities of existing state Electricity Boards, Independent Power Producers, Management Boards for Multipurpose Projects (for example, Bhakra–Beas Management Board, Damodar Valley Authority) and irrigation departments of state governments. These RWPBs will operate on commercial principles based on a set of incentive structures that maximize the value of water and power for producers. For example, these water and power boards will determine price of hydropower to reflect its value to society in meeting the peak power requirements. This price incentive will maximize the output of hydropower during the peak requirements by conjunctive use of surface water and groundwater for irrigation. There will be enough flexibility in the system to allocate water according to its economic value in use. Prices set for consumers by these boards will be based on the advice of the regional ERCs and will reflect the economic cost of supply for electricity and water. If some users/consumers have to be provided water or power below its cost of supply, direct and transparent subsidies will be provided by the state governments to regional water and power boards.

Electricity Use in Groundwater Pumping for Irrigation

The development and management of water resources plays a crucial role in the economic growth and social development of India.

[14] It is likely that the Bhakra Beas Management Board is operating the system so as to optimize the power and irrigation output.

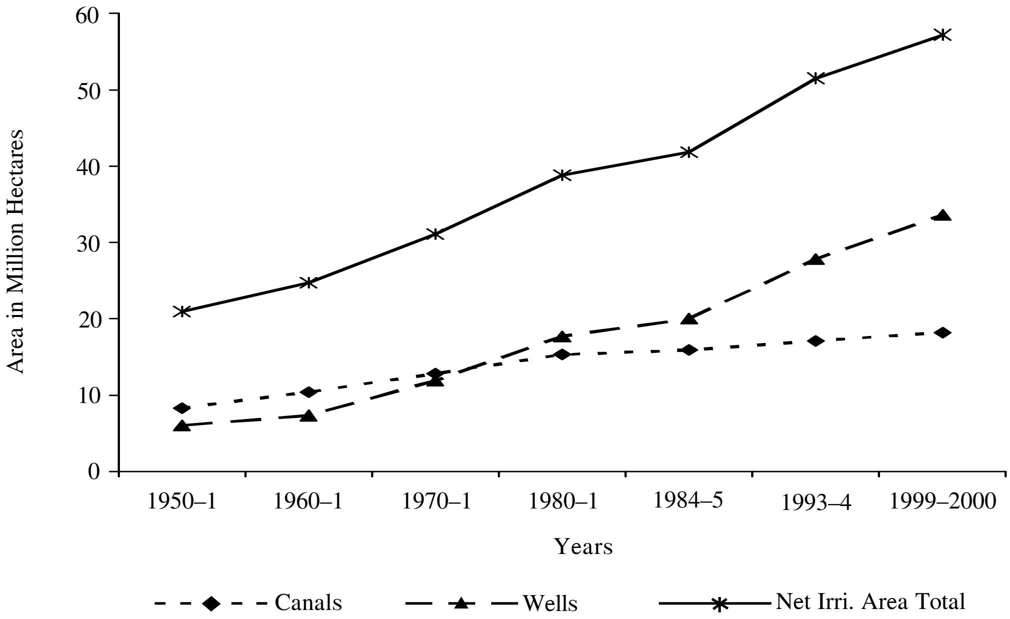

Figure 8.3: Net Irrigated Area by Canals, Wells, and Total

Source: Directorate of Economics and Statistics, Government of India.

Investments in water infrastructure (multipurpose dams, canals, small check dams, tubewells, and pumpsets) have generated direct and indirect benefits to the people in various regions of the country. Irrigation provides bulk (55 to 65 per cent) of the foodgrains output and a substantial part of the output of commercial crops. Irrigated agriculture provides employment, incomes, and livelihood to millions of farmers and agricultural labour in the country.

Irrigation is the predominant user (more than 80 per cent) of water resources in the country. Electricity use in pumping groundwater constitutes more than a quarter of the total electricity consumption in several states. As a result of rapid rural electrification, highly subsidized power, and focused rural credit, private sector groundwater-based irrigation now provided water[15] to 33.6 m.ha. in 2000. Thus, net area irrigated by private wells and tubewells is almost double that of the net irrigated area under canals in 2000 (see Figures 8.3 and 8.4). Net irrigated area (NIA) under wells and tubewells as per cent of total NIA is higher than 50 per cent in Bihar, Gujarat, Punjab, Madhya Pradesh, Maharashtra, and Rajasthan. In Haryana and Tamil Nadu, share of net irrigated area by tubewells is around 50 per cent while in Orissa and West Bengal the share is around 40 per cent.

Annex Table 8.1 presents data on interstate variations in irrigation in India. Gross irrigated area (GIA) is more than 5 m.ha. in Haryana, Andhra Pradesh, Madhya Pradesh, Punjab, Rajasthan, and Uttar Pradesh. Uttar Pradesh alone accounts for 17.7 m.ha. of GIA or about a quarter of the total in

[15] However, it should be recognized that irrigated area under tubewells is partly sustained by the seeped in waters from unlined canals. For example, according to available estimates, the natural groundwater recharge in Punjab could sustain half the existing number of tubewells in Punjab. In other words the investment in canal works has enhanced groundwater availability in Punjab by a factor of two (Dhawan 1993).

the country. GIA as per cent of gross cropped area (GCA) is higher than 60 per cent in north western states of Punjab (91 per cent), Haryana (85 per cent), and Uttar Pradesh (66 per cent); and is higher than 50 per cent in Tamil Nadu. States where GIA as per cent of GCA is less than the all-India average of 40 per cent are: Kerala (16 per cent), Maharashtra (17 per cent), Karnataka (26 per cent), West Bengal (26 per cent), Orissa (30 per cent), Rajasthan (36 per cent), and Gujarat (38 per cent).

Net irrigated area (NIA) under wells and tubewells as per cent of total NIA is higher than 50 per cent in Bihar, Gujarat, Punjab, Madhya Pradesh, Maharashtra, and Rajasthan. In Haryana and Tamil Nadu, share of NIA by tubewells is around 50 per cent while in Orissa and West Bengal the share is around 40 per cent.

The number of electric pumpsets increased to 10.3 million in 1993–4 and to 12.5 million in 1999–2000. The number of diesel pumpsets are estimated to be around 6 million in the country. Thus, there are around 500 pumpsets per thousand hectares of area irrigated from groundwater.

In relation to the amount of land they cultivate, poor farmers are better represented than richer farmers in their use of groundwater. Small and marginal farms (less than 2 hectares) make up only 29 per cent of the total agricultural area. Yet these small farms account for 38 per cent of the net area irrigated by wells and 35 per cent of the tube wells fitted with electric pump sets. Proportionally more of the large increase in agricultural outputs—due to groundwater use—goes directly to benefit the poor.

Adequate water supply and sanitation services have benefited millions in rural and urban areas. Apart from a rapid increase in the use of groundwater for irrigation, groundwater supplies 80 per cent of the rural and 50 per cent of the urban population (Pitman 2002).

PRICING OF ELECTRICITY FOR IRRIGATION PUMPING

There are three regimes of electricity pricing for irrigation pumping in India:

- Free electricity to farmers as in the case of Punjab, Andhra Pradesh, and Tamil Nadu;[16]
- System of flat rates (FR) under which an electric pumpset owner is charged at a flat monthly rate per hp (horsepower) of the pumpset regardless of actual power use. In this method, the marginal cost of pumping more water is zero and the farmer has incentive to pump more for his own use or for sale to other farmers. Most of the states have flat rate tariff system for a majority of farmers. Some farmers (ranging from 10 to 15 per cent) in some states use metered tariff. For example, in Haryana, electricity supply to almost 90 per cent of agricultural consumers (approximately 283,000) is unmetered. In Maharashtra, metered connections used 865 million kWh or 11 per cent of the total agricultural consumption of 7757 mn kWh in 2002–3; and
- Metered tariff or pro-rata tariff where an electric pumpset owner is charged per unit (kWh) of power consumed on the basis of metered consumption of electricity As mentioned above, about 10 to 15 per cent of farmers in many states use metered tariffs for power use.

During the mid-1970s and 1980s, most of the SEBs shifted away from metering of electricity sales to agriculture consumers and introduced flat-rate tariffs based on the capacity of the pumpset (Shah 1993, World Bank 2001). This was mainly because the SEBs were finding it difficult to monitor the large number of pumpsets and collection rates were very low. Among the states that have high electricity consumption in agriculture—Andhra Pradesh, Tamil Nadu, Uttar Pradesh, Punjab, Karnataka—electricity is either

[16] In addition to free power system, some special self-financing schemes are operating in Tamil Nadu. For example, farmers having power connections for their pumpsets by payment of Rs 10,000 or the actual cost of extension of power connection, the rate of tariff shall be Rs 250 per HP per annum or metered tariff at the rate of 50 paise per kWh, at the option of the consumer.

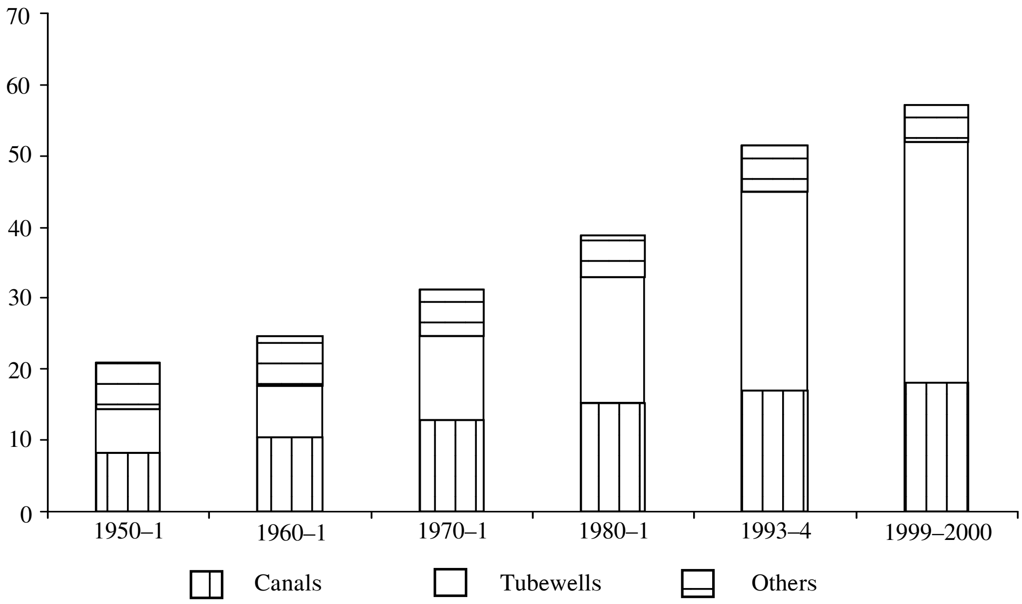

Figure 8.4: Net Irrigated Area by Canals, Tubewells, and Total

Source: Same as Figure 8.3.

free or charges are based on flat rate tariffs. Rajasthan is the only state which has about half of its agricultural connections metered, but these metered connections account for only one-fifth of the total electricity consumption. In Haryana, about 80 per cent of the total pumpsets are charged on the basis of flat rates per hp. Maharashtra and Kerala have some metered agricultural connect-ions. In many states, the charges per hp are higher for pumpsets of higher horsepower. For example, in Andhra Pradesh, in 2002, the farmers had to pay a tariff of Rs 225 per hp per year for pumpsets unto 3 hp; Rs 375 for 3–5 hp; Rs 475 per hp for 5–10 hp and Rs 575 per hp for 10 hp and above in DPAP districts. In contrast to Andhra Pradesh, the farmers in Tamil Nadu[17] have been supplied free electricity since 1991 (with the exception of a short period). In Haryana, in 2002, fixed rates per hp per year were Rs 540 for borewells of depth up to 100 metres and Rs 360 for borewells of depth of 200 metres and above.

Although the tariff is fixed and realized by SEBs, the state governments[18] have constantly interfered in tariff setting due to their desire to provide power at concessional rates to certain sectors, especially agriculture. In some cases state governments have been asked by the state ERCs to provide funds directly to the SEBs to compen-sate the SEBs for the subsidies provided to agriculture and domestic consumers. Invariably, these have fallen short of the level of subsidies provided by the SEBs. Given the limits of cross-

[17] Pro-rata method of tariff was in operation till 1984 in Tamil Nadu. For the first time in 1984, government of Tamil Nadu introduced flat tariff for agriculture that is Rs 50 per hp per annum for upto 10 hp and Rs 75 per hp per annum for above 10 hp pumpsets. Then free electricity for all categories of farmers was introduced from 1991 onwards.

[18] In the power sector in India, the public sector controls about 90 per cent of generation; almost all of transmission; and except for a few pockets, most of distribution. Federal utilities account for a proportion of generation and transmission, but most of the sector is in the hands of state electricity boards (SEBs), which are vertically integrated utilities owned by the respective state governments.

subsidization possible from other users of power (mainly industry), the SEBs have faced revenue deficits and financial problems. These financial problems have been partly responsible for low investments in the power sector resulting in shortages of power and unreliable supply of electricity, particularly in the rural areas. Thus, the power sector in India has been operating under the vicious circle of low tariffs, low revenues, and low investments resulting in inadequate and unreliable power supply. The unreliable power supply, in turn, affects the farmer's ability and willingness to pay higher tariffs for electricity.

Providing free power to farmers remains a politically tempting ploy and the tariff issue will continue to be important for India's power sector reforms and agricultural policy[19]. However, there is enough awareness that the burden of such subsidies be taken off the utilities and that they be made transparent by placing them on the state budget (thereby also forcing greater fiscal discipline on the state government). There is also recognition that the interests of the farmers will be served better with reliable and adequate power supply rather than free power[20].

Reform of the power sector has been initiated with the establishment of independent regulatory agencies responsible for setting tariffs and regulating power purchase agreements. The Central Electricity Regulatory Commission (CERC) has been in operation since April 1999 and nineteen States have either constituted or notified the constitution of State Electricity Regulatory Commission (SERC). SERCs of Orissa, Andhra Pradesh, Uttar Pradesh, Maharashtra, Gujarat, Karnataka, Rajasthan, Delhi, Madhya Pradesh, Himachal Pradesh, and West Bengal have issued tariff orders. The agricultural tariff, on average, increased by about 80 per cent in three years from a level of 22.6 paise per unit in 1999–2000 to 41.6 paise in 2001–2) partly as a result of the tariff awards recently given by the State Electricity Regulatory Commissions.

Since 2001, a number of SERCs have mandated/recommended that new connections be based on metered tariff and metering should be introduced in all existing agricultural connections as soon as possible (GERC: 2003). The Electricity Act, 2003 provides for gradual reduction of subsidy and/or cross subsidy in a progressive manner. In Gujarat, one of the guiding principles which the Electricity Regulatory Commission has to keep in view, while specifying the terms and conditions for tariff determination is:

> [Tariff determination] shall, be in a manner that the existing subsidy given to any class or classes of consumer by charging higher tariff from other classes of consumer is progressively reduced to the extent that within a period of five years from the commencement of this Act, the tariff to every class of consumer shall reflect a minimum of 67 per cent of that licensee's average cost of supply of electricity to that class.

Section 29 (5) of the national Electricity Regulatory Commissions Act, 1998 lays down as under:

> If the State Government requires the grant of any subsidy to any consumer or class of consumers in the tariff determined by the State Commission under this section, the State Government shall pay the amount to compensate the person affected by the grant of subsidy in the manner the State Commission may direct, as a condition for the licensee or any other person concerned to implement the subsidy provided for by the State Government.

Further section 32 (4) of the Gujarat Electricity Industry (Reorganization and Regulation) Act, 2003 lays down as under:

> If the State Government requires the grant of any subsidy to any category of consumer or class of consumers in the tariff which is determined by the Commission under this section, the Sate Government shall pay the amount to compensate the person affected

[19] For an interesting analysis of economic and political issues in power sector reforms, see Lal (2004).

[20] Andhra Pradesh chief minister Reddy has been quoted by the Press Trust of India (*The Indian Express*, Delhi, August 23, 2004) as saying that free power will be given only to those farmers who have authorized connections. More significantly, at the *India Today* state of the states Conclave held at New Delhi on August 6, 2004, at least three chief ministers, belonging to different political parties, categorically declared that what farmers and others wanted was 'quality power, not free power.'

by the grant of subsidy in the manner which the Commission may direct, as a condition for the licensee or any other person concerned to implement the subsidy provided for by the State Government.

Notwithstanding the above legal position, 'Subsidy support (including subvention) from the Government of Gujarat has reduced from Rs. 25.8 billion in FY 2001–2 to Rs 18 billon in FY 2002–3. As per the tripartite agreement with ADB and Government of Gujarat, the subsidy is capped at Rs 11 billion annually'.

Based on an analysis of the financial and administrative aspects of Indian State Electricity Boards (SEBs), Ruet (2003, p 32) has suggested that, 'If there is a will to address the cost and efficiency of SEBs, they have to be 'enterprised' that is turned from administrations into firms not only in their status, but also in their decision-making. Reforms need to enable SEBs to look at cost efficiency without any discretionary power'. In his opinion, structural reforms—corporatization, setting up of regulatory commissions and unbundling—constitute a first step towards entreprization. Based on several studies of the power reforms process, Ruet (2003) has made some practical proposals on (i) operational, (ii) managerial, and (iii) regulatory measures, and provide a self-consistent framework for reform. Some of these are given below:

- Institutionalize metering of all consumers;
- Develop viable units based on the concepts of decentralization and profit-centers;
- Promote open access and wholesale competition on multi-buyer model;
- Encourage regulatory commissions to go for price-based regulation rather than cost-based regulation, and explore other market-based pricing mechanisms;
- Encourage regulatory commissions to give multi-year formula and rules in tariff fixing;
- Set of efficiency improvement targets; and
- Phased out annual subsidies from the government to the licensees which ensures that the licensees breakeven.

Interstate Variations in Electricity Tariffs

As a result of the differing system of power pricing, there are significant variations in prices charged for electricity used in pumping water for irrigation. In Punjab, electricity has been provided free of cost for farmers since 1997. In Tamil Nadu, electricity for farmers was free until 1995 but nominal flat rates were charged until early 2004. Free power for farmers has been introduced in Andhra Pradesh and Tamil Nadu[21] after the elections in May 2004. In Maharashtra, the farmers' lobby has been clamoring for free power since elections in August 2004. In 2001–2, the average tariff (paise/kWh) for Tamil Nadu is estimated as the lowest (1.3 paise/kWh) while that for Madhya Pradesh is 7.2, for Bihar 13.4, and for Karnataka 38.8 (compared to an all-India average of 41.5 paise/kWh). In Gujarat and Maharashtra, the average tariff is higher than the all-India average at 62 and 82 paise/kWh, respectively. (Figure 8.5).

Figure 8.6 presents a comparison of electricity tariffs and average cost of power supply in some states. It may be noted that the variations in cost of supply are relatively less than those in the estimated tariffs across states. In many states, tariffs are low even though the cost of supply is quite high. As discussed later, there is a need to re-estimate these tariff levels and cost of supply to agriculture due to overestimation in the electricity consumption and cost of supply during off-peak periods.

Electricity Subsidies for Irrigation Pumping

According to the Planning Commission (2002), while the agriculture sector accounts for nearly

[21] In May 2004, the newly elected Congress chief minister of Andhra Pradesh Y.S. Rajasekhara Reddy reversed his predecessor's tentative tariff reform and reintroduced free power to farmers in his drought-hit state, while the chief minister of Tamil Nadu, as mentioned earlier, reversed her own incipient reform policy to do the same in her state. This has been followed by the rival political formations in Maharashtra promising free power to farmers ahead of elections in that state.

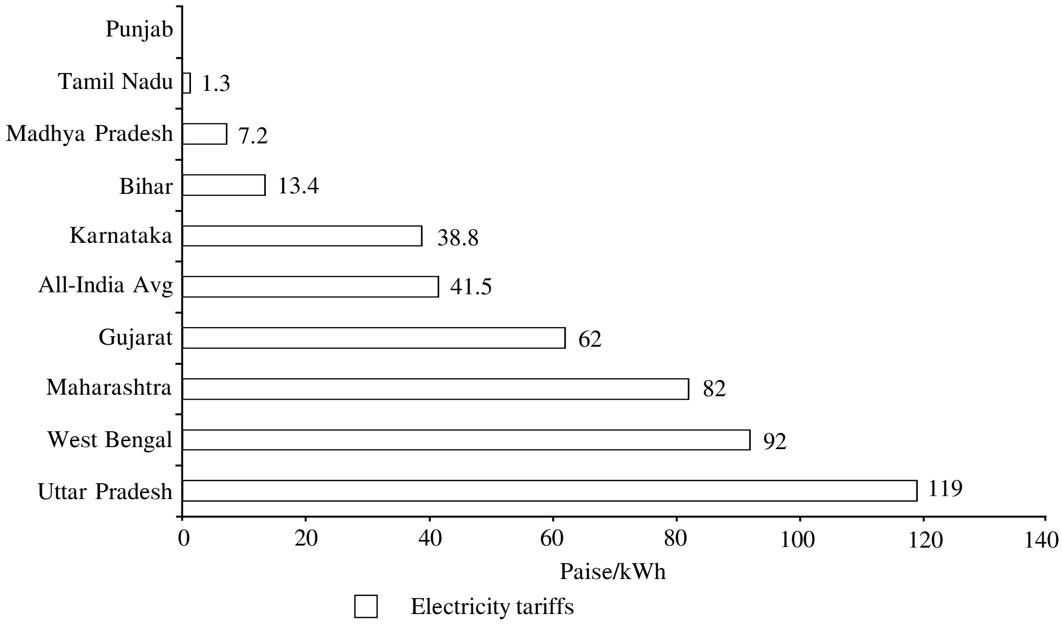

Figure 8.5: Electricity Tariffs in various States, 2001–2 (paise/kWh)
Source: Same as Figure 8.1.

one-third of the sales of the SEBs and the EDs, the sales revenue realized from this sector has been only 3.2 per cent of the total revenue realization during 1999–2000. Revenues from sales to agriculture are low because of the policy of state governments to provide electricity at subsidized rates to agriculture.

Gross subsidy on account of sales to agricultural consumers is estimated[22] to have increased from a level of Rs 156 billion in 1996–7 to Rs 281 billion[23] in 2001–2. The estimated subsidies for the year 2004–5 were Rs 250 billion. While some state governments partly compensate the SEBs for the subsidized sales of electricity to agricultural and domestic sectors, others do not provide any compensation at all. The 2001–2 Annual Plan Proposals indicated the likely subvention from the state governments as Rs 83 billion or about one-third of the total subsidy to agriculture (GOI 2003). The SEBs make an effort to recover the losses due to the subsidized power supply to domestic and agriculture consumers by way of cross-subsidization mainly from the industrial and commercial consumers.[24] Such cross-subsidization accounted for Rs 57 billion or 20 per cent of the total agricultural subsidies. Thus, as per these official estimates, about one-half of the subsidies to the agricultural sector or Rs 141 billion remain uncovered and show up as losses for the SEBs.

These subsidies have been overestimated both in terms of (i) estimated electricity consumption in the agricultural sector and (ii) overestimation

[22] Planning Commission, government of India: Annual Report (2001–2) on The Working of State Electricity Boards and Electricity Departments, May, 2002.

[23] According to World Bank (2004b), power sector losses have come down as a percentage of GDP in recent years.

[24] However, it is observed that such an option is also narrowing down and the level of cross subsidization has been coming down over the years. The surpluses generated by way of cross subsidization is estimated to have come down from a level of Rs 90 billion in 1997–8 to Rs 57 billion during 2001–2. Thus, the cross subsidy from commercial and industrial sectors (as a percentage of effective subsidy to agricultural consumers), which was 51 per cent in 1997–8, sharply declined to 20 per cent by 2001–2

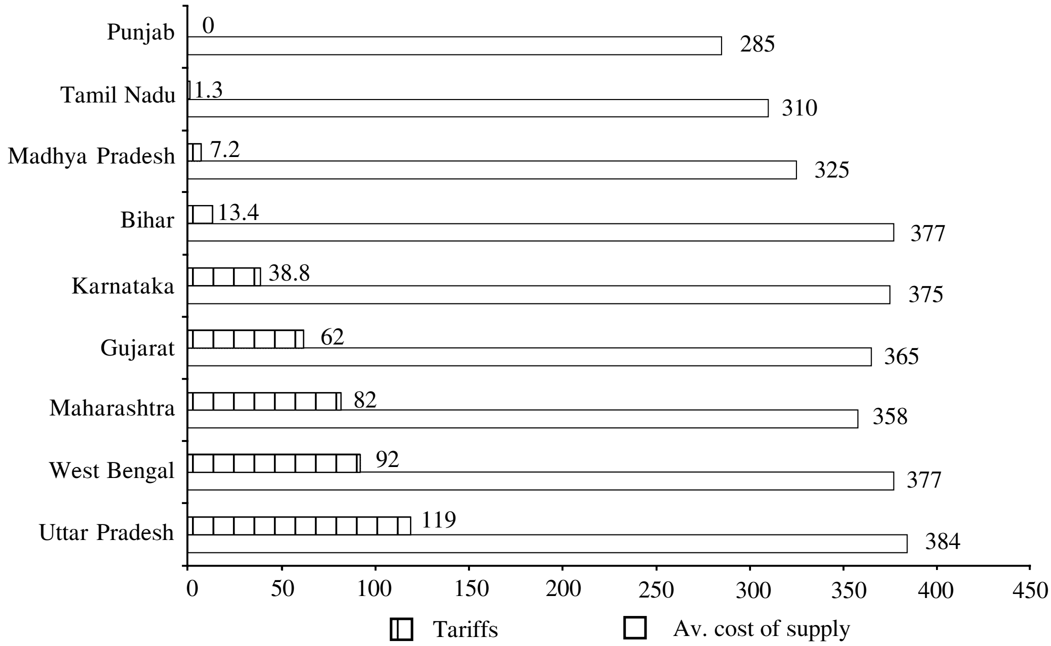

Figure 8.6: Tariff and Average Cost of Supply in Major States, 2001–2

Source: Same as Figure 8.1.

of the 'value of electricity' to society when electricity is provided to agricultural consumers during off-peak periods. In the government estimates, the subsidies to agriculture are calculated as the difference between average revenue realized from the agricultural sector and the average cost of supply for the power sector for all users. There is no distinction made for the marginal cost of supply of power to the agriculture sector that in fact may be lower than the average cost if most of the power supply to agriculture is during night time when the opportunity cost of power is equal to the marginal cost of supply (cost of fuel and O&M). As an illustration, we have estimated the implications of these two 'over-estimations' in subsidies to agriculture. If total consumption[25] in agriculture is taken as 70 per cent of that estimated for 2001–2 (98.62 billion kWh) and one-half of this is valued at average cost of supply and one-half is valued at its marginal cost (50 per cent of average cost), the estimated subsidy will be Rs 168.9 billion, implying a reduction of Rs 112 billion (from the estimated Rs 281 billion). If these figures of 'true' subsidies are used (Rs 168.9 billion), the state government contributions and cross-subsidies would cover about 83 per cent of the total estimated deficit in revenues of the state electricity boards. This means that uncovered losses of the SEBs due to agricultural subsidies are only 17 per cent of the 'true' level of subsidies in agriculture (Figure 8.7).

According to the World Bank[26] 'electricity tariffs for farmers in India amount to less than 10 per cent of the cost of supply. That means a power subsidy for the agricultural sector of an estimated US$6 billion a year—equivalent to about 25 per

[25] According to Kannan and Pillai (2000), subsidization involves problems of inefficiency and 'about 30–40 per cent of what is usually reported as agricultural consumption in fact represents unaccounted-for-energy'. This again is part of the vicious circle—if it were properly priced and measured, then losses would, as part of more commercial electricity operation, also decline.

[26] Monari, Lucio: Power Subsidies: A Reality Check on Subsidizing Power for Irrigation in India Private sector and infrastructure network, Note number 244, The World Bank Group, April 2002.

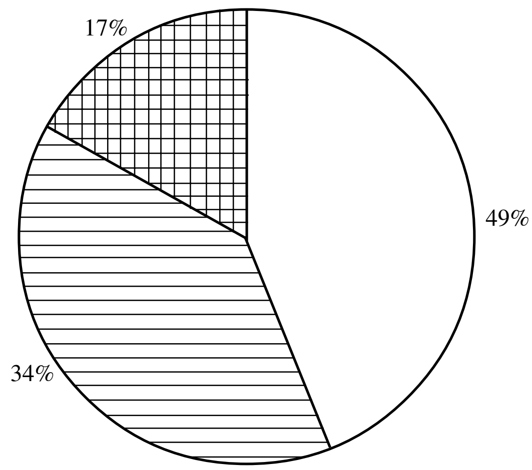

Figure 8.7: Ratio of Government Subsidy and Cross-subsidy in Total Subsidy to Agriculture

cent of India's fiscal deficit, twice the annual public spending on health or rural development, and two and a half times the yearly expenditure on irrigation'.

Electricity Subsides for Agricultural Consumers and State Budget Deficits

The estimated subsidies to agriculture are a substantial portion (48 per cent) of the total revenue deficits in state budgets of all the states taken together. However, the ratios of subsidies to agriculture and revenue deficits are different for different states. Table A8.5 gives data on 'estimated' electricity subsidies in agriculture for the year 2000–1 from the Planning Commission. This does not include estimated subsidies of Rs 16.6 billion in the agriculture sector of Punjab. This gives a total subsidy of Rs 263.6 billion to agricultural consumers. In addition to these estimated subsidies for agriculture consumers, domestic consumers also received another Rs 100 billion as subsidy in that year.

There were subventions from the state governments estimated at Rs 74.6 billion (to cover subsides to both domestic and agricultural consumers). These subventions covered only 20 per cent of the total subsidy (of Rs 363.6 billion). Major subventions from state governments were in Andhra Pradesh (Rs 16.3 billion); Karnataka (Rs 17.5 billion); Gujarat (Rs 13.2 billion); Madhya Pradesh (Rs 4.6 billion); and Haryana (Rs 4.1 billion) (Figure 8.8).

The cross subsidy from other sectors was estimated at Rs 57.9 billion, leaving an uncovered subsidy of Rs 218.7 billion. (As mentioned elsewhere, these subsidy estimates are 'over-estimates' to the extent of 30 to 50 per cent due to both overestimation of consumption and cost of power supply to agriculture).

Table A8.3 also shows that the revenue deficit in the budgets of all states was Rs 513 billion in 2000–1. Thus, estimated subsidies to agriculture were about 48 per cent of the total revenue deficits in state budgets.

However, the ratios of subsidies to agriculture and revenue deficits were different for different states. In Andhra Pradesh, Haryana, and Madhya Pradesh, estimated agricultural subsidies were higher than the revenue deficits of the state governments that is the ratios were higher than 100 per cent (See Figure 8.8) Electricity subsidies to agriculture were around two-thirds of revenue

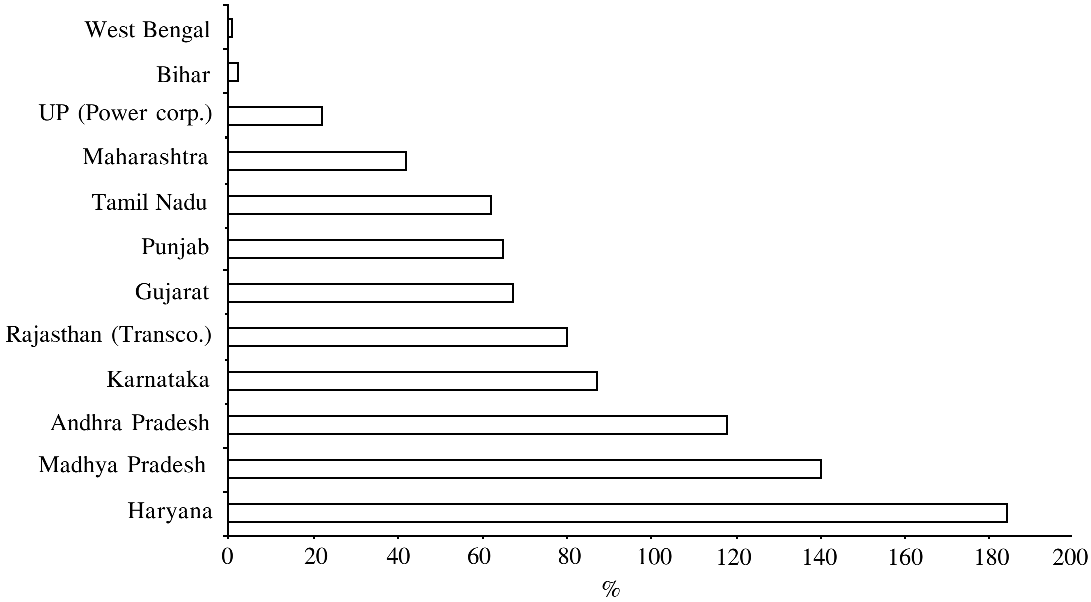

Figure 8.8: Electricity Subsidies of Revenue Deficits (%) in State Budgets, 2000–1
Source: Table A8.3.

deficits in Punjab, Gujarat, and Tamil Nadu. These were around 80 per cent in Rajasthan and Karnataka. These results indicate that if the subsides to the agricultural consumers are reduced substantially, revenue deficits in many states can be reduced/eliminated. The ratios of electricity subsidies to revenue deficits were lower than the all-India average. In UP (22 per cent), Maharashtra (42 per cent) In West Bengal and Bihar, these were less than 2 per cent of budget deficits.

Electricity subsides to agriculture are 26 per cent of gross fiscal deficit (GFD) of all the states taken together. However, there are substantial variations in the ratio of electricity subsidies to agriculture and GFD among states. The Reserve Bank of India presents data on GFD for each state. Three components of the GFD are: revenue deficit, capital outlay, and net lending.

At the all-India level, electricity subsides to agriculture are 26 per cent of GFD (Annex Table A8.4). In two states (Madhya Pradesh and Haryana), electricity subsides for agriculture are around 80 per cent of GFD while in three states (Andhra Pradesh, Gujarat, and Karnataka) these are around 50 per cent of GFD. In Rajasthan, Punjab, and Tamil Nadu, these subsidies account for about 40 per cent of GFD.

Overestimation of Electricity Subsidies for Irrigation Pumping

Power subsidy to agriculture is calculated as the difference between the total cost of power supply and total revenue collected from the agriculture sector. At the all-India level, in 2001–2, average cost of supply has been estimated at 327 paise/kWh and the estimated electricity consumption in the agriculture sector was 98.62 billion kWh (or 29 per cent of the total sales). Per unit revenue has been estimated as 41.54 paise implying a total revenue of Rs 41.0 billion. Thus, the total cost of supply to agriculture is estimated as Rs 322.2 billion and the total subsidy to agriculture is estimated as Rs 281.2 billion.

This methodology tends to overestimate the subsidy to agriculture on account of the following factors:

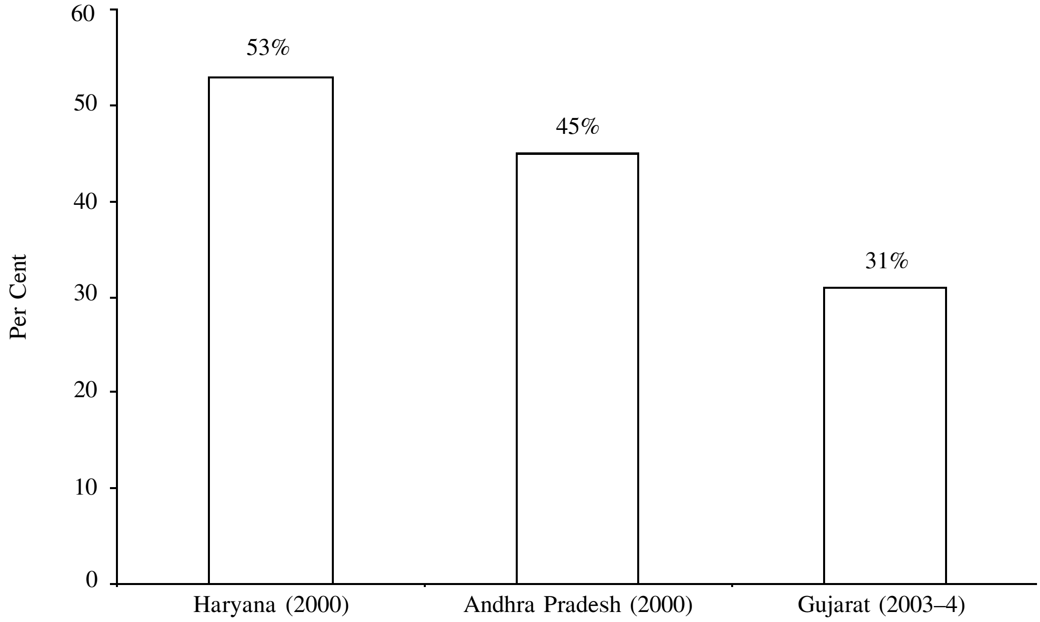

Figure 8.9: Overestimation of 'Estimated' Electricity Consumption by Agriculture

- overestimation of the 'estimated' consumption of electricity in the agriculture sector and
- overestimation of the cost of supply of power to agriculture.

Overestimation of the 'Estimated' Consumption of Electricity in the Agriculture Sector

Some efforts have been made recently to assess the extent of the overestimation of electricity consumption to agriculture in some states (see Figure 8.9). Haryana assesses the units consumed by the un-metered agriculture based on the number of hours of pump use as monthly defined by each circle or regional division. HVPNL's assessment for unmetered consumption in 2000 was 2463 kWh/kW. To estimate farmers' actual power use in Haryana, metres were installed on a sample of 584 pumpsets and their readings recorded every fortnight for a year from December 1998 (World Bank 2001, p. 15). Based on the sample metering (1500 kWh/kW) and the methodology summarized in the study, electricity consumption by agriculture sector in 2000 was estimated at 2876 GWh. This level of consumption is about 65 per cent of the total electricity consumption (4401 GWh) in agriculture as estimated[27] by Haryana Vidyut Prasaran Nigam Limited (HVPNL)—the Haryana electricity utility. Thus, there was an overestimation to the extent of 53 per cent in the electricity consumption in the agriculture sector[28].

In Andhra Pradesh, agricultural consumption was revised downward after energy audit conducted by APTRANSCO during 1996–7. Power supply to agriculture was estimated at 7835 mn kWh in 1996–7 compared with 11400 mn kWh in

[27] HVPNL's assessment for un-metered consumption (2463 kWh/kW) is 64 per cent higher than the study results of 1500 kWh/based on sample metering. HVPNL's estimated consumption for metered connections (about 20 per cent of the total) was 1438 kWh/kW.

[28] The results show that transmission and distribution losses are therefore correspondingly higher than the utilities claim (47 per cent, compared with the official 37 per cent).

1995–6, a decrease of 31 per cent. This indicates an overestimation to the extent of 45 per cent in electricity consumption in agriculture.[29]

In Gujarat, the supply of power to irrigation pump sets is largely unmetered since 1987. About one-sixth of the total agricultural connections (130 thousand out of 623 thousand) get metered supply at Rs 0.70 per kWh. For estimating unmetered agricultural consumption, GEB has used a norm of 2096 unit per year per hp. On this basis the Board projected the energy sales to agriculture at 13,230 million kWh for 2003–4. However, the Gujarat Electricity Regulatory Commission pointed out in their order in 2003 that 'the figures adopted by respective state Regulatory Commissions are 1250 units/hp/year in Andhra Pradesh, 1452 units/hp/year in Haryana, 1590 units/hp/year in Karnataka, 1250 units/hp/year in Madhya Pradesh, and 1100 units/hp/year in Uttar Pradesh. We appreciate that the situation in Gujarat is rather different, as pumping of ground water is done from great depths in North Gujarat. An average consumption of 2300 kWh/kW of connected load per annum, which is equivalent to 1700 kWh/hp per annum, was considered for estimating un-metered agricultural consumption'.[30] Taking into account the connected unmetered agricultural load of 50,92,910 hp, the Commission estimates the agricultural consumption to be 8658 mn kWh instead of 11349 mn kWh. Thus, unmetered sales to agriculture were overestimated by 31 per cent.[31]

In Punjab, as in other states, Punjab state Electricity Board (PSEB) data on agricultural consumption are not actually measured consumption (since there are no metres) but are derived as residual—they overestimate agricultural consumption by the extent to which distribution losses and pilferage are shown as agricultural consumption (World Bank 2003). This study recognizes that the agricultural consumption in Punjab may be overestimated, as in neighbouring Haryana, to the extent of around 50 per cent.

Overestimation of the Cost of Supply of Power to Agriculture

As discussed earlier, estimation of subsidies to agriculture is based on the average cost of supply for the power sector for all users. There is no distinction made for the marginal cost of supply of power to the agriculture sector that in fact may be lower than the average cost if most of the power supply to agriculture is during night time when the opportunity cost of power is equal to the marginal cost of supply (cost of fuel and O&M). Estimates for the marginal cost of supply are not available. Nor is much data available for the actual numbers of hours of power use in agriculture during night time despite a number of farmer's surveys. Some preliminary assessment is made here of the overestimation involved in using the average cost rather than marginal cost of supply of power to agriculture.

Average cost of power supply in Haryana has been estimated[32] at Rs 2.8/kWh. It has been stated (World Bank 2001, p. 17 fn) that the cost of power supply to agriculture consumers is higher than the average cost of supply to all the consumers due to higher capital cost for provision of extended low voltage lines to supply power to the farmers in remote and rural areas and also higher distribution losses. According to estimates of HERC for FY 2001, the average cost of supply is Rs 3.89 per kWh where as the average cost of

[29] This explains the sudden increase in the T&D loss figures for 1996–7 estimated at 33 per cent instead of 19 per cent in the previous year. This means, in the past, T&D losses were being shown under agricultural consumption.

[30] For estimating unmetered agricultural consumption for FY 2003–4, the Commission decided to adopt the same norms as laid down by the Mishra Committee that is 1700 kWh/hp/annum.

[31] The energy sale to metered agricultural consumers is 1881 mn kWh. Thus, the total agricultural sales are projected to be 10,539 mn kWh in place of the estimated figure of 13,230 mn kWh by GEB in FY 2003–4 that is a reduction of 20 per cent on the total agricultural consumption.

[32] Based on 29.7 per cent T&ED losses. As per the Annual Revenue Requirements filed to the Haryana Electricity Regulatory Commission (HERC) for 2000, total cost of power supply was Rs 27,900 mn and total power procured by HVPNL was 14,238 mn kWh.

supply to agriculture consumer is Rs 4.02 per kWh. As against this, in Andhra Pradesh, fully allocated costs for agriculture were estimated to be Rs 2.36 per kWh by APERC while the cost of supply for LT industrial and domestic was estimated to range between Rs 3.24 and Rs 4.96 per kWh (Ramachandra 2003).

As pointed out[33] by Alagh (2004), 'the Ministry of Power in the Electricity Act allows a cost plus pricing rule. In some parts of the country the state level power pricing regulator has not even done the cost calculations properly and wants the farmer to pay more, presumably as an act of "good faith" '.

This approach of estimating cost of power supply to agriculture ignores the fact that a part of the power supply to agriculture is at night when the opportunity cost of power is equal to the marginal cost of power supply. Farmer survey data (World Bank 2001a, 2001b) do not provide data on the actual number of hours for which power is available at night. On average farmers have reported that the three phase supply was available for 6 to 10 hours per day, compared with the 8 to 9 hours promised by the official rostering.

Flat Rate Electricity Tariffs vis-à-vis Metered Tariffs

In a comprehensive analysis of issues involved, Shah[34] et al. (2003) have suggested that the flat-tariff option, combined with intelligent power supply rationing, is a logical, viable alternative that could cut wasteful groundwater extraction and reduce power use in groundwater extraction. The approach would involve:

- gradually raising tariffs to cut power utility losses;
- supplying farms with fewer hours of power per year, but ensuring a quality power supply during periods of moisture stress; and
- metering at the feeder level to measure and monitor farm power use, to allow good management.

According to the authors, 'the key to making a flat tariff work is supply rationing'. For example, Gujarat does not need to supply 3000 hours of farm power per year. It can make its farmers happy (and cut its losses) by supplying only 1200 hours, provided that those 1200 hours are made available when most needed. It may be noted that the key words in the suggestion are 'rationing' and 'supplying power when most needed'.

It is suggested that the rational tariff with intelligent power supply rationing to the farm sector holds out the promise of minimizing the wasteful use of both resources (water and power) and of encouraging a technical change towards water and power saving. *Although no basis* for such estimates are given, the authors claim: 'Our surmise is that such a strategy can reduce annual groundwater extraction in western and peninsular India by 12–18 km^3 per year and reduce power use in groundwater extraction by around 2–3 billion kWh of power, valued at Rs 40 billion–Rs 60 billion per year' (Shah et al.: 2003)

It has been accepted by Shah et al. that 'the metered and flat-tariff regimes are not simply alternative pricing policies—they are completely different business philosophies'. Using a metered tariff, a power utility can confidently recoup its costs and supply customers with as much power as they want, when they want it. The flat tariff, by contrast, allows power utilities to use sophisticated management to provide a high-quality, but carefully rationed, power supply and yet remain viable. As a method for indirect management of groundwater use, there are strong theoretical arguments in favour of the metered electricity tariff. Farmers would learn the real cost of power and water and be forced to economize on their use. Plus, the power utilities would gain valuable information on actual power usages (essential for efficient management and cutting commercial losses).

In view of the above considerations, it is suggested that flat rate tariff with rationing of

[33] For an interesting debate on pricing for power and other commodities, see Alagh (2004).

[34] Shah (2003). Also see Shah (2000, 1993), and Shah and Raju (1987).

power may not be an optimum use of scarce resources.

Allocation of Peak Power to Agriculture will have High Opportunity Cost

It has been suggested by Shah et al that:

> With intelligent management of power supply, it is possible to satisfy irrigation power demand by ensuring 18–20 hours of power a day for 40–50 key moisture-stress days in the kharif and rabi seasons (around 2 and 5 weeks respectively).

It is important to recognize that the 'allocation' of power to the agricultural sector has to be seen in a 'power systems' perspective by recognizing the opportunity cost of allocating power to agriculture during the peak periods (during the day or season). Allocating 18–20 hours of power a day for 40–50 days in a year will deprive other users for this critical power for their priority uses during these periods. It is difficult to estimate the 'opportunity cost' of this type of management of power since this will result in reduced availability of peak power to other consumers (such as households, commercial establishments, and industry) during these 40–50 days. The 'benefits foregone' in alternative uses may be so high that from a societal perspective the allocation of power to agriculture may not be an optimum use of scarce peak power. Alternatively, the costs of coping strategies for users other than agriculture may be so high that this will raise the total system costs to a high level. Further, Flat rate tariffs with power rationing will make the farmers too much dependent on the bureaucracy of the power supply company and the influence of the politicians.

Flat Rates with rationing will not result in revenue maximization for utilities

It is argued here that in the ongoing reform process in the power sector, it would not be possible to ensure that farmers will get the power that they need at the time when they need it because that will be against the philosophy of revenue maximization that is being suggested for power supply companies.

Power distribution companies are becoming profit-centers and the incentives for their managers are for maximizing revenues from available power supplies. Accepting the system of flat rates for electricity use will provide incentives to managers in power sector to 'minimize' supply of power to the agricultural sector since the revenue from an additional unit of electricity will be negative and will reduce the total revenues for the power company. Given the trend towards 'enterepretization' of SEBs, it would be reasonable to expect that the managers will maximize revenues by allocating peak power to the consumers who pay for this power at the highest rate. Under the circumstances of flat rate tariffs, the power supply to agriculture during peak period is likely to be reduced from the current level of about 50 per cent of the power availability.[35] This will result in the type of 'de-electrification' that occurred in East UP during 1980s and 1990s (Shah: 1993; 2000) since power distribution companies will avoid supplying to the farm sector.

Meter Installation and Metered Tariffs as Part of the Power Reform Process

As discussed earlier, state ERCs have been set up as a part of the reform process to rationalize tariffs and improve power supply. Some of these ERCs have mandated/suggested installation of meters for all consumers. Haryana has initiated a programme to complete meter installation to all tubewells within two years. In certain locations where meters were opposed, extensive communication engagement by HVPN staff has resulted in successful installation. HVPN is supplying meters in steel cupboards and is not charging any security deposits, rentals or upkeep charges. In Gujarat, metering of agriculture connections is accelerated by intensifying Tatkal Scheme. Total 69620 Tatkal connections have been released with meters by 31.07.2003. Against the total 625370 Agriculture

[35] It is difficult to get data on how much of the power use in agriculture is during the peak period. This figure of 50 per cent s from the IWMI-Tata studies (IWMI–Tata 2003, 2000).

Connections, 130054 (20.80 per cent) connections are already metered up to 31 July 2003.

Flat Rate Tariffs do not Provide any Incentive for Energy or Water Conservation

In the flat rate system of electricity pricing, once the user pays the charges as per pump capacity, the marginal cost of electricity for operating the pumpset is zero and the farmer can pump more water subject to availability of power and water. In areas of relative water abundance (for example east Uttar Pradesh, Bihar, Orissa, and West Bengal) this may be a good thing since additional water supplies can be used for irrigating crops on farm or water may be sold to farmers who do not own electric motors. However, in areas of relative water scarcity (western India and peninsular India), this will create problems since there is no incentive for energy (and groundwater) conservation.

Flat rates to comply with directives of regulatory commissions will be very high

Reducing subsides through raising flat rates will be politically unacceptable since this will involve raising fixed rates to very high levels. For example, to comply with the demands from the Gujarat Electricity Regulatory Commission, Gujarat's board intends to hit farmers with a 350 per cent price-hike, raising the annual charge from Rs 500/hp (unchanged since 1989) to Rs 1,700/hp and eventually this will become Rs 2,100/hp (Shah et al. 2003).

Flat rates for electricity result in higher costs for small and marginal farmers

Although small and marginal farmers generally operate pumps with lower hp in absolute terms, there appears to be an inverse relationship between farm size and the horsepower per hectare of gross cropped area. Small farmers tend to invest in higher hp per unit of cultivated area relative to large farmers. For farmers who use electric pumps only, under the flat rate system of electricity pricing in Haryana, for small and marginal farmers,[36] electricity tariffs accounted for more than 13 per cent of gross farm income compared with only 6 per cent of gross farm income for large farmers. According to the World Bank (2001) study, 'to gain more insight into the regressive nature of the flat rate tariff, it is useful to compare the share of electricity tariffs for electric pumpset owners with the share of diesel costs for non-electric diesel pump owners'. For non-electric diesel pump owners, the share of diesel costs account for an average of 7 per cent of gross farm income compared with electricity charges that constitute 13 per cent of gross farm income for small and marginal farmers using electric pumpsets only. The highly regressive nature of the electricity tariff cost share as opposed to diesel cost share arises due to the flat rate tariff structure of electricity pricing, where in farmers pay on the basis of installed hp rather than on the basis of per unit consumption (as in the case of diesel pumps).

In Andhra Pradesh also, the then (1999/2000) tariff based on a flat rate structure is regressive penalizing marginal and small farmers who are using less electricity for a given capacity. For electric pumpset users, electricity tariffs for marginal farmers[37] were 7.0 per cent of gross farm income compared with 2.0 per cent for large farmers. As a comparison, diesel costs were 5.6 per cent of gross farm income for marginal farmers (World Bank 2001a). As a result of higher electricity charges, the variable irrigation costs for paddy for marginal farmers (Rs 3000/ha) are 50 per cent higher than those for large farmers (Rs 1919/ha).

As against this regressive tariff structure under the flat rate system, electricity regulatory commissions may devise 'life line rates' under

[36] In Haryana, marginal and small farmers operating less than 2 ha of land accounted for 52 per cent of total farmers while large farmers operating more than 5 ha accounted for 17 percent of total farmers.

[37] In Andhra Pradesh, marginal farmers (less than 1 ha operational holding) accounted for 38 per cent of total farmers) while large farmers (greater than 5 ha) accounted for 5 percent of farmers.

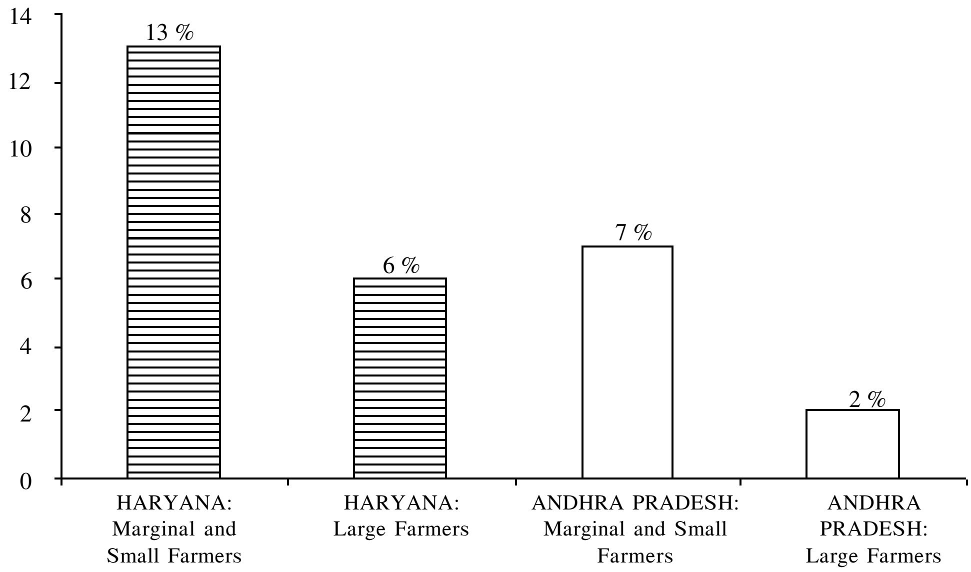

Figure 8.10: Electricity Costs of Gross Farm Income (%) in Haryana and Andhra Pradesh, 2000

metered tariffs for some categories of users (upto a given level of electricity consumption).

Metered Tariffs also have Administrative Problems

It has been stated that 'metering costs account for a substantial proportions of the total costs that electricity boards bear in supplying power to water extraction mechanisms (Shah 1993, p. 116). It was estimated that in Uttar Pradesh, metering and collection costs amounted to some 26 per cent of the total revenue realized per connection; in Maharashtra the figure was around 16 per cent. It may be noted that these ratios are for revenue collected (which was low due to subsidized tariffs) from each connection and not of the cost of supplying power. In a recent study (World Bank 2001) of flat rate system in Haryana, a number of problems have been noted including the detection of illegal connections and the presence of discrepancy between the hp record of the utility and the actual pump size hp. The readings of 78 electronic meters installed on agricultural pumpsets showed that, on average, the actual connected load is about 74 per cent higher than the official utility record. The implementation of unmetered tariffs is seen to result in a significant loss of revenue for the utilities due to under-reporting of the actual capacity of pumps by farmers. This tends to encourage discretion for the utility staff to monitor and verify the capacity of pumpsets in the field at regular intervals and may result in increased collusion between consumers and utility staff and corruption.[38]

Innovations in Institutional Mechanisms and Metering Should be Scaled-up

Innovations in metering (including 'Smart Cards') and charging for power consumption should be

[38] In the Haryana study (World Bank 2001), under the farmers' attitude survey, it was found that about 69 per cent of farmers surveyed favored metered supply. According to HVPN these statements by farmers are not confirmed by reality on the ground because the metered connections have decreased from 107 thousand in 1996 to 74 thousand in 2000, compared to unmetered connections that have increased over the same period from 267 thousand to 285 thousand.

scaled-up so that charging separate tariffs for peak and off-peak power is possible. Efforts should be made to have a politically acceptable solution where off-peak power is charged at very low rates (to cover marginal cost of supply) and peak power is charged at its opportunity cost that may be higher than its cost of supply. This will provide the right price signals to consumers to use power when it is most valuable for them. Also, it will maximize the revenues of producers since they will allocate power where it brings best value.

Innovations in institutional mechanisms for power distribution in agriculture (for example, making village panchayats responsible for power distribution) should be tried. Bulk power could be supplied to a person (as in China) or a community organization who, in turn, is responsible for its distribution and collection of revenues. As a part of the Orissa power sector reforms, village committees have been set up in a number of villages to facilitate interaction between utility and consumers, grievance redressal, bill distribution, metering, and cash collection. Such village committees are expected to perform like a cooperative where they will be billed based on transformer readings and entire responsibility for collection will be transferred to them. In Gujarat, for handing over distribution system to local bodies/consumer cooperatives, MoU has been signed among GEB, GERC, and IRMA for a pilot project given to IRMA for feasibility study and identification of cooperatives in each of the five zones of GEB. According to Shah et al. (2003) there are institutional solutions to this that are not receiving sufficient attention. In the early decades of this century, the US resolved this problem by promoting Rural Electricity Cooperatives (RECs); India also tried these in the 1960s but only half-heartedly. RECs are interesting because they attack precisely the problem that makes power supply to South Asian agriculture costly and unprofitable. If the village buys power in bulk and retails it to its members, the transaction costs of power supply can be reduced dramatically.

Equity Between Canal Irrigation and Groundwater Irrigation

Farmer organizations, especially in western states like Gujarat, justify power subsidies on equity grounds. Over the fifty years since Independence, State and central governments have made massive public investments in canal irrigation infrastructure that have created 'hydraulically privileged' communities; these receive what is really very costly irrigation at nominal charges. South Gujarat, for instance, uses 2/3rd of Gujarat's surface water and does not even pay for it. North Gujarat uses only 1/4th of the state's water; farmers have made huge private investments in developing the groundwater resource; and now they are asking: what is wrong if they expect the Government to provide some relief in the recurring cost they incur in lifting groundwater, which is 10-15 times more than the canal irrigation charges? If transmission and distribution costs in canal irrigation are not passed on to farmers, why should T & D losses in electricity be passed on to farmers? (Shah 1993).

In 1996, water buyers in eastern UP paid Rs 26–30/hour of pumping from 5-hp diesel pumps with a yield of 18–20 m3/hour. Irrigating a hectare of paddy would need 70 hours and a hectare of wheat in rabi would need 100 hours costing Rs 1,960/ha and Rs 2,800/ha, respectively. Canal irrigation rates for paddy and wheat in UP have, for years, been Rs 180/ha and Rs 70/ha, respectively. Thus irrigating wheat and paddy with purchased tube-well water is nearly twenty times costlier than canal irrigation.

For example, in Andhra Pradesh, for marginal farmers, the cost of irrigation of kharif paddy for canal users was Rs 492/ha, almost one-sixth of the variable cost of electric pumpset users in the same category. After taking into account the differences in crop yields, the variable irrigation cost for canal users constitutes only 4.2 per cent of gross income compared with 17 per cent for the electric pumpset users.

Who Benefits from Subsidies?

In view of the income and livelihood implications of removing subsidies, it is important to know who benefits from electricity subsidies in irrigation pumping. In two states—Andhra Pradesh and Haryana—for which sample survey data on beneficiaries of irrigation are available by farm size, marginal and small farmers up to 2 ha of operated land are about two-thirds and one-half of the total farmers, respectively. In Andhra Pradesh, out of a sample of 2120 farmers, marginal farmers (less than 1 ha operational holding) accounted for 38 per cent of total farmers; small farmers (1–2 ha) 30 per cent; medium farmers (2–5 ha) 27 per cent, and large farmers (greater than 5 ha) accounted for 5 per cent of farmers.

In Haryana, out of a sample of 1659 farmers, marginal farmers (less than 1 ha operated area) accounted for 31 per cent; small farmers operating 1–2 ha of land accounted for 21 per cent of total farmers; medium (2–5 ha) accounted for 22 per cent while large farmers operating more than 5 ha accounted for 17 per cent of total farmers.

Subsidized electricity, particularly the use of flat rate tariffs, encourages farmers to install pumpsets that are higher than those required for their own use. This has resulted in most of the farmers selling a part of their water in the market. Small and marginal farmers benefit indirectly from electricity subsidies since they get water at prices that are lower than that which would have prevailed in the absence of subsidies. For example, in eastern Uttar Pradesh, 'Judging groundwater markets from the angle of their accessibility to poor and marginal farmers, it is found that the smallest farmers with landholdings up to 0.4 ha are the biggest beneficiaries, as about 60 per cent of them irrigate their crops using water purchased from the owners of private water extraction device (WED). (Pant 1992, 2004; Shah 1993; and Shah and Raju 1987).

Impacts of Raising Electricity Prices

This section presents some estimates of the impact of reducing or eliminating electricity subsidies in irrigation pumping in various parts of India. In some cases the impact of raising electricity prices is shown on irrigation costs while in some other cases results of simulation exercise (Haryana) and a macro impact analysis using SAM-based multiplier model is presented (for Tamil Nadu).

Impact of Raising Electricity Prices for Irrigation Pumping in Gujarat

Irrigation costs are a substantial portion of the cost of production of crops, particularly in dry regions. Electricity costs form a significant part of irrigation costs of pumping ground water. If electricity costs are raised, this will adversely affect the profitability of some crops unless the farmer benefits in terms of improved supply of electricity that reduces his non-electricity costs. This section examines some hypothesis and empirical evidence in this regard.

In Kumbhalmer village of Gujarat,[39] for wheat, when subsidized electricity charges are taken, irrigation costs at Rs 4573/ha were 40 per cent of the total cost of production of Rs 11549/ha. These costs are based on fixed electricity prices on the basis of pump capacity, at subsidized rates. The net returns for wheat is Rs 10461/ha. It was found that farmers actually incur just half of the actual economic cost in terms of irrigation cost. When economic costs of irrigation are considered, the net economic returns for wheat for well owners (Rs 4278/ha) in Kumbnhalmer decline to about 50 per cent of those when subsidized prices for irrigation are considered (Rs 10461/ha). Net economic returns for water buyers are negative for the mustard, pearl, millet, and sorghum crops when economic costs of irrigation are considered instead of private costs. For alfalfa, irrigation cost at Rs 25604/ha were 70 per cent of total cost and net returns are negative at economic cost of irrigation. Groundwater irrigation leads to positive economic benefits when both crops and milk production become part of an integrated farming system.

[39] See Kumar, M.D. et al. (2004).

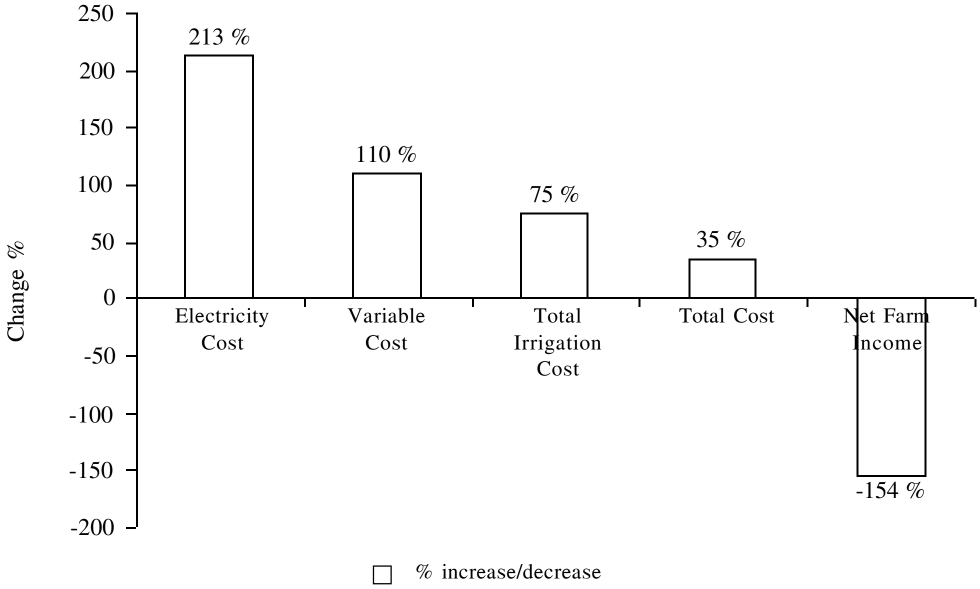

Figure 8.11: Impact of Eliminating Electricity Subsidies on Marginal Farmers, Haryana (per cent increase/decrease)

Source: Table A8.5.

Impact of Reducing/Eliminating Electricity Subsidies in Haryana

Although small and marginal farmers generally operate pumps with lower hp in absolute terms, there appears to be an inverse relationship between farm size and the horsepower per hectare of gross cropped area. Small farmers tend to invest in higher hp per unit of cultivated area relative to large farmers. For farmers who use electric pumps only, under the flat rate system of electricity pricing in Haryana, for small and marginal farmers,[40] electricity tariffs accounted for more than 13 per cent of gross farm income compared with only 6 per cent of gross farm income for large farmers (World Bank: 2001).

Table A8.5 and Figure 8.11 provide some insights into the impact of raising electricity tariffs for marginal farmers in Haryana. While subsidized flat rates for electricity cost the farmer Rs 3950/ha, the total irrigation costs at Rs 11230/ha are about 38 per cent of the gross farm income. At these subsidized electricity rates, the estimated net farm income is only Rs 5480/ha or 18 per cent of gross farm income. If there is an average tariff increase of 213 per cent (as envisaged in the World Bank study), this will raise the electricity cost to Rs 12365/ha and the total cost of production will be higher than the gross farm income and net farm income will be negative by Rs 2935/ha. Even a 40 per cent increase in the cost of electricity, other things being the same, will wipe out the difference between gross farm income and cost of production. A doubling of electricity costs will mean that farming will not be profitable if imputed cost of family labor is included. In other words, for marginal farmers to continue farming, they will have to accept a zero wage rate for their family labor.

[40] In Haryana, marginal and small farmers operating less than 2 ha of land accounted for 52 per cent of total farmers while large farmers operating more than 5 ha accounted for 17 percent of total farmers.

Implications of raising electricity rates with or without supply reforms: Scenario Analysis for Haryana

Small and marginal farmers in Haryana have shown a high willingness to pay for improved reliability of power supply because the poor quality of supply has affected them so severely. By contrast, medium-size and large farmers (about 60 per cent of those owning electric pumps) are less willing to pay in the short run because of their expensive backup arrangements, which reduce their vulnerability to supply fluctuations. So it is the smaller and poorer farmers who end up bearing the cost of wasted resources and unreliable supply. To improve equity as well as efficiency in the use of water resources, it is therefore imperative to shift to electricity metering and per unit tariffs (World Bank 2001).

To gain a better understanding of the potential impact on farmers of different reform packages, the World Bank study (2001) simulated several policy reform scenarios:

Business as usual—with tariff increases but deteriorating quality.

Gradual reform—with steeper tariff increases and some improvement in quality

Accelerated reform—with the same tariff increases but more aggressive improvements in quality. The accelerated reform scenario envisions more aggressive institutional, regulatory, and technical reforms than the gradual reform scenario. These accelerated reforms would reduce theft, improve billing collection, shorten the wait for service, and improve the utilities' capacity to manage loads. And they would lead to greater reductions in the duration of power cuts (70 per cent, compared with 40 per cent for gradual reforms) and in days lost because of transformer burnout (70 per cent, compared with 40 per cent)

Both the gradual and the accelerated reform would involve a transition period during which tariffs would rise but the quality of supply would remain uneven. Small and marginal farmers, who would be most affected by the variations in quality, could reduce their costs during this period by investing in smaller pumpsets with more efficient motors. Farmers' willingness to invest in new pumpsets would depend, of course, on efforts to improve the quality of supply as quickly as possible, to minimize the risk of pump burnouts. Given this risk, an incentive package may be needed to encourage farmers to invest in new pumpsets—as well as some kind of insurance against the cost of burnouts—until the quality of supply is more consistent.

The study carried out the simulations for a six-year period to allow for the introduction of tariff reforms and for investments to rehabilitate the transmission and distribution network. The results show that tariff increases for agriculture, matched by improvements in quality, would benefit farmers, particularly small and marginal farmers. Under the business as usual scenario the incomes of small farmers would drop by 100 per cent and those of large farmers by 50 per cent.

With accelerated reform, the incomes of small farmers would rise by 100 per cent and those of large farmers by 40 per cent. Over the six-year reform period, during which the quality of power supply is expected to improve, the cost to farmers of a new pumpset—as well as of the (more realistic) per unit tariff—would be completely offset by higher productivity and farm income. In the shorter term states that encourage energy conservation as part of their reform package could offer incentives to rural cooperatives or village electricity committees to help farmers purchase the more efficient pumpsets as the quality of power supply improves.

Free Electricity in Tamil Nadu versus Subsidized Electricity in Andhra Pradesh

In this section, we evaluate the implications of free electricity in Tamil Nadu versus subdidized electricity in Andhra Pradesh. Palanisami and Kumar (2003) show that even though electricity is free in Tamil Nadu, the variable irrigation cost, on average, in Tamil Nadu (Rs 4048 per ha per year) is higher than in Andhra Pradesh (Rs 3025

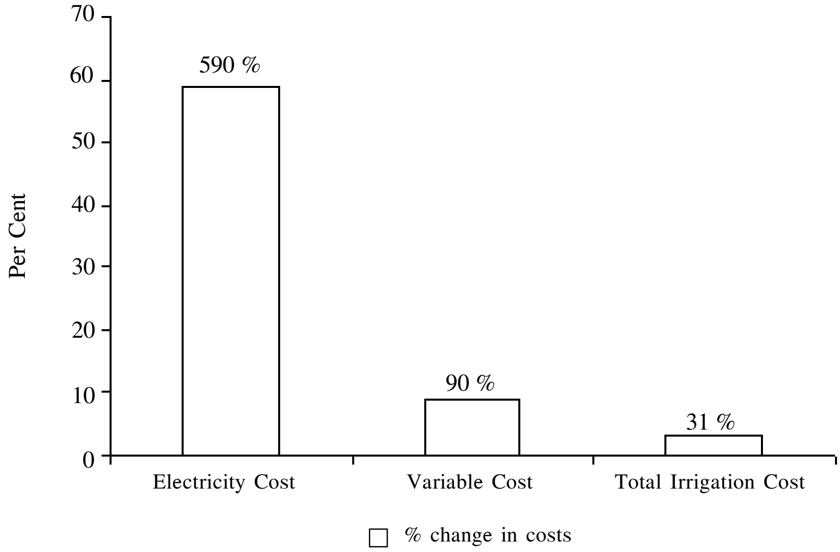

Figure 8.12: Impact of Eliminating Electricity Subsidy, Tamil Nadu (per cent increase in Costs)

Source: Table A8.6.

per ha per year) where farmers have to pay fixed charge ranging between Rs 225 to Rs 575 per hp per year. For marginal farmers, variable irrigation cost is Rs 7890 ha/year in Tamil Nadu compared with Rs 7088/ha/year in Andhra Pradesh. This is due to higher labor costs in Tamil Nadu (Rs 7710/ha/year) compared with Rs 5182/ha/year. If the cost of electricity in Tamil Nadu is same as that in Andhra Pradesh, variable irrigation costs in Tamil Nadu will increase by Rs 1768 or 22.4 per cent of the total variable irrigation cost (Rs 7890 per ha). With free electricity, total irrigation costs of Rs 22289/ha/year form 40 per cent of gross farm income (Rs 56201/ha/year) of a marginal farmer in Tamil Nadu. If marginal farmers in Tamil Nadu have to pay the same costs for electricity as in Andhra Pradesh, the share of irrigation cost in gross farm income will increase to 43 per cent of gross farm income.

Irrigation Cost Implications of Eliminating Electricity Subsidies in Tamil Nadu

Here we explore the cost implications of removing electricity subsidies in Tamil Nadu as presented in Table A8.6 and Figure 8.12. Three levels of pricing for electricity are considered: (i) Free electricity (as in 2004); (ii) Subsidized Flat rate tariff where farmers are charged at a fixed price of Rs 250 per HP per year; (iii). Electricity is priced at its estimated economic cost of supply to agriculture at Rs 3.1 per kWh.

Impact of Eliminating Electricity Subsidies in Tamil Nadu: Results from a Macro Study

A recent study (Bhatia et al. 2006) for Tamil Nadu presents, among other results on the benefits of flexible water allocation,[41] the economic and environmental impacts of eliminating electricity

[41] The results suggest that a shift to a flexible water allocation system would bring major environmental, economic and social benefits to the State. Compared with the current 'fixed sectoral allocation' policy, a flexible allocation policy would, in 2020, result in 15 per cent less overall water used; 24 per cent less water pumped from aquifers; 20 per cent higher State income; with all strata, rich and poor, benefiting similarly, with one important exception of agricultural laborers.

subsidies for irrigation pumping. Two levels of pricing for electricity are considered: Subsidized Flat rate tariff where farmers are charged at a fixed price of Rs 250 per HP per year. Alternatively, electricity is priced at its estimated economic cost of supply to agriculture at Rs 3.1 per kWh. The water prices used for groundwater pumping for two assumptions are as follows:

- Under subsidized electricity, Rs 1.78 per cu.m. for shallow aquifers and Rs 2.81 for deep aquifers.
- Under economic cost of electricity, cost of water pumping is Rs 2.31 per cu.m. for shallow aquifers and Rs 4.27 per cu.m. for deep aquifers.[42]

Simulation results have been obtained by using an optimization model for each of the 17 basins that determines the level of irrigation pumping for different crops at different prices for water pumping, given the available water from surface sources. The optimization models give results of optimal volume of pumping of water at different costs of pumping, allocation of water for different crops and outputs of major crops such as paddy, sugarcane and so on. The SAM based fixed-price multiplier model (with embedded input-output model) takes the results of the optimization models for seventeen basins as inputs, and then determines the aggregate (direct plus indirect) impacts of different scenarios. The results show that were the Government of Tamil Nadu to adopt flexible water allocation policies, the State Income (as measured by Gross Value Added, GVA) in 2020 would be 21 per cent greater than if allocations to sectors were to remain fixed

Assuming flexibility in water allocations to various sectors, the impacts of removing electricity subsides (electricity priced at Rs 3.1/kWh) are estimated in terms of water use in agriculture, total volume of water pumped, output of major crops and total gross value added or State Income for Tamil Nadu for the year 2020. It is found that, as a consequence of the increased cost of water pumping, water use in agriculture in many basins for some crops is not economic and the total groundwater use in agriculture is reduced by 4711 MCM (10294 as against 15005 MCM under simulation when electricity for pumping is subsidized). This reduction of almost 32 per cent in groundwater use results in a total water use reduction of the same volume (24506 as against 29217 MCM) or a reduction of 16 per cent in total water use.

This reduction in groundwater results in a reduced area under paddy by 147,000 ha or a reduction of 12 per cent while high cost of pumping almost eliminates sugarcane crop (area reduced from 157,000 ha). Areas under other crops are not affected due to their higher gross value added per unit of water.

As expected, the results of SAM-based fixed price multiplier model show that the effect of removing electricity subsidy is mainly on the agriculture sector incomes and the rest of the economy is affected only marginally since the outputs of all other sectors remains more or less the same. Although for the agricultural sector, this results in a reduction of Rs 18 billion (or 23.7 per cent) in the income from agriculture, from Rs 76 billion to Rs 58 billion. The reduction in the total income in the state (from Rs 7233 billion to Rs 7223 billion) is only 0.1 per cent or Rs 10 billion only (due to marginal increases in the outputs of industry and tertiary sectors). This is an interesting result since it shows that electricity price increases have significant direct effects on incomes in the rural areas but does not have much effect on the rest of the economy[43] in Tamil Nadu state.

Need for Direct and Transparent Subsidies

It is important to recognize that state governments may wish to provide subsidies for electricity use to marginal and small farmers. Such subsidies

[42] For details of assumptions and results, see Bhatia et al. (2006)

[43] This is mainly because the share of agriculture sector in total state income in 2020 is expected to decline to only 4 per cent (down from17 per cent in 2000).

should be direct and transparent and should be in terms of mandatory financial transfers from the state government to the power company. Since the power companies will get their full revenues, they will have adequate resources for investment to improve the reliability and quality of power supply. Availability of quality power at prices the farmers are willing to pay will reduce the use of diesel oil that would result in savings in import costs and reduction in greenhouse gas emissions. This will also reduce unnecessary investment in diesel engines where many farmers are buying diesel engines as a back-up system due to unreliable power supply.

Role of the World Bank

The World Bank has been actively involved with the power sector reforms in India. Both through its lending programmes and policy studies, the World Bank has promoted various aspects of policy reforms including reorganization of the institutional structure in the power sector, the process of privatization of distribution, and setting up of regulatory commissions. The World Bank played an important role in the power sector reforms in Andhra Pradesh and Orissa (Sankar and Ramachandra 2000, Ramachandra 2003). For example, in Andhra Pradesh, the World Bank had a ten-year reform programme beginning in 1999 and provided a loan of US$ 210 million equivalent to India for Andhra Pradesh Power Sector Restructuring Project (World Bank Report No. 18849 IN, 1999).

The World Bank has supported debate on various issues on power sector reforms, particularly the issue of subsidized tariffs to agriculture and financial health of the SEBs. The World Bank's Energy Sector Unit in the South Asia Regional Office carried out an excellent study of the 'Power Supply to Agriculture' in two states—Haryana and Andhra Pradesh. The study reports present the analytical framework, and survey methodology and results. The detailed reports for each state provide very useful field survey data on various aspects of electricity use in agriculture that is rarely found elsewhere.

The World Bank has also played an important role in generating hydrological data through its hydrology project over several years. The Bank had several projects on restructuring of the water sector in states such as Orissa, Tamil Nadu, Rajasthan, and Uttar Pradesh.

The Bank has supported India in hydropower development over many decades. The engagement started with Second Koyna Power in 1959 and continued over the years, until the late 1980s and early 1990s, when the Bank cancelled its involvement in several of India's potential hydropower projects before they even got started. These were Upper Indravati, Upper Krishna, Srinagar (Uttar Pradesh), and Sardar Sarovar (Narmada). But more recently, the Bank has supported two projects, Nathpa Jhakri (1500 MW) and Koyna Stage IV (1000 MW), both of which were successfully commissioned and are now achieving their objectives.

Of late, the Bank has been considering involvement in the further development of hydroelectric resources of India. In an internal document, the Bank's comparative advantage in hydro development has been articulated as follows in terms of financial, policy, and institutional issues (World Bank 2004a).

The World Bank can play a significant role as a source of funds for investments in priority projects in the water sector such as multipurpose projects, hydropower plants, new irrigation schemes, and small check dams. Through its economic and sector work, the World Bank can play a critical role in analysing the socio-economic impacts of multipurpose projects, hydropower projects, river-linking schemes, and watershed development programmes.

As part of the World Bank Water Resources Sector Strategy (2003), the Bank could assist in the development of an adequate stock of well-performing hydraulic infrastructure and mobilizing public and private financing. The Bank could assist in the utilization of the vast untapped potential of the hydropower sector by helping in the process of reforms of the electricity sector.

The Bank's involvement could have significant benefits in terms of institutionalizing national/ international good practices for design and management of large multipurpose water projects involving several states. The Bank could help in setting up of river basin organizations on the lines of Tennessee Valley Authority (TVA) or assist in the restructuring of the Damodar Valley Corporation (DVC).

In order to gain from flexibility of water allocations, there will be a need to provide institutional framework for sale and transfer of water among users and to provide technical measures for such a transfer (for example, infrastructure). The World Bank could encourage regulation/legislation that provides water rights and entitlements of farmers so that the transfer of water from low- to high-value uses is facilitated, and those who give up their implicit water entitlements do so voluntarily in exchange for appropriate compensation.

The Bank could also help in institutional development of the irrigation sector on the lines of the hydropower development in the country. This will remove the dichotomy of the two subsectors (irrigation and hydro) where there is a growing disequilibrium between a modernized and aggressive power sector and a traditional water resources sector. With an irrigation sector that is financially responsible, it may be possible to avoid a situation where investment decisions on major infrastructure do not give adequate attention to the multipurpose benefits of dams, but focus only on the delivery of power.

The Bank's policy dialogue with the central and state governments could help in policy reforms for the irrigation sector where direct targeted subsidies are provided to marginal farmers and price of electricity used for pumping is raised over time. This will also provide an incentive for irrigation departments to raise charges for surface water supplies. The Bank could promote the scaling-up of pilot programmes of institutional reforms, decentralization of responsibilities to communities for targeted subsidies. Financing the costs of transition from low-level to high-level equilibrium is a key task where the World Bank can play an important role in terms of principled pragmatism.

Other financial institutions would have more confidence in the hydropower sector if the Bank were to be involved. The Bank's advice and provision of long-term financing could leverage and facilitate a time-slice approach to new investment in hydropower. Thus, the Bank's support would help reduce the high upfront costs and lead to reduced generation costs and lower tariffs.

The Bank has this year doubled its lending to the country to US$9 billion for the three-year period from 2004–7. Detailed discussions on additional financing for each of the infrastructure sectors—power, water resources, railways, and roads are under way.

CONCLUSIONS

To recapitulate, the following conclusions may be considered from the above analysis:

- Water and energy interactions in India have significant implications for growth, poverty reduction and environment. There are substantial synergy benefits from the use of water for hydropower that, in turn, is used for pumping water for irrigation.
- The current policy framework and institutional arrangements do not result in an optimum development and use of water and energy resources. Investment in hydropower has been constrained in the past due to high capital costs and long gestation periods. Investment in multipurpose storage projects has been constrained due to concerns of environment and resettlement of project-affected people.
- In the current system of operation of multipurpose schemes, water is released not

in accordance with the needs of power generation but based on water requirements for irrigation purposes. This results in shortfall in hydel generation and in corresponding variations in the quantum of purchase of power from other sources. Under the current compensation formula used by the state.

- Available studies show the benefits of synergy from the use of water for irrigation and hydropower. In the case of the multipurpose Bhakra dam system, the total (discounted) benefits from canal irrigation and hydro power together are almost three times the sum of separate benefits from canal irrigation and hydro electricity.
- The results of a study in Tamil Nadu show that the current practice must move away from fixed, command-and-control water allocation policies towards flexible allocation mechanisms which facilitate the voluntary movement of water from low-to high-value uses. Compared with the current 'fixed sectoral allocation' policy, a flexible allocation policy would, in 2020, result in 15 per cent less overall water used; 24 per cent less water pumped from aquifers; 20 per cent higher State income; with all strata, rich and poor, benefiting similarly, with one important exception of agricultural laborers.
- As a part of the next generation power sector reforms, there is an urgent need for a debate on the methodology of tariff fixation for hydropower and other renewables. The CERC as well as state ERCs have to critically evaluate the 'Cost Plus' approach that is not in line with the philosophy of reforms. Further, the tariff fixation for large as well as small hydro plants based on a 'Cost Plus' approach should incorporate ways of valuing social and environmental benefits from this clean, renewable energy.
- The ongoing reforms in the power sector have to be extended to include the water sector so that synergy benefits of the use of these interdependent resources are maximized and negative externalities can be avoided. This would require regional water and power boards (RWPB) that will coordinate the activities of regulatory agencies, existing power and water suppliers and users.
- A re-assessment of electricity subsidies for irrigation pumping shows that the actual subsidies are only about one-half of those currently estimated and about 80 per cent of the total revenue deficits are met from cross-subsidies and direct subventions from the state governments. This shows the need for proper estimation of the level of electricity consumption and the economic cost of supply to agriculture (during off-peak periods). This will require metering of consumption at various stages/levels and reduction in theft, transmission and distribution losses, and in inefficiencies in operation, transmission and distribution that are resulting in high costs of supply.
- Metered tariffs for electricity for all sectors have been accepted as an important part of the power sector reforms. Metered tariffs based on the cost of supply during peak or off-peak periods will provide the right economic signals and enable the farmers to use as much electricity as necessary for his/her own operations and for sale to others. With metered tariffs, it is possible to give the farmers the benefit of lower prices for electricity used by them during off-peak periods/seasons. This will also make it possible to charge 'lifeline rates' for marginal and small farmers particularly during off-peak periods.
- Flat rate tariffs with power rationing will make the farmers too dependent on the bureaucracy of the power supply company and the influence of the politicians. If a 'power systems' perspective is used the 'opportunity cost' of allocating 18–20 hours of power a day for 40–50 days in a year will be very high since this will deprive households and industry of this critical power for their priority uses. Further, under the flat rate system, marginal and

small farmers pay more for electricity as a ratio of their income than what the large farmers have to pay.

- It may be necessary to subsidize marginal and small farmers for their electricity use for reasons of food security and livelihood security.
- The World Bank can play a significant role as a source of funds for investments in priority projects in the water sector. As a part of the World Bank Water Resources Sector Strategy (2004c), the Bank could assist in the development of an adequate stock of well- performing hydraulic infrastructure and mobilizing public and private financing. Other financial institutions would have more confidence in the hydropower sector if the Bank were to be involved. The Bank's involvement could have significant benefits in terms of institutionalizing national/international good practices for design and management of large multipurpose water projects involving several states. The Bank could help in extending the ongoing reforms in the power sector to include the water sector so that synergy benefits of the use of these interdependent resources are maximized and negative externalities avoided.

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APPENDIX 8.1

TABLE A8.1: Gross Irrigated Area and Area under Tubewells, 1999–2000

(m.ha.)

State	Gross Cropped Area (m.ha.)	Gross Irrigated Area (m.ha.)	GIA/as % of GCA	Area under Tubewells as % NIA (Net Irrigated Area)
Andhra Pradesh	13.0	5.7	44.1	43.3
Bihar	10.0	4.8	48.2	57.7
Gujarat	10.2	3.8	37.8	78.8
Haryana	6.0	5.1	85.0	49.6
Karnataka	12.1	3.2	26.1	37.6
Kerala	3.0	0.5	15.7	32.1
Madhya Pradesh	26.2	7.1	27.1	57.2
Maharashtra	22.4	3.8	16.9	64.6
Orissa	8.5	2.5	29.5	40.0
Punjab	8.2	7.5	90.9	67.6
Rajasthan	19.3	6.9	36.0	68.9
Tamil Nadu	6.5	3.6	55.0	48.9
Uttar Pradesh	26.6	17.7	66.4	72.9
West Bengal	9.5	2.5	26.1	37.3
Others	7.8	1.6	20.8	4.4
All-India	189.4	76.3	40.3	58.7

Source: Directorate of Economics and Statistics, GOI.

TABLE A8.2: Average Tariff for Agriculture

(paise/kWh)

	1992–3 Actual	1993–4 Actual	1997–8 Actual	1998–9 Actual	1999–2000 Provi.	2000–1 (RE)	2001–2 (AP)
Andhra Pradesh	8.6	6.4	16.1	16.0	15.4	15	14
Bihar	10.5	14.8	12.2	11.4	13.4	13.4	13.4
Gujarat	11	19	18.0	17.0	15.0	39.0	62.0
Haryana	25.5	29	61.1	53.7	35.5	37.0	47.7
Karnataka	4.2	2.8	11.6	23.6	31.5	30.5	38.8
Kerala	25.1	29.4	54.6	59.6	67.2	67.2	67.2
Madhya Pradesh	24.5	19.7	5.3	4.7	7.2	7.2	7.2
Maharashtra	15.2	22.7	21.5	30.0	45.7	82.3	82.3
Orissa (GRIDCO)	30.9	21.2	85.0	96.5	102.0	107.7	0
Punjab	10.8	19.5	FS	0	FS	FS	0
Rajasthan (Transco.)	31	30.8	34.6	25.6	33.6	46.3	46.3
Tamil Nadu	0	0	1.6	1.2	1.2	1.3	1.3
Uttar Pradesh (Power corp.)	31.6	31.9	49.7	49.7	64.3	107.8	119.0
West Bengal	19.2	25.3	23.3	26.4	36.0	57.9	91.9
Average:	16.1	17.9	20.2	21.0	22.6	35.4	41.5

Note: FS–Free Supply.
Source: Planning Commission, Government of India: Annual Report (2001–2) on 'The Working of State Electricity Boards and Electricity Departments', May 2002.

TABLE A8.3: Electricity Subsidies and Revenue Deficits in State Budgets, 2000–1

(Rs billion)

	Electricity Subsidies for Agricultural Consumers	Revenue Deficit (+) in the State Budget	Electricity Subsidies as Per Cent of Revenue Deficit
Andhra Pradesh	36.9	31.1	118
Bihar	0.6	29.6	2
Gujarat	45.8	68.6	67
Haryana	19.0	10.3	184
Karnataka	19.0	21.8	87
Madhya Pradesh	31.3	22.5	140
Maharashtra	25.9	62.2	42
Punjab	16.6*	25.7	65
Rajasthan (Transco.)	20.6	26.1	80
Tamil Nadu	24.4	39.2	62
Uttar Pradesh (Power corp.)	12.6	58.2	22
West Bengal	0.4	74.1	1
All-India Total	247.0**	513.2	48

Note: ** excludes Punjab.
Source: 1. Planning Commission, Government of India: Annual Report (2001–2) on The Working of State Electricity Boards and Electricity Departments, May 2002. 2. Reserve Bank of India, State Finances: A Study of Budgets 2001–2; March 2002. For Punjab, data are from World Bank (2003).

TABLE A8.4: Electricity Subsidies and Gross Fiscal Deficits in State Budgets, 2000–1

(Rs billion)

	Electricity Subsidies for Agriculture Consumers	Gross Fiscal Deficit (+) in the State Budget	Electricity Subsidies as Per Cent of Gross Fiscal Deficit
Andhra Pradesh	36.9	72.1	52
Bihar	0.6	48.8	1
Gujarat	45.8	84.2	54
Haryana	19.0	24.1	79
Karnataka	19.0	41.5	46
Madhya Pradesh	31.3	36.6	85
Maharashtra	25.9	99.9	26
Punjab	16.6*	44.6	37
Rajasthan (Transco.)	20.6	48.0	43
Tamil Nadu	24.4	57.8	42
Uttar Pradesh (Power corp.)	12.6	122.8	10
West Bengal	0.4	112.2	1
All-India Total	247.0**	952.8	26

Notes: ** excludes Punjab. Components of Gross Fiscal Deficit are: Revenue deficit + Capital Outlay + Net Lending.
Source: 1. Planning Commission, Government of India: Annual Report (2001–2) on The Working Of State Electricity Boards and Electricity Departments, May 2002. 2. Reserve Bank of India, State Finances: A Study of Budgets 2001–2; March 2002. For Punjab, data are from World Bank (2003).

TABLE A 8.5 Impact of Eliminating Electricity Subsidies for Marginal Farmers in Haryana

(Rs per hectare)

Item: Cost Component or Farm Income	Current Tariff: Flat Rate Tariff for Electric Pumpset	With Average (213%) Tariff Increase, No Reform and Supply Improvement	Percent Increase Compared with Flat Rate Tariff
Electricity cost	3950	12365	213%
Total variable irrigation cost	7630	16045	110%
Total irrigation cost	11230	19645	75%
Total cost	24270	32685	35%
Net Farm Income	5480	–2935	Negative
Gross farm income	29750	29750	0%

Source: World Bank (2001).

TABLE A 8.6 Impact of Eliminating Electricity Subsidies in Tamil Nadu

(Rs per pumpset per year)

Item	Free Electricity	Electricity Rs 250/hp/year (Flat rate tariff)	Electricity Priced at Economic Cost Rs 3.1/kWh	Percent increase Compared with Flat Rate Tariff
Electricity cost	0	1875	12960	590%
Labor and maintenance	10600	10600	10600	0%
Total variable irrigation cost	10600	12475	23560	90%
Annualized capital charges for tubewell and pumpset	23022	23022	23022	0%
Total irrigation cost	33622	35497	46582	31%
Unit irrigation cost (Rs per cu.m.)	3.11	3.30	4.31	31%

Note: Figures are for a 7.5 hp pumpsets drawing water (10800 cu.m.) from a deep aquifer. For details, see Bhatia et al. (2004)
Source: Same as Table A8.5.

9

Pricing, Regulation, and Financing Strategies

SEBASTIAN MORRIS

Most of the inefficiencies, misuse, and environmental damage relating to water and irrigation in India have their roots in the mispricing of water and electricity. The issues related to pricing are, however, deeply interlinked with water rights, subsidies, and financing.

LARGE BUDGETARY SUBSIDIES

Budgetary subsidies (of the centre and states) constitute as much as 13 per cent of GDP. A large part of the budgetary subsidies are on account of economic goods and services like water and electricity where the recovery rates are quite low. If cross-subsidies are also brought in then the total implicit subsidies are around 20–25 per cent higher[1] (Srivastava et al. 2003). The scope to reduce the fiscal deficit by raising the charges and to introduce more efficient delivery of these services is therefore very large. Principal among these services is energy (electricity) and water.

In the first flush of reforms in India, the solution to the problem of large subsidies was seen as the reduction in the subsidy or its elimination. This is neither necessary nor feasible. The real solution to having low and sustainable subsidies is to recast subsidies as direct (to the user) so that the efficiency gains and incentive gains can be taken advantage of as also the ability to limit and direct the same.

Direct Subsidies and Endowments as the Key

Direct subsidies would be 'incentive compatible' and bring forth political support for the contemplated change. The space for feasible reform is created by the fact that as much as two-thirds of the total 'fiscal' cost[2] currently incurred in subsidization is in excess of the value of the transfer actually delivered to the subsidized groups.[3] About a third of the 'fiscal' cost may be

[1] These are Srivastava et al. (2003) estimates. But in electricity it is well known that the agriculture sector is treated as a residual, and the cost of supply to the non-subsidized sectors is also exaggerated. Today no sector other than agriculture is charged below cost. All others are charged well above costs. Therefore the cross subsidies would have increased from their 1997 figures, and is likely to be about 50 per cent of the reported implicit subsidy.

[2] This would also include cross subsidies, since cross subsidies functionally are no different from (differential) taxes.

[3] In the case of programmes of expenditure of the Planning Commission taking the Jawahar Rozgar Yojna as an example (which many claim to be among the better structured programmes), 'it cost Rs 4.35 to direct one

accounted for by illegitimate transfers (leakages, avoidable wasteful consumption, diversions, substitutions by high priced segments resulting in revenue losses) and the remaining by avoidable (dead weight) losses and inefficiencies that arise naturally out of the mode of subsidization.

If allocative diseconomies, and the fallouts of the same are also brought in (that is, the entire social cost), then in actual value the transfers to the subsidized is a small part of the total social cost. Thus the strategy for reform would be to retain the transfers at the current realized (or better) levels by announcing at the highest levels as policy that these would be protected, even as reform and removal of distortions take place. This would nullify the opposition of the subsidized to reform, or in fact invite their active support as we have argued in the case of electricity.

Interdepartmental Coordination Cannot be Avoided

Such measures would necessarily demand the attention and decision of several departments/ ministries, and this more than any other reason has prevented the wider recognition and acceptance of direct subsidies. Appropriate measures that remove the policy level infirmities, unlike what is generally believed, are not politically unpalatable in the sense of the decision-maker having to alienate or go against important political groupings like farmers or rural populations. They would only need to overcome the vested interests who in numbers are small.[4]

Since deadweight losses and wastage are large in the current systems of subsidization, a more efficient method of subsidization in avoiding these losses can release vast resources which can then provide the wherewithal to overcome the marginal dissent the few vested groupings who may be adversely affected in the reformed (subsidization) system. In the case of food, direct subsidies, such as well-designed system of stamps, that do not distort the market prices nor create a parallel distribution system as the current PDS does, can improve efficiency significantly (Joshi and Little 1996).

Reform Has to be Benefit Neutral

Reform also need not impose sudden large burdens on the exchequer if essentially sound, consistent and politically sustainable measures are pursued. This is because the future ‘savings’, both fiscal and social, can at least in part be taken advantage of through appropriate measures that bring in the financial markets and institutions into the process. Reform that results in enhanced gain to the currently subsidized sectors (both through the retention of current level of transfer benefits and through efficiency gains) would be necessary if reform as such has to move forward.

On the Wrong Foot in Electricity

The proposals and actions in electricity thus far have not had the potential to unlock the hidden waste and inefficiencies. Reform then ends up being viewed as a zero sum game by farmers. Ill-advised politicians but with considerable political energy and sincerity have spent themselves on the futile option of directly cutting out subsidies. This has alienated them from the subsidized sectors, allowed opposition to reform to organize, resulting in immense damage to the reform process. (Morris 2002a). Thus directly attacking agricultural subsidies through enhanced denial, uncompensated rise in tariffs in the states of

rupee one to the poor’ (Srinivasan 2000). Similarly, the ratio of central government spending to actual transfer benefit realized by the poor in the case of food subsidies is as low as 6.35 (Srinivasan 2004). A large part of the total loss of the Gujarat State Electricity Board amounting to as much as 200 per cent of the reported losses c.1995 is in the form of leakage and wastage (Morris 1999).

[4] Vested interests as a barrier to reform has been exaggerated in a vital sense. If reform means removal of subsidies altogether, then the entire farming community would be against reform and would therefore become a vested interest. On the other hand if as we propose, subsidies are to be retained and directly delivered, the vested interests that one would have to contend with are only those that gain out of leakages—typically the employees of SEBs who connive and others outside who gain out the diversion of electricity. These can be easily contended with if the bulk of the farmers are weaned on to the side of reform.

Madhya Pradesh, Andhra Pradesh, Tamil Nadu, and now Gujarat has brought political disaster upon energetic chief ministers who earlier had much goodwill and commanded large majority in the assemblies.

Unfortunately today since ham-handed reform was pushed through in electricity there has been a massive political reversal in many states (Gujarat, Madhya Pradesh, Andhra Pradesh, and Maharashtra). Free electricity to the agriculture sector has become the slogan of political rightness and the ill-designed reform has to bear the responsibility for such reversal. Political initiative and commitment to anything but the status quo and populism may have been killed. The tragedy is that simple options that would have actually enhanced the political support for reforms in electricity were available but either not understood or ignored. Enormous political energy, and what is even rarer, bureaucratic commitment and organization have been all wasted in micromanagement of dysfunctionalties and perversities created by infirm policies, and poor design of schemes (such as subsidy mechanisms) which should have been corrected in the first place. We had earlier (Pandey and Morris 2004) commented on the stupendous efforts in electricity reform and specifically on revenue mop up in Madhya Pradesh. We were also not optimistic that the effort would be sustained since political commitment was being wasted in administrative approaches to manage dysfunctionalties rather than to remove the same, and build up political support to reform thereby. It would require a herculean effort to bring reform back on the agenda. The setback coming from the ill thought-out advice of policy-makers and others who did not worry about the incentive compatibility of the measures they sought, or in simpler language about its implementability and political implications, would now unfold to the detriment of the economy.

Allocative Price Distortions at the Root of the Problem

Under-pricing of water and electricity used in pumping up groundwater (electricity supply to the agriculture sector) has been at the root of the fiscal crisis. The budgetary contributions that had to be made to cover the losses in the irrigation

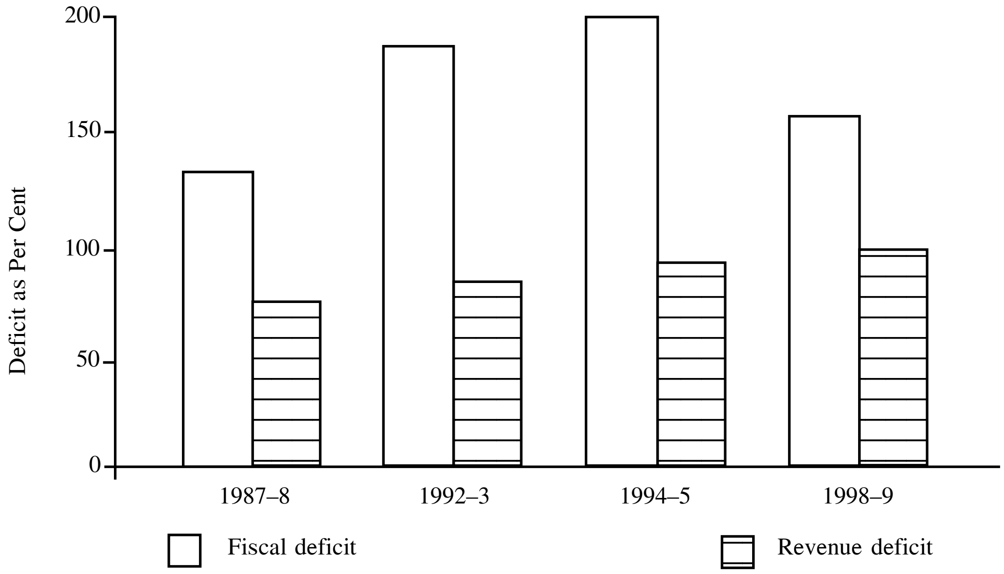

Figure 9.1: Subsidies and Deficits

Source: Table 9.1.

TABLE 9.1: A Comparison of Budgetary Subsidies: Selected Years (Centre and States)*

Year	Estimated Subsidies	Fiscal Deficit	GDPmp	Revenue Receipts	Subsidies as a Per Cent of		
					GDPmp Deficit	Fiscal Deficit	Revenue
1987–8(M-R)	42324	32182	354343	66838	11.90	131.51	63.32
1992–3(Tiwari)	95373	50726	748367	135422	12.74	188.02	70.43
1994–5(NIPFP)	136844	70062	1012770	178012	13.51	195.32	76.87
1998–9	235752	155760	1740935	274769	13.54*	151.36	85.80

Note: *Table 5.2 of Srivastava et al. (2003), p. 50.
Source: Mundle and Rao (1992); Tiwari, A.C. (1996); Srivastava, D.K. et al. (1997); Srivastava and Amar Nath (2001). Combined fiscal deficit taken from the Indian Public Finance Statistics (various issues).

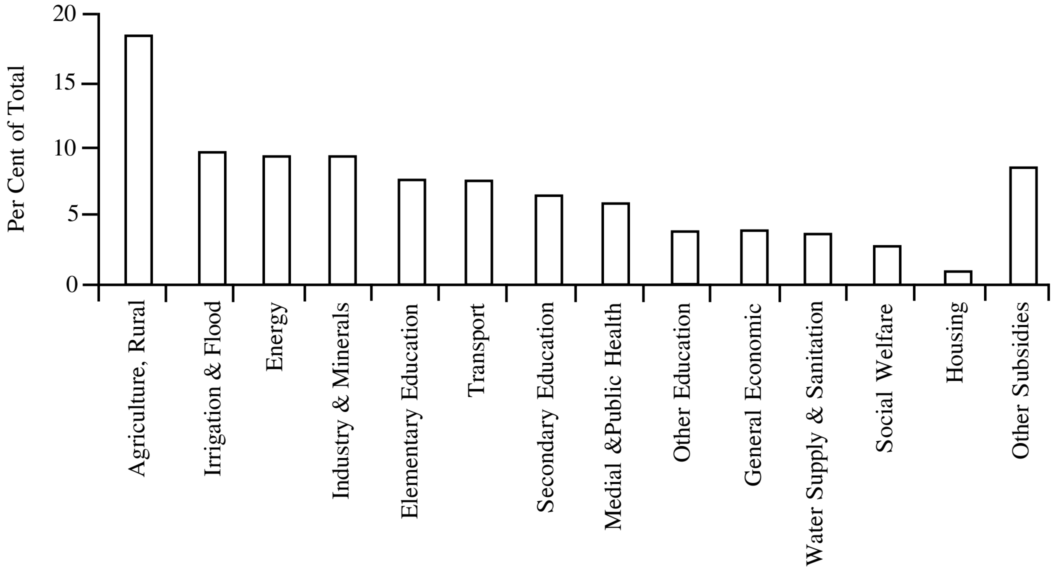

Figure 9.2: Sectoral Contributions to Overall Subsidies (Union plus State)

Source: Table 9.2.

sector in 1998–9 were estimated to be Rs 23,802 crore (Srivastava et al. 2003) (see Tables 9.1, 9.2, and 9.3).

Assuming that electricity subsides occur only at the state level, and nearly all of these are on account of supply to agriculture, the total budgetary subsidies on account of water (irrigation and electricity to farmers) is approximately Rs 23,802 + 15,115 crore, that is, about Rs 40,000 crore. In the same year (Srivastava et al. 2003), quoting GOI, reported the cross-subsidies in electricity to be about Rs 8000 crore, thus giving an estimated total subsidy of about Rs 48,000 crore on account of water provision to the agricultural sector. This as a proportion of GDP at market prices is about 2.76 per cent of GDP[5] (see Table 9.4).

[5] The Planning Commission (2002) estimated the subsidy to the agricultural sector on account of electricity to be Rs 30,462 crore. The gross subsidy including the 'subsidy' to domestic consumers was around Rs 43,060 crore in the same year. Much of the subsidy to households

TABLE 9.2: Relative Share of Major Sectors in All-India Subsidies

Sector/Head	Amount (Rs crore)	Share (%)
Agriculture, rural development, and allied activities	44568	18.90
Irrigation and flood control	23802	10.10
Energy	22927	9.73
Industry and minerals	22101	9.37
Other subsidies	19820	8.41
Elementary education	18606	7.89
Transport	17490	7.42
Secondary education	15214	6.45
Medical and public health	13740	5.83
Other education including technical education	10286	4.36
General economic services	8937	3.79
Water supply and sanitation	7734	3.28
Social welfare and nutrition	6391	2.71
Housing	4136	1.75
Total	235752	100.00

Source: Srivastava et al. (2003).

TABLE 9.3: Sectoral Shares of All State Subsidies

Sector /Head	Amount (Rs crore)	Share (%)
Agriculture, rural development, and allied activities	25380	16.28
Irrigation and flood control	23525	15.09
Other subsidies	18661	11.97
Elementary education	16291	10.45
Energy	15115	9.69
Secondary education	14147	9.07
Medical and public health	12259	7.86
Transport	9191	5.89
Other education including technical education	7319	4.69
Water supply and sanitation	7082	4.54
Industry and minerals	4999	3.21
Housing	1954	1.25
Total	155923	100.00

Source: Same as Table 9.2.

TABLE 9.4: Financial Performance of SEBs

No.		1996–97 (Actual)	1997–8 (Actual)	1998–9 (Actual)	1999–2000 (Actual)	2000–1 (RE)	2001–2 (AP)	'Growth Rate' 2001–2 over 1996–7 (% pa CAGR)
1	Cost of supply (paise per kWh)	215.6	239.73	263.05	305.12	327.16	349.85	10.2
2	Average tariff (paise per kWh)	165.3	180.3	186.77	206.98	226.26	239.92	7.7
3	Per cent of recovery	76.7	75.21	71	67.84	69.16	68.58	-2.2
4	Average agriculture tariff (paise per kWh)	21.2	20.22	21.01	22.61	35.38	41.54	14.4
5	Commercial losses (with subsidy, Rs crore)	–4674.31	–7597.95	–10508.8	–15088.1	–17793.7	–24837.2	39.7
6	Commercial losses (without subsidy, Rs crore)	–11305	–13963	–20860	–26353	–25259	–33177	24.0
7	Net internal resources (Rs crore)	–2090.7	–6209	–8954.4	–13316.3	–15620.6	–19103.9	55.7
8	Subsidy for domestic consumers (Rs crore)	4386.01	5258.43	6332.48	8121.11	10036.07	12238.51	22.8
9	Subsidy for agriculture consumers (Rs crore)	15585.2	19021.36	22473.13	24650.02	26950	30462	14.3
10	Subsidy to agriculture and domestic consumers (Rs crore)	20210.75	24749.78	29261.49	33144.68	37331.05	43060.1	16.3
11	Subvention received (Rs crore)	6630.6	6364.8	10351.55	11264.53	7465.33	8339.62	4.7
12	Uncovered subsidy (Rs crore)	5805.03	9374.16	10599.95	16616.37	24118.45	28976.92	37.9
13	Gross subsidy per unit of sales (paise per kWh)	75.4	87.25	98.81	110.98	118.57	126.62	10.9

Source: p.xv of Planning Commission (2002).

Large Costs to Deliver Little Subsidy

Subsidies to agriculture on account of electricity as reported by the Planning Commission have grown at about 14.5 per cent CAGR over the period 1996–7 to 2001–2. The compounding effect of price-based subsidies on revenues is indicated by the growth in losses which was at a rate of around 24 per cent. Given that over this period the average applicable tariff rates grew at a rate of 8 per cent (the realized tariffs grew only at 7 per cent) or more, which was higher than the inflation over this period, the losses unadjusted for tariff increases (resulting in increased tariffs for paying consumers) would have grown at a rate faster than 24 per cent!

The reported cost of supply is based on assuming that electricity losses cannot be recovered. Thus the cost of subsidization is growing at a rate of 24 plus percentage. The reported cost of supply is based on assuming that electricity losses cannot be recovered. Thus the cost of subsidization is growing at a rate of 24 plus percentage. The benefits derived by the farmer

may be fictional since the cost to serve for this segment (not the realized tariff) was close to or below the notified tariffs for the segment. Thus conceptually subsidies can account only due to the agricultural segment and on account of losses, theft and diversions. Thus the cost of agricultural subsidies is of the order of Rs 43,000 crore.

would be a small fraction of the same. Cost of supply to agriculture need not have been more than Rs 2.2 in that year [given that agriculture is typically supplied offpeak]. Hence the delivered benefits adjusting for the same is only Rs 30,462×2.2/3.50 which is Rs19,148 crore. Since agricultural consumption is misreported by at least 30 per cent the benefits adjusted for the same is no more than Rs 14,729 crore. Since about a third of agricultural consumption is wasteful and could have been avoided the actual subsidy benefit delivered cannot be more than Rs 9800 crore that is say about Rs 10,000 crore and hence about a third of the total cost of subsidy. In relation the total cost of subsidy attributable to agriculture is between Rs 30,462 and Rs 43,000 crore. The difference is an estimate of the fiscal gain that the movement away from price based subsidies to direct subsidies can realise. Price-based subsidies have brought about vast allocative inefficiency losses. Besides the large static efficiency losses, farmers and others using these distorted prices make incorrect investment and input choices. What is not often recognized though is that the underlying basis for the corruption and mis-performance of the state electricity boards also lie in the use of differential prices (Morris 2001c).

So intertwined are the issues of under pricing, subsidization and management, that attempts to reform electricity and water supply by conventional measures (such as privatization, unbundling, independent regulation distribution reform) have all failed or are likely to fail unless the overarching policy level infirmities are first removed, and policy is made internally consistent. (Morris, S: 2001c).

In canal water and publicly supplied water too it was in the era of redistribution (from 1964 onwards) that the prices began to get out of line with the costs (Vaidyanthan 2003) and over a period they generally do not even cover the O&M costs of water production and delivery'. (Vaidyanthan 2003; World Bank 1991; GOI 1992; World Bank 1998). Instead of prices being used to subsidise, defined quantities could have been given away while retaining the prices at the long run marginal costs Then the use, allocative, input choice and technology choice inefficiencies, that together have by now have become stupendous could have been avoided. That no other options than the bipolar one of removing the subsidies altogether or continuing with price based subsidies reflects a singular inability of the policy designers, for which it is unfair to ask the politician to take blame, since mispricing lies at the root of most of the other failures. The priorities for water development have got quite misplaced. Drinking and town use water which should have had the highest priority is sometimes even denied supplies since the administered low prices for such uses restrict supply expansion. The need for re-priotizing water use has been argued. Cf. Alagh, Y.K. (c.2003). We would content that prices must not contradict priorities as they do today.

STATEGY FOR ELECTRICITY[6]

The core of the approach is the movement from price-based subsidization to 'entitlements'. Price-based subsidization has the major infirmity that they rob prices of their crucial roles in the system —to inform the investment and input choices as also the direction of technical change. They are seemingly easy to administer[7] but only when the product in question cannot be diverted and has entirely inelastic demand—conditions that are rarely met. Indeed when different prices are used as in the case of electricity, the 'price arbitrage' diverting supplies from low paying customers to high paying customers (illegitimately) is what is at the root of corruption, the resistance to metering, the inability to hold anyone accountable to revenues. This is because the product (energy account) and the revenue account can never be reconciled. The feedback effect of this perversity

[6] We have discussed the reform strategy for electricity covering inter-alia the ushering in of market, how direct subsidization can be brought about to overcome the crippling distortions on the sector and the necessary regulatory strategy. This section is only a presentation of the core findings related to subsidies. See Morris (2002b) principally.

[7] Price based controls and subsidization could have been a short term measure in a national emergency at best.

has all but destroyed the state electricity boards (SEBs) and made them irreformable. Additionally the dysfunctionality of the interface[8] between productive public enterprise and the government in the operational decisions of such entities has been responsible for the poor management systems within SEBs.

It is useful to outline systematically the nature of the distortions that occur with price-based subsidization as is the case today. We may classify them into those on the user side and those on the utility side.

The following are the user side distortions:[9]

- Excessive and wasteful consumption by low-priced consumer segments. In the case of irrigation this is considerable since the marginal price is close to zero. Thus inefficient pump sets, poor associated equipment, inadequate use of capacitors resulting in very low power factor, all of which wastes energy is more the norm than the exception since these involve private costs and as long as the marginal price of electricity is zero there are no savings to be made. The collective gains in not wasting electricity also go unrealized since this is a common resource and there is no private incentive to save. Micro studies have shown that the possibilities of saving electricity in pumping operations are very large (see Reddy et al. 1991 for an early analysis of the problem. See also Sant and Dixit 1995 who additionally argue that tariff rationalization even by SEBs could have saved vast sums).
- Cropping pattern distortions since with horsepower (HP) based tariffs it makes sense to grow crops that are water intensive irrespective of the social (true) cost of the same (see, for instance, Singh et al. 2004).
- Input use distortions that arise from the above. Because of cropping pattern distortions, related input distortions such as in fertiliser use, in the use of water to destroy weeds, in using flooding rather than deep ploughing are all possible.
- Repelling the use of water saving technologies, especially in the drier areas since these costs have to be borne privately by the farmer while the incremental cost of extracting ground water is zero with HP based tariff. Thus attempts by government to promote sprinkler and drip irrigation systems have gone. Yet the social and private profitability had the price of electricity not been distorted is beyond doubt in the drier areas and in the case of water intensive crops (see for instance Narayanamoorthy 2004).
- Environmentally destructive practices: besides the environmental fallouts of the above, in areas of water scarcity the attempt at excessive drawl (above the rate of charging of the aquifer) would damage the resource, reducing its ability to store water. The overdrawl of water in water scarce areas is too well known and much of it can be attributed to zero marginal price of water. Salinity ingress in coastal areas of Gujarat and especially in Saurashtra are examples.
- With long usage of low-priced (or zero-priced) electricity, farmers get used to thinking of water as a free public good. Even policy-makers and politicians get used to the idea of subsidy being necessarily in the form of price differences.
- Attempts to bring about measurability of the electricity consumed, to meter, etc. are strongly resisted.
- Since output (agricultural produce) markets are competitive and not essentially subject to controls (except in a limited way in food-grains through the support pricing), the benefits of these low electricity prices when not wasted are competed away so that without the use of such low priced water, the farmer would make large losses, because his

[8] This is a problem common to nearly all public enterprises, and is the one single reason for the failure of public enterprises in India. For a discussion of the political economy of the interface between government and public enterprise, see Morris (1986).

business without the subsidy would be unviable. This is particularly true of drier areas without alternative sources except deep wells from which water is drawn with much use of electricity. In such situations, there would be much resistance to reduction in subsidy. Therefore an all or none situation is created. If farmers' say in a region or state are weaned away from distoritonary input subsidies they would not be able to compete with farmers in neighbouring regions where such input subsides continue (Pandey and Morris 2004). This makes the task of reform even more difficult.

- Where farmers are a strong group politically —as in the case Punjab and Haryana—the above would further consolidate their political cohesion around the subsidy so that programmes of phased price subsidy removal (when uncompensated with direct subsidies) become unrealistic or can be pushed only at great political cost to the party pushing for the same. Indeed all efforts at solving the subsidy problem other than the one which credibly converts current benefits to endowments would become issues around which political mobilization would take place.

The utility side distortions are perhaps even more important. These distortions result in a breakdown of the distribution business as such. They may be listed as follows:

- Low prices for agriculture create the need for cross-subsidization and hence high prices for other segments. Even with no other distortion, this reduces the consumption by the higher priced segments so that increased cross-subsidization takes place with the (increasing) reduction in the ability to cross-subsidize.
- The political temptation to indulge in cross-subsidization is strong since, while much political capital is gained, the ill effects take a much longer duration to reveal, and initially hurt only a non-numerous group. Their long-term consequences to hurt every one, including the subsidised sections, take place slowly but surely.
- The commercial departments of utilities face a range of prices, and the temptation to arbitrage the same is strong and often irresistible. With a few taking advantage of the same the practice can spread like wildfire since the arbitrage is large per unit of electricity sold, and can be used to soften up those resisting or trying to oppose the practice of condoning theft or conniving with theft (Morris 1999). Arbitrage of the price difference necessarily means 'theft', which takes place in connivance with utility employees, and is accounted as sales to the subsidised consumers or as 'losses'. Even where the above mentioned practices have not emerged or are restricted to a small part of the organization, the ability to account for sales revenue is lost without extensive metering at virtually all points in the distribution network (Morris 1999).
- The higher prices to the cross-subsidized segments (whose consumption is high but face competitive output markets—as in the case of the small industry) can result in evasion and theft by such groups. This is natural given that such firms lack market power. If neighbouring competitive firm indulges in theft, this one is forced to the same or get driven out of the market.
- Vastly lower prices for important segments result in shortages and the need for allocation through some administrative mechanism. Administrative allocation in the face of shortages can further accentuate the problem of revenue realizations. Shortages when attempted to be uniformly allocated (even when not perversely) have asymmetric quality effects across various uses. Thus while IP pumpsets/households may be able to 'bear' interruptions, critical processes in many industries would not be able to, so that in response to the interruptions they exit out of the utilities system to set up their own captive units. Thus multiple and parallel feeders,

single wire transmission, two and single phase transmission are taken up as 'options'. These amount to pathetic efforts to respond to the distortions caused by price-based subsidization, rather than removing the distortion in the first place. All of them are guaranteed to fail, or impose huge costs on the system (Morris 2001b).

- When the price for the segments whose long run price elasticity is significant rises beyond the 'stand alone costs', they would permanently quit the utility greatly reducing the cross subsidy ability of the utility. This in turn increases the prices for others, so that quitting the utilities becomes a mass phenomenon.
- When power cuts have to be imposed, certain essential services hospitals, railway traction, electricity companies, telephone companies would have to be provided electricity. This creates the need for parallel and additional feeders/dedicated lines, etc. Soon enough demands from VIPs and others emerge. To accommodate these and others and to manage the shortages, the demand for additional feeders and lower level control over the feeders emerge. Besides raising the cost of supply and operations, this also creates and makes possible a 'politico-administrative' mode of operations that has little reference to the commercial and revenue realizations aspects except in a perverse manner. When such a culture gets entrenched the opportunities for revenue and contributions through appropriate scheduling (such as purchasing even 'expensive' power as long as the unit realization is higher to serve paying customers) would be missed.

The Only Option

The necessary reform without which no other measure would deliver the system from its continuing losses is direct subsidization. What we propose is very different from the direct subsidies proposed under the Electricity Act 2003.

In its essence the only option possible today would be to institute direct subsidization in the sense of the subsidy being handed over to the farmer in the form of electricity stamps or coupons through a well-crafted system. The key aspect of the system would be to work out the actual realized transfer benefits under the current system (which are quite small in relation to the actual losses incurred—now more than a third of the current losses incurred, as brought out earlier) and to hand the same over in the form of entitlements, and move the prices immediately to reflect costs. The farmer uses his entitlements to pay the distribution entities. Distribution companies accepting such coupons can then collect cash from the government. Then the marginal prices are right even if the average prices for consumer groups are far from the marginal. Since it is the marginal prices that decide the allocative, input use and technology choice decisions the system does not move far away from optimality. And absurdities like production of water intensive crops in areas of water scarcity, attempts to control through two and single phase supply[10] or investments and R&D to use/find ways to convert single or double phase electricity supply to three phase on the part of farmers, or the repulsion of water saving technologies and investments can all be entirely avoided (Morris 2001a, 2002b).

When tradability (without any restrictions and sometimes with local area restrictions) in the entitlements is allowed the system moves to a situation where all distortions other than the 'first order' of transfers (that identified in comparative statics), are removed. Complete tradability would remove even this one but then the subsidy is no longer a production subsidy but an income subsidy. Sometimes it may not be desirable to move altogether to an income subsidy, in which case there would have to be limits to tradability. The principal insight is that in subsidization there is no need, or it is entirely dysfunctional, to change the marginal prices from their true values.

[10] Other such measures include phased power cuts, regulated hours of supply, supply at low frequency, etc. All these administrative measures with the passage of time create further distortions and increase the line losses.

The Steps in Direct Subsidization of Electricity for Farmers

We may list the sequence and elements in the institution of a direct electricity coupon based system for farmers:[11]

- Announcement by government at the highest level that farmers would not lose is necessary.
- Getting the farmers agree to a subsidy scheme that is non-distortionary and can save the government and the economy money over a five-year time horizon, and has the support of farmers. Direct bargaining of the government with farmers groups and lobbies would be necessary.
- Announcement of a direct coupon-based subsidy scheme.
- One time identification that fixes the endowment as a function of operational (owned) holdings, whether BPL, access to canal irrigation and region, and such other criteria which farmers themselves can decide.
- Separation of the identification exercise from the issuance. This unbundling is necessary for correctly targeting the beneficiaries.
- Identification process can be made entirely transparent, through an open and iterative process, so a self-generating and self-correcting list of beneficiaries is possible. Thus a taluka/block level listing of endowments due to each farmer can be put up for public scrutiny and reactions.
- With such cards the coupons can be issued routinely through post offices and bank branches almost as easily as banking instrument are handled.
- Tradability of coupons would render the design of the system simple enough. If no tradability is desired to keep the subsidy entirely a production subsidy then a more involved design of the coupons that links each issued coupon with the person to whom issued would be necessary.
- Coupons would have to be on security paper and have completely unique numbers and identification. Carry over limitations can be imposed. Government itself can trade in the coupon market.
- Cap on subsidy is easily imposed and that would define the number of coupons.

[11] Taken from Alagh, Morris, and Parekh (2004).

Fiscal Feasibility Exists

In 2001–2 government expenditure on subsidy in the form of subventions was Rs 8339.62 crore leaving an uncovered subsidy of Rs 28,977 crore on account of both domestic consumers and farmers. The subsidy cost to the agricultural sector was reported as Rs 30,462 crore. Our rough estimates of the benefits delivered to the farmer is of the order of Rs 10,000 crore. Even if Rs 20,000 crore per year is put up in the form of electricity coupons it would lead to much social and fiscal gain since nearly all the distortions mentioned before can be avoided.

The proposed identification is a one time activity and involved no repeat work. As such it demands that the government is 'good' only once and not all the time. It is therefore light on governance. Once such a scheme is implemented nothing more is required. It unbundles the 'problem of reform' from the problem of subsidization. It amounts to 'right subsidization' rather than removal of subsidies so is farmer friendly at a cost with an upper bound to the government, which is no higher than current costs. Later other subsidies such as fertilizer and other farm subsidies could be bundled along with electricity subsidies through more general coupons issuance that allows the farmer to lay out the coupons on any of these inputs.

THE CHALLENGE OF IRRIGATION

Vicious Circle of Low Prices and Inefficiency

Subsidies under the head 'Irrigation and Flood Control' had been estimated to be Rs 23,802 crore in 1998–9. They constituted 10.10 per cent of all India budgetary subsidies. The state governments incurred as much as Rs 23,525 crore of these subsidies which constituted over 15 per cent of all budgetary subsidies of the state governments over the same period (Srivastava et al. 2003). Today in many places full cost recovery that includes the capital charge even at these low depreciation rates has for all practical purposes been given up, and it would be a major victory to even recover the O&M costs in full. Irrigation is almost entirely a non-merit good and does not suffer fundamentally from excludability problems. Both traditional systems as well as the systems created by the British were based on full charges. In the case of most projects, the problem with irrigation has been that the scale and of construction has been far larger than possible through private initiative without concessions, and the charges at commercial rates of depreciation (in keeping with the borrowing tenures of capital markets) would make the water much more expensive than its economic price since asset lives can be very large. Recovery rates close to 100 per cent or better were much the practice even in post-independence India. It was during the 'redistribution era' from 1964 onwards (Morris 2003) that recovery rates began to decline (Vaidyanathan 2003). Today recovery rates are absurdly low resulting in a situation where maintenance is grossly neglected, there is little resource to add fresh capacity and much of the expenditure of the ID is spent in covering salaries (World Bank 1998b, GOI 1992). Notice from Table 9.6 that the recovery rate has been under 10 per cent in all states and in most states under 5 per cent. These are very poor rates for an eminently appropriable good used as an input in agriculture. They are lower than in the case of poorly appropriable goods such as education and sewerage and sanitation services!

The World Bank noted that:

> Common physical constraints include, in particular, inadequate maintenance, resulting in progressive deterioration of the surface 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, viz. farmers. Further, there is no direct link between the irrigation service provided, revenues generated, expenditures, and staff incentives. The state IDs are traditional government departments which in most cases have changed little over time .... The main financial constraint are firstly, low water charges, requiring continual subsidization by state governments of operations and maintenance (O&M), and the entirely of construction, and secondly, partly as consequence of the weak revenue generation, persistently inadequate allocations for O&M, most of which go for staff salaries leaving negligible amounts for actual maintenance works. Finally incentives for efficient use of water are largely absent. Surface water charges are in addition to being low based on area rather than charge volumetrically, and electricity for pumping is also heavily subsidized on a fixed rate basis.

The problem with regard to irrigation and especially the ID could not have been better summarised. As a framework for reform the report called for a change from the vicious circle to a virtuous circle, with the key being the need to change 'the incentive structure both at the level of the service provider (the present government monopoly) and the client (farmer)'.

Elements of the Strategy for Irrigation

The key action that would make the reform in the direction outlined above possible is non-distortionary subsidization of electricity to farmers and of surface water supplied. The case of electricity has already been considered. Raising water charges is the key change without which all other changes would either be nullified or would not be possible. Thus on any extensive scale private funds or market borrowings would not be possible unless the revenue stream is set right. But raising tariffs is not politically easy since around 60 per cent of India's population is involved in agriculture and the market for votes is important. We argue quite like in the case of electricity that the key is to right structure the current subsidies that are implicit in the low charges for water as endowments while raising the water rates. This in changing the allocative price of water would bring about much user efficiency.

'Leverage Point' for Change

The improvements to the system which can result in additional supplies when valued at these higher prices of water should support private/commercial investment with expanding supplies. In other words if the actual delivered benefits to farmers can be protected and in a way that removes all distortions to the judicious use of water then the reform on the utility side would be meaningful. A strategy for a paradigm shift is more than a laundry list of the problems or even of what needs to be done. The strategy has to articulate the 'linking pin' as it were or the 'leverage point of change' (Morris 2002a) which is crucial and necessary for success. In that sense right subsidization is crucial.

Thus it is easy to say that maintenance expenditures should be a priority, but within the government maintenance cannot become a priority unless the budgetary processes are changed. Current process in creating a link between accessing Plan funds and fresh investment creates strong incentives to put up projects on the part of parastatals and departments of government to pursue new projects rather than worry about maintenance since they come out of non-plan funds where there is little or no leverage (Mitra and Pillai 2003, Sen 2003).

DISTORTIONS ARISING OUT OF LOW TARIFFS

Inefficient water use for the reasons that the marginal (allocative) price (as sensed by the user) is low brings about much demand for water pushing certain basins to the limits of the capacity that can be sustainably tapped. The difference between the conjunctive demand for water and the gross water supplied by irrigation is far too large (Vaidyanathan 2004).

There is large scope for efficiency if farmers see the correct marginal prices that not only reflect costs but also in some manner (especially in water scarce areas and where the resource has been tapped at close to sustainable capacity) the scarcity so that such regions have a higher incentive to conserve water and make investments in water saving technologies than other regions. Subject to feasibility and benefit exceeding cost, such regions could then place demands on import of water. With only one kind of response from farmers (the clamour for more water because prices are very low) giving way to many possible responses the options to converge to socially efficient solutions would be revealed.

The problem of pricing of water provided from publicly owned systems and of electricity used in pumping up groundwater are interrelated. This aspect is not understood or given due importance in the discussions that bear on reform and change. A rise in electricity charges without a rise in the tariffs for water creates major distortion between groups of farmers especially when they are not too far from each other and one group does not have access to the canal water. Similarly, if water rates for surface irrigation systems are raised steeply they would be incompatible with continued HP-based tariffs for electricity. This situation does not justify non-reform but calls attention to the need for interlinked solutions. In both cases the subsidy actually delivered to the farmer would have to be retained to get the farmer's agreement and support to reform without which reform (cosmetic changes and tokenism apart) is not really possible.

From (Price) Tariff Distortions to Endowment Based Subsidies

Consider a farmer who today gets an allocation of water W at a tariff P_o which is far below the cost of production of water. Let us say that he is now charged P_n which is the long run marginal cost of water production, while the subsidy inherent in the earlier scheme $(S) <= W*P_m\text{-}P_o$ is made available as an endowment. He would sell more water to result in greater total output, and he as also the farmer who was earlier out of the picture now get water. Interestingly the gap between this situation and the earlier one of low tariffs is very large when trade is not possible in the first situation. This is so when the earlier supplies are based on land possessed at some time in the past, and are not entirely separable from the land holding or the operated holdings.

Let us presume that the allocations in the earlier situation are all fair and without bias to all farmers in the ayacut/command area and originally reflected the optimal (given the relative prices of a variety of crops, their other costs of cultivation, and requirement of water). Then the quantities allocated would have been in consonance with the condition of ($f1_{w1}(I,W1) = T1+P; f2_{w2}(I, W2)$ etc.), where $f1$ or $f2$ are productivities that are functions of water input *(W)* and other inputs *(I)*, and the above are marginal productivity of water.

But the fact of variations in other factors such as land actually available at any time with the farmer, the family labour that he is able to bring (which tends to have a low/zero marginal price when there is disguised unemployment), his ability to carry out cultivation due to changes arising out of other income possibilities, changes in the production function of crops which happens all the time as new varieties are introduced, the relative effectiveness of other inputs changing, all would demand flexibility in the use of water so that the social optimal within the ayacut/command area is maintained. While tradability may not be sufficient in all situations to maintain a state close to the optimal it is a most necessary condition. Almost all the case studies that have examined the cropping pattern and the changes in cultivation more generally, once (more efficient) WUAs begin to function, have drawn attention to the major changes in cropping patterns, efficient use of water by the individual farmer, and enhancement of the area irrigated. Most of these have happened because the WUA is able to bring about a change in the (implicit) allocative price of the water shifting it closer to the marginal return from water. This happens because the individual information of the farmer gets channelled for the collective good (Vaidyanathan 2003, World Bank 1998b). The earlier disincentives against worrying about inefficient use by a close-by farmer is reversed being counteracted by the gain the farmer can make if other farmers are pushed to efficient and non-wasteful use. Explicit tradability could do the same. But tradability without WUA could be less egalitarian than allocations under WUAs that are active.

Recognizing the Value of Collective Monitoring

In irrigation-water provision by central especially public or large producer, the costs of supervision by the supervisor to ensure strict adherence at the farm level of water drawn, etc. would be too large. Adherence is then built in through strict and large punitive measures. When overdrawl for example is noticed, and such punitive measures are in place for long enough periods only, then would farmers have been 'trained' into the right behaviour. Alternatively, if the private information of each farmer can be brought on to the problem, which happens when the WUA structure is created the farmer sees some other farmer's over drawl as implying less being available to him.[12] This means

[12] An important aspect of agriculture which systematically continues to be ignored by the planner is the role of specific information. The farmer to maximize his profits (or more typically to maximize the value-added from the farm in peasant economies and systems) can never be on clock time. Someone has to be on job time, that is, all the time. Even when the farmer sleeps he cannot avoid responding to the hail or to other sudden changes in the weather. His acumen and dedication in early detection of pests and diseases is important to their control. This is what makes the economies of owner supervision most crucial. Corporates or other organizational forms would have to face the great challenge of developing the incentive and management structures and processes that can handle such exigencies. Hence, even though the scale economies arising out of the logistics is very large, and other marketing/branding economies are also large, contract farming is the more successful form than direct cultivation by corporates. Plantations under corporations have been successful only when they did not have to face competition (or such competition could be pre-empted) from individual farmers. So large are they that services with scale economies like marketing, irrigation and water storage, all have taken forms that do not intrude into the owner supervision aspect

self-regulation. This comes essentially from the water company—farmer relation being translated into a farmer—farmer relation. Since there are other gains too from better management which involve common gains but mean private or partly common costs, a cooperative structure once formed and trained, can sustain itself. Hence the particularly large value of WUA especially in the management of the distributaries and in water distribution given a total supply from the bulk water company irrigation department. Thus there is no denying the opportunity to push for water user associations, create appropriate frameworks that encourage farmers to come together in WUAs.

WUA do not Take off

WUAs have been pushed in various ways and have been under active promotion for over a decade. Where they have taken root the social gains have been large, but they have taken root in few places and even today in barely 12 per cent of the total area under irrigation have WUAs been formed. Limitations within the irrigation department to take up a complex activity that is not linearly or sequentially achieved and, what is critical, involves overcoming the free-rider problem in the formation of the WUA, explain the rather limited success in this area. Governments everywhere would not be able to shoulder a task inherently complex and not amenable to rules or agreed processes. Recourse to NGOs too would not be a solution to multiplying the number of WUAs, since an activity like formation of a working cooperative to enhance gains is tremendously intensive in leadership and organizational capacity. But we suspect that the very slow growth of effective WUAs despite notable successes elsewhere and the demonstration effects of success may be pointers to possible difficulties arising from infirmities in the design or policy. Questions that come to mind are: Are the benefits/power to control the WUA (voting rights) flexible enough to allow for a certain degree of inequality that is required for the functioning of cooperatives and associations? And have the formal rules of constitution and management enhanced the free-rider problem instead of lowering it? We do not know enough about WUAs to answer these, but prima facie the one farmer–one vote rule in the election of members as office bearers of WUAs would indicate that an unnecessary egalitarianism may have maimed the prospects of WUA in the country. The larger problem is that cooperative solutions require continual exercise of leadership and energies being spent, so that their ultimate replacement/evolution into property rights, rules and possible markets is desirable and the design should lead to such outcomes.

For the Indian situation the more important issue is that they have not come up in numbers. So even though they are most desirable, a perhaps less desirable but eminently multiplicable model/s which does not have to overcome the large free-rider and associated leadership problems would be necessary as one more of the possible alternatives to reform. In another sense too this is desirable. As the development of the market economy takes place the role of private property gets entrenched. And this does not happen without a destruction of most non-private especially community 'property' and custom-based perhaps contingent rights to property or to the uses of property. In that process very functional systems and commonly understood rights such as community rights over commons, community management of certain resources like fishing grounds, water bodies and irrigation systems developed a long time ago, etc. when not recognized or ill-recognized by the new paradigm of capitalism, would be lost.[13]

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of farms. The large economies of owner supervision arises from the absence of the agency problem and the value of specific and local information, and information generation itself to farmers in the cooperative-competitive relationship with each other. Ignoring the economies of owner supervision may have been at the root of the failure of Soviet farming.

[13] The enclosure movement described by the classical economists and important in understanding of the transition from feudalism to capitalism is perhaps archetypal of such a process from the first industrial nation—England-itelf. For the case of Russia see the descriptions of the decline of the 'Obschina' in Lenin, '*The Development of Capitalism*

The Tragedy of Tank Irrigation

The problem of tank irrigation is essentially this. If the new paradigm is unable to create the special spaces for such properties and rights (and limitations) of use, there is of course much loss of well being and suffering. And if this has gone on long, attempts at revival purely on the basis of the old models, may be still born. New designs that are clear, formal, and less dependant on continual exercise of leadership or decision-making are necessary. They would have to be attempted, even as one builds on the features of the old rules and systems that are still functional. Thus any attempt to reform the tank-irrigation system of South India would have to also recognize the private rights to groundwater in some constrained form for optimal management of the ayacut and the reservoir. Tank irrigation has been on the decline in South India which is being plagued by problems of poor maintenance and low involvement of the beneficiaries (SANDEE 2004, GoTN 2002, Shankari 1991).

The HP based tariffs for electricity which at very low or near zero marginal cost make it possible to derive the benefits of groundwater and hence tap into the positive externalities of tanks privately may have been the most important of all reasons for the decline of the common property institutions of management of tanks. This aspect is strangely not as widely recognized as it should be, despite the large literature that points to the substitution of tanks with borewells and wells.

The Problem of Water Rights

Water rights in pre-capitalist societies, before significant tradability of grain and other products of water was possible, were naturally defined in terms of right to self-use, without necessarily clarifying that the right to use is constrained (not for commercial use) or that it also included commercial use. Additionally, the issue of negative externalities in the use of water were largely local and could be dealt through custom and well-understood but perhaps not formally defined rules. Today, the use of water is far beyond the survival needs or for subsistence agriculture. The products/services of activities where water is a significant input which are eminently tradable—food grains and other agricultural products, electricity, water intensive industries use a significant part of the economy. This means that the rights to water have to explicitly take into account the commercial uses of water. Similarly, there are uses for water that return less water to the ground than others. These aspects need recognition in the definition of water rights so that socially efficient and feasible pricing which can emerge out of such water rights can be pursued.[14]

The Contingent Basis for National Optimality

The gains from the pursuit of a nationally optimal water development strategy are particularly large in India. This is because the rainfall is intense over the monsoon days which are bunched over a couple of months in most states and, except in the

in Russia', Progress Publishers, Moscow. Much of the enthusiasm about common property institutions for a variety of problems is quite misplaced in this regard. Not only as mentioned here they go against the tide but involve large resources in leadership to fructify. Thus to the problem of poor city services, citizens' organizations are suggested as a remedy which itself would be a common property requiring the free-rider problem to be overcome. The property rights approach linked to regulation of private business that uses the private information of those who own the common property (have recourse to the same) would be far more fruitful.

[14] This is of course easier said than done. The conflict potentiality is large especially in societies with enclaved development or much inequality in income distribution. Thus both African and Latin American societies show much conflict over water rights. Privatization in some countries has brought about the danger of monopolization of water rights (Boelens 2003). This was also noted by the World Bank (1998a), for instance, in Chile. Large income inequalities by bringing the inelastic consumption needs of the poor in conflict with that of the rich, creates a difficult situation and the role the state plays can in some situations instead of mitigating the problem leave marginal groups devoid of their basic rights. In societies with egalitarian income distributions and which have grown rapidly (typically the East Asian tigers), the state has monopolized water, and through its plans, investments and allocations ensured basic access to all of water.

southern tip and the north east, is limited to about three months in the year. Therefore the required storage is large relative to the annual use of water. In addition large inter-year variations, and interregional variations mean that the returns to transbasin and inter-subbasin transfers are substantial. Historically too, India was always a hydraulic society and the high density of population in India was always based over control and storage of water. That need is now enhanced with higher incomes (which develops the commercial need for water) and a large population. Further expansion of water resources necessarily mean its efficient use (well understood in the debate but not realized in practice due inter alia to mispricing) and what is not so well recognized, the need for national level optimality in the planning of water development and the linkages between prices, planning, and demands for water.

Water in India is a state subject. This per se is not the problem. But the attempt to develop certain large river systems on the basis of a basin and transbasin level optimality without clarifying the constitutional and legal basis for the same is at the root of the interstate water disputes that hold back exploitation for decades. The current arrangements have their basis only in contracts and the ownership (central and shared) of the underlying assets that store and manage water and not fundamentally in the water rights and the constitution, and as such are subject to the political push and pulls on the executives' decisions making process. A judicial/commission overlay of the process in the form of the 'tribunals for water award of the waters of a system (basin) that is interstate' is not adequate enough as the recent experiences of state governments attempting to cancel their agreements with other states would show. Even more than the reluctance shown by certain states to adhere to tribunal awards, the awards themselves may not be based on a true intrabasin optimality. The right aspect rather than the efficient use aspect would have had the larger bearing. In any case there is no framework to ensure optimatilty of use in the transbasin case.

Water is Also An Economic Good

Compounding the problem greatly has been the limited (pre-commercial) basis of the definition of water rights. The rights of a state are to use, but not to sell. The right when necessarily including the right to sell, has the potential to move the system closer to the transbasin and intrabasin optimal use, since a state/region currently not using its allocations could earn out of its sale of water or water rights. And the (perverse) incentive therefore to use/inappropriately develop, however inefficient these are (in relation to alternative development or use of the same in other states/ areas), would to that extent have been attenuated. When the right to sell across the state exists, and marginal (allocative) prices of tariffs reflect the cost of generating/making available water right down to the wholesale and retail levels, states would see water as being fungible with revenue.

Tradability and Water Rights

With direct subsidization, if currently inefficiently used, water can be traded transbasin, and the gains accrue to the farmer who reduces his consumption, then a political basis for transbasin or intrabasin transfers would have been created. This would mean that endowment coupons could be traded transbasin or over the basin and not just within the command area of a project.

The inefficient farmer in the better endowed areas would have to reference his use of water with respect to the market prices whether or not he bought the water, or he had been endowed with the same through a subsidy scheme. This would in a major way change the behaviour of states in water negotiations. States with water deficits but with high marginal product of water (in part arising from their greater availability of land) would be able to bring to the table this higher marginal product to bid high royalty payments or prices to get the water.

Negotiations under the current framework wherein water rights are incompletely defined necessarily make the parties view the outcome as a zero sum game, when indeed with a correct definition of the right to water, their approach could have been much that of developers. States with large water resources would attempt to develop the same, with the intention to sell the same through long- and short-term contracts. While this has happened to a certain extent (especially in the development of hydropower), they have generally been imposed from above by planners and the centre by appeal to, and in, the national interest. Typically, the states allowing use of the waters of its rivers have gained little while others receiving the waters have gained much. The gain of the state giving up water arises only on account of the larger central funding of its water development. Rarely have benefiting states funded projects in other states giving up water. This implies that the optimal is rarely pursued systematically. The asymmetry has stood in the way of interbasin and particularly transbasin optimality.

Avoiding Monopolization of Water Rights

One of the arguments against tradability in water rights is the possible emergence of monopoly control over water. Monopoly of course need not hold back either appropriate pricing or tradability. There are possible checks to monopolization of water that can accompany when tradability is introduced as was the case in Chile (World Bank 1998b). Conceivably several possibilities arise. In a situation where there is limited potential to transfer out the water from within an area (a command area or an ayacut), and the traded prices are reflective of the marginal product of water, and there are no substitutes such as groundwater, the water rights, holder in the ayacut could extract a large part of its scarcity value in the form of rents. This can happen when the rights are tradable and persons with large financial resources could buy at current market prices the rights and then enhance their prices given monopoly/high market power through control of the supply. If supply elasticities are large in this situation and there are no entry barriers to water development the ill-effects are temporary and muted since the supply can expand until the marginal product approaches close to the cost of water provision. But this may not be feasible or may take too much time to be of much solace to the farmer, so the assumption that the marginal product of water would be significantly above its cost of production is a reasonable assumption to make not only in water scarce areas, but also in the situation of under-development of the resources.

To guard against cornering of rights, the rights to trade have to be circumscribed in interesting ways by which the value of water rights (and access) can be derived only by farmers and others who cannot garner the same easily. Thus if the rights are permanently vested in the farmers who enjoy endowments and cannot be reassigned without a formal process similar to that of sale of agricultural land and inheritance, but the water use coupons issued, say quarterly, can be traded, then the possibility of cornering is limited to the flow of water over a limited period. Since nobody can buy coupons much into the future the possibility of cornering water for extended periods is remote. Nevertheless, the value to cornering the coupons that allow access during crucial months of the crop cycle is large, such as in drier than usual month. This can be avoided by linking delivery to operational holdings initially within the ayacut and later across larger parts of the command area. The fact that the enforcement of the water quantities defined by the coupons cannot be done without the explicit cooperation of the farmers imposes limits to the ability of outsiders to extract the scarcity value.

Organizational and Design Problems in Government-Owned Projects

Except for a miniscule part of the water development, and that too in recent times, much of water development has been almost entirely with the government. While coordinated and optimal water development is hardly possible without the involvement of the state, the role of the government has gone far beyond planning or regulation to design, project implementation and construction, and operations. The private sector's role thus far has been limited to provision of construction services with the private party typically bearing only the construction risk.

Massive Delays and Cost Overruns

Few projects have been turnkey or in few packets, but have typically involved discrete contracts, with the task of project integration and the risk arising out of the same lying within government. Delays and cost overruns in water (hydro and irrigation) have been extraordinarily large and been the highest for any sector. The cost overruns here have exceeded over 100 per cent and time overruns have been even larger (Morris 1990, 2003). The policy and legal infirmities with regard to land acquisition have been important but not the only factor in these delays and cost overruns. The financial constraint—actually arising from the tendency to spread thin the resources over a number of project rather than focus the same over a more limited and feasible set of projects—is a major reason.

When the construction project implementation and maintenance are separated, as is the case today, there are large perverse incentives on the part of the private party to cut corners on quality and quantity. This is compounded when government procurement does not give adequate weight to past performance or allow reputation to have a significant role in procurement. The possibility of long-term relationships of construction contractors with government is almost non-existent given the L1 criteria without the adherence to other practices that would have made L1 functional.[15] Procurement problems are rampant (Pandey 2003). Even a small improvement as in the case of the construction contracts of the National Highway Authority of India for the NHDP (the Golden Quadrilateral) where even a small improvement was able to bring much functionality and insulation from poor maintenance is illustrative (Rastogi 2003, 2004).

A reservoir/hydroresource being in part an 'experience good' and in part a complex entity like a power plant cannot be procured in the same way materials are procured. Thus, whether or not the setting of concrete has been as per design in all portions of a dam can be revealed only with use. The monitoring costs are high and motivation is less in the current systems of procurement. Even changing the procurement of the public works department (PWD) to more rational measures and processes, such as specifying the necessary certification by independent engineers, allowing a higher weight for reputation, using the prior information on performance of contractors across a number of government departments, not allowing the same contractor to operate under different legal entities, and following many of the tenets from good public procurement practices can ensure far better results.

Multiplying Risks

An associated problem with government procurement today is the numerosity of the packages that are awarded to the private sector and generally there are many private parties that are expected to work together. While in the contract the relationship of each contractor is with the government or the parastatal, in reality there would be umpteen points of contact where coordination between the parties would be required. These coordination tasks pose large risks. The scope for parties to take shelter under the non-performance/delay of another party, and situations compounding delays and cost overruns are many. The government/ parastatals in taking all residual risks in construction would actually end up bearing much of the construction risk. The adherence to L1 without adherence to other concomitant safeguards, as argued above creates a higher probability of the winner suffering from 'winner's curse' and therefore having a strong tendency to cut corners or corrupt the procurer. Excuses for non-performance and delays can be exploited to shift risks and costs on to government. This compounds the risks that the procurer bears on construction and project implementation. Hence it is not surprising that the very best of parastatals

[15] For a detailed discussion of the problem of public procurement in India, see Pandey (2003).

of the government and large private groups, whose consciousness of costs is not in doubt, whose project implementation capabilities are very good, and who have had much experience, have moved over to turnkey assignments or to fewer packets. Thus both Reliance and the NTPC follow the policy of fewer packages with clear demarcation of tasks and responsibilities, greatly reducing the project construction and implementation risks. Coordination risks and monitoring costs being intangibles are not recognized in government budgeting processes, so that the gains that are possible in terms of manageability and reduced risks are lost in the pursuit of and an inappropriately specified L1. Other extraneous criteria such as breaking up the packages into small size to encourage smaller construction firms, preferences for local parties, not penalizing poor performers, ignorance of private information about contractors that have much value in predicting performance, involvement of multiple committees in the tender process, imposing large bidder-side costs are all elements that bring about failure in the procurement process.[16]

Government departments including the ID are incomparably weaker in their procurement as compared to PSUs like the NTPC. They have lower capacity to monitor, or to lay out tasks in such a manner as to reduce coordination and define these tasks in contracts. Most important of all they are subject to strong pressures to get going with the procurement/construction even when all the loose ends have not been tied. The best and easiest way forward would be to necessarily link maintenance with construction and project implementation through appropriate PFI forms. If indeed the government can boldly go with design, build, and finance (DBF) or even design, build, finance, and operate (DBFO) option, the latter with either annuities or user charges or both, then bulk water development can take a big leap forward. The current fiscal situation additionally provides strong imperatives to go in this direction.

[16] These are quite widespread in India. Responses to poor performance have further compounded the problem by building multiple layers of decision-making, imposing (ritualized) monitoring and enhanced reporting requirements, and detailed prequalification requirements have only added to the bidder side costs and uncertainties. The Controller and Auditor General in his several studies have brought out some interesting ways in which L1 parties gain through ‘adjustments’ of work quantities, besides the usual ways of cheating on quality and quantity (Pandey 2003). Real reform can come only from more appropriate designs and rules such as the use of independent engineers, bundling construction with maintenance, use of more turnkey forms, etc.

FINANCING WATER DEVELOPMENT

The DBFO Option

With fundamental problems of contracting and limited financial capacity, the DBFO option would have much use as a vehicle for organization and institutional reform of the ID. In the DBFO option the private sector is brought in as a developer and its responsibilities include the design (subject to approval by appropriate technical authorities/regulator), construction, and management of water projects. The output of bulk water and hydropower projects is relatively easy to specify so that a private finance initiative (PFI) that is DBFO in form is most appropriate. Thus instead of building a dam and operating the same the government could specify the water requirements as a function of rainfall pattern over the months, giving appropriate values for fungiblity between months, and at sluice gates/or at various points in a command area/the electricity to be generated both gross and net (in case pumped storage facilities are being contemplated), the values for trade off between electricity and irrigation in case of multipurpose projects, the siltation rates, etc. It may still retain control over the project site though even on this the options for the project could be previously sounded out with the private sector since there are always aspects of the site that are not known in advance.

The risk of geological and topographical surprises although they ought to be minimized by the government by carefully crafted surveys (or through independent contracts with the private sector), since the impact of such surprises is on the construction cost, they ought to be made on account of the party that is involved in the design and construction. The aspect is better considered as involving diligence by the private party, hence is best handled by the builder. The total (systemic) returns to the increased costs of proper topographic and geological surveys would be most certainly positive.

Annuities

If the project is based on annuities (so much for unit quantity of water) then the demand risk is being borne by the state. On the other hand, in projects where the private water developing party is expected to earn revenues from water distribution companies/or from farmers for water sold at regulated prices (price cap for instance), then the demand risk is borne by the private sector. In this case the capacity decision of the project has to be on account of the private party. Otherwise the state would have to take off a certain quantity of water, and in case there are surpluses (purchases are smaller than capacity output) the government would have to be ready to pay for the availability whether or not it has use for the same. Where the capacity (and hence the basic design) of the project is determined by the state, the demand risk too is better borne by the state. The option of the state carrying out the operations (allocations, supply and inflow decisions) while the private sector carries out design, construction, and maintenance is also worth considering. Herein the state would have to specify the capacity of the reservoir, associated equipment and the availability norms, the standards of maintenance including the maximum siltation rates (when the control over the catchment area is with the private party).

Public 'Comparator'

The costs of such an approach would seem to be large if the government were to do an ex-ante comparison of the PFI approach with construction using the existing system and processes. But such a comparison would be quite misleading for the following reasons:

- The coordination risks that the government bears in the current system are entirely excluded, but would need to be estimated and accounted for. If this is actually carried out using past data, then on that count alone the ex-ante costs would have to go up by 50 per cent or more.
- There is perversity within government departments in attempting to understate the costs, with a view to show improved viability of projects so as to access funds from the exchequer and from such sources as the Planning Commission. There are very large perversities in the capital budgeting and expenditure processes within government that would make project reports based on which projects are cleared within the government suspect.[17] The involvement of the multilateral agencies in funding is known to have improved matters somewhat especially when their role is large. But because the government typically bears the risk and gurantees the loan from the MLA, MLAs have only a limited incentive and concern to improve matters, certainly not to bring about major changes. Since there are many ways in which project costs ex-approval can go up, project evaluation within the government is little better than a farce.
- Additionally the cost of the service per unit of output, *ceterius paribus* would appear to be higher for privately funded projects on account of the limited period over which funds are available from markets to which the private party has access.[18]Thus if debt can be raised only up to say fifteen years while the life of the principal assets of the

[17] For an overview of the perversities in the expenditure and budgetary processes see Morris (2003a). For perversities in project approval by the Project Investment Board (PIB) see Morris (1986). For details of the problems in the current budgeting process for state governments see Mitra and Pillai (2003).

[18] To the extent that the private party has raised funds from MLAs and other institutions that lend long, the problem is reduced. It is of course very important for the MLAs to increasingly provide funds to private parties building public infrastructure, rather than continually support government and its parastatals.

projects is much higher say thirty years, then there is a problem of the private party requiring a higher revenue stream than the government when its owns the project. This difference would significantly raise the capital costs of private projects. At the societal level it creates an intergenerational transfer problem by making early users of the facility pay more than late users. Today for water/irrigation schemes the government, for cost recovery, uses a depreciation rate that would imply an assumed life of fifty years.[19]

Higher Allowed Depreciation is Not Dysfunctional

Too much has been made of this intergenerational issue by neo-classically-oriented economists, without recognizing the dynamics of the situation. Today, in the advanced countries where most of the water systems that the society requires are already in place and growth rates are typically less than 1 per cent, the issue is significant if a new project is going to be built and capital subsidies are called for. There ought necessarily to be transfer clauses, so that governments can claim the value of the projects once costs have been covered, or risk cover may have to be provided to the private party by the government. In the Indian case where much of the network is still to come, that is, the capacities have yet to be built, the problem is not significant. The resources out of the higher tariffs borne by the current generation, when further invested would in allowing for higher growth, make the intergeneration problem less of an issue. After all faster expansion of the network for such basic services and products like water and irrigation when there is continued denial[20] gives a social value large enough to justify a marginal deviation from the static optima of neo-classical analysis.

More than for the reason of intergenerational equity the current low charges to farmers would create problems when in a new project at full cost pricing the depreciation rates are higher. If there is willingness and affordability at such prices then with appropriate transfer clauses (or clauses of reversion of supplies to government) the project should go ahead, and surpluses on government account once the concession period is over should be used for expansion of water supplies if there are continuing demands, or the system should then revert to the correct long run marginal cost (LRMC) pricing with the government keeping the surpluses. If such full private-cost prices are too high to promote near optimal use of the supplies, then the government should subsidize the private builder. In the PFI case, and especially when the government is fiscally stressed but under pressure to expand supplies, the contribution of the government should take the form of additional revenues (over the charges collected from users of water) and in the form of annuities. With the fiscal situation becoming better, the support of the government can take the form of credit support (credit support and enhancement), provision cover for interest rate risk, besides revenue support, depending upon the details of the project structure.

Financial Closure

Private parties unlike governments would not take up project implementation in a physical sense unless the project is financially closed, since the

[19] Actual life of the assets have varied greatly. Ex-post some projects such as the Hoover Dam show a life in excess of 500 years. In India too some of the well-built dams and the catchment areas of which are still under forests and reasonably well preserved show further useable life in excess of the design stage assumptions. Many others show siltation rates far in excess of what was anticipated and poor construction and design quality that would considerably reduce their life. The issue here is that in a technical sense dams and similar projects have large life in excess of the duration over which debt is available.

[20] We define denial as happening when there is enough income to buy the service/product in question but the service is poorly provided or is absent. Given very low price elasticities for public necessities in the consumption of the initial amounts (necessity phase), the welfare losses that those subject to denial have to bear are large, and sometimes much more than the cost of production of the good. Good examples would be water and electricity where for the basic consumption the willingness to pay is very high for the first few units of consumption.

risks they bear otherwise would be impossibly high. Governments have inbuilt tendency to start construction. Merely imposing financial closure on government projects, while useful is not the answer. To the extent that it leads to better understanding of the project and the risks such an approach would be important. But given the case of cost overruns, there is no way the government can externalize the cost (even in part). Insistence on financial closure is not necessarily going to ensure the strong incentives that exist for the private party to work within the budgeted costs. With private parties at least to the extent that the party loses its equity there are incentives for cost control and behaviour ex-ante to reduce surprises/anticipate risks.[21] This is most important in the Indian context since it is surprises and poor and delayed implementation that have resulted in high cost of projects.

Contextualizing DBFO

It is surprising that the DBF and the DBFO options have not been used in countries like India for projects in water supply. Part of the answer may lie in the process of reform trying to mimic the developments in the advanced countries in their detail and prescription. The attempt should have been to apply the core aspect of the reform (the innovation or the principle) to a contextually different situation. In the advanced countries when the idea of the DBFO took root there were hardly any water projects left since much of the capacities had been developed either privately or publicly in a much earlier period through direct state/local government involvement or through concessions. Thus the existing literature does not discuss the DBFO-type options for irrigation projects.

How Much Annuity Financing?

The Annual Plan Outlay on account of 'Irrigation and Flood Control' for the centre, states, and Union territories has been of the order of Rs 10,000 crore in the late 1990s, and the revised estimates for the same for 2002–3 has been Rs 17,750 crore (MOF, various issues). Since these are Plan expenditures, a large part of the same is directly for capital expenditures. Taking about Rs 15,000 crore directly as capital expenditures or expenditures supporting capital formation, the same may be reasonably assumed to be available for annuities for PFIs in case government adopts that route. It would constitute the current upper bound for the revenue support ceterius paribus that the government can provide to private parties taking up DBF/DBFO projects. This flow arises from allocations to the ID and the user charges currently accruing to the government. With the marginal user charges being higher on new projects, this revenue without stress on other aspects of government's budget can be expected to grow at a marginally higher rate than the growth of government expenditures.

Government expenditures in real terms have been growing at around 6 per cent (roughly at the growth rate of the economy). Thus a growth rate of 6.5 per cent in real terms of capacity addition would be feasible (assuming that water projects do not face a rising cost curve). If about a third of the same is available for water storage and bulk distribution projects (dams, reservoirs and canals), then the government can take up PFI support to the extent of 5000*(1/Per Period Payment N = interest rate) which for 12 per cent interest rate (assuming that all risks passed on to the private party are commensurate with a risk premium of 4 per cent if the risk-free rate today is 8 per cent) would be equal to 5000*(13.65), which is roughly Rs 68,000 crore. If user charges finance everything else except that which accounts for the difference in the depreciation rates, then the total investment that can be mobilized is 68,000* 6.4 = Rs 435,000 crore. Assuming a standard period of construction to be about ten years for water projects this would mean an annual realization of private investments of Rs 43,000 crore approximately of private investments that can be leveraged, rising at rates higher than the

[21] When of course there are major deviations arising from unanticipated risks (fundamental), which exhausts the equity of the private party, even in the case of PFIs, the project would end up on the government account.

growth rate of the economy. Even if our assumption of the capital expenditures currently taking place are wrong by a wide margin, say it is Rs 5000 crore instead of the assumed Rs 15,000 crore, the estimate of the private investment that can be supported is about Rs 14,000 crore. Thus if the same resources being put into capital expenditure by the government are used as revenue payments to support private investments (PFIs) then the investment rate can go up, and what is more important can be far more efficiently carried out. Taking credit for the efficiency gains would mean that every year far more effective capacity would be than what is possible under the current regime.

Evaluating PFIs

What should be the public comparator for projects to go PFI? We would first of all underemphasize the need for a public comparator as a universal requirement. If private parties not depending upon state subsidies/annuities are willing to take up water supply projects entirely through user charges, which are capped by a regulator on the basis of price cap regulation valid through a region and unrelated to the specifics of the particular project, then there is no need for any comparator. The regulator/government would then need to ensure that it is optimal in its external effects on resource use and does not impose any safety hazards. To go for bids for PFIs in the case of projects that in part or full depend upon revenue support it would be necessary to have a baseline estimate of the project. It is important that in the comparison exercise the necessarily higher 'cost' of a private project arising on account of the limitation in the duration over which debt can be raised is kept out. That is relevant only to work out the user charge and the extent of support that is if at all to be provided by the government.

The fact that there have been hardly any large projects in irrigation in the private sector would mean that to start with the asymmetry in the information base between the government and the private sector would have to be addressed. Many changes ought to happen—greater transparency, compulsory provision of information, maps and topographic sheets to private citizens and parties outside the government, etc.—before innovations in design can happen. It is not as large problem as it is made out to be. A private sector with large demands ahead could build these skills very quickly by recruitment of excellent talent (poorly motivated and little used) in the irrigation departments, especially of hydraulic and civil engineers, surveyors, geologists, etc.

Bulk Water Business in the Private Sector

In bulk water development and supply large private (including foreign) companies could have an additional functionality. For fresh supplies there would be less resistance on the part of farmers or retail companies/cooperatives of farmers including WUAs to pay the full cost to the bulk provider when the bulk provider and developer is not seen as being the state. Such a developer would have made comprehensive willingness to pay and affordability assessment at regulated prices, besides studies to draw the boundaries of the demand and collection risk. He would ask for additional safeguards to ensure payments. Governments should not typically cover the collection risk, since that would, given the competitive populist politics, result in defaults to the private bulk supplier who would then evoke such provisions.

It is far better to strengthen the legal position of the bulk supplier in his responsibility as a collector of user charges by special provisions and changes if necessary, including provisions by which he could evoke the powers of the magistrate to collect water charges. But his most important instrument to collect would be the freedom to deny water to such companies or cooperatives that do not pay on time. He would in order to hedge his dependence on a limited number of buying entities have planned for extensive networks that may be a little superfluous from the purely technical matter of optimally distributing irrigation water but would give him the flexibility to reach a larger number of buyers than whom he can serve at any time. This flexibility is important not only from the point of view of providing a hedge against collection risk but also to enable retail water markets to develop and be linked to wholesale water markets and prices therein, as and when intraproject trading is opened up.

Existing productive water assets with the state can also go on O&M contracts valid for long periods. Here the key challenge is to evolve a regulatory framework. The more complex task of socially and environmentally efficient design need not be addressed since the asset already exists.

The regulatory tasks are common to new projects too. Thus based on studies of the current maintenance costs incurred by the state with adjustments for both better capex (since the state may have under fiscal stress put off or neglected maintenance) and lower cost of the private sector due to lower wage cost and efficiency, an estimate of the true costs likely to be incurred by the private party could be arrived at as also a time profile of the same. Given the price cap for bulk water which could be common for an entire region or basin or specific to the ayacut/command area of a project (with some variations for transportation costs), the value of the maintenance contract can be estimated. Much would depend upon the gains the private party could make through repairs, renovation, and augmentation activities (RR&A) by enhancing the supplies which would be to its account.

Thus if

R(*t*): annual expenditure planned for RR&A for say *Nr* years;

RK(*t*): construction cost of project over *Nk* years for new projects;

Nc: concession period (about the same as longest tenure in the debt market);

r: discount rate (including the risk premium for the project ï risk premium (assumed to be 4 per cent) i = 8 %; so that *r*) and 12 %;

Cx(*t*): annual capex for maintenance;

OM(*t*): O&M expenditure annual (for simplicity assumed to rise over the concession period in the same manner as the price cap) as relevant for the private sector;

PWo: wholesale prices for water (regulated) at the beginning of the period, that is the current price cap. Assume also for simplicity that the indexation of the price cap correctly forecasts the rise in the O&M expenditure;

Inf: the rate at which the price cap, *OM*(*t*), and *Cx*(*t*) rise over the years, assumed to be uniform through the concession period;

and

V: is the estimate of the value of the MO business, then *V* is given by

$$\mathrm{V} = \sum_{it}^{Nc} \frac{(PWo^{*}\,(1 + Inf))\ *\ Q(t) - (OM(t) + Cx(t))^{*}(1 + Inf)^{t}}{(1 + r)^{t}} - \sum_{it}^{Nr} \frac{R\,(t)}{(1 + r)^{t}} - \left\{ \sum_{-Nk}^{0} \frac{RK\,(t)}{(1 + r)^{t}} \right\}$$

It is important that *PWo*, the price at which water is supplied by bulk water storage and generation company, reflects cost fully from the very beginning. This would ensure the private profitability of the business/O&M contract from the very beginning, and would create strong incentives for the private bulk water company to collect all water charges from the WUAs/retail water companies (RWCs)/WDCs/farmers' co-operatives (FCs) and to measure actual supply correctly. Besides the regulated price, the valuation would crucially depend upon the estimate of the O&M expenses. It is well recognized that it is here that the private sector has a distinct advantage. In the Indian context given that state systems have neglected maintenance, *Q(t)* could be significantly higher than current levels of output both because leakage/seepage can be avoided through better design and RR&A activities for which the private parties unlike state entities would have strong incentives . Parties with a capacity to reach high *Q(t)* would bid higher.

If *PWo* is based not on the life of the asset but on the maximum tenure of debt possible in markets, that is assuming that the asset is depreciated over a fifteen- year period, then only large positive bids are possible. (A concession period is lower than fifteen years.) This may not be politically feasible for new capital intensive projects, and a much larger concession period has to be expected (there are limits to this). If *PWo* is based on the (long) life of the asset then a required annuity payment from the government say for fifteen years can be made the bid criteria. On the other hand, for existing projects which have been in existence for many years the tariffs based on asset life could for MO projects with RR&A still attract positive bids.

Water Distrbution Business and Entitlements

A framework such as the above for bulk water generation and distribution companies which sell water at regulated prices to WUAs/RWCs/WDCs/FCs would not be politically feasible even with the 'subsidy' implied by annuity, if *PWo* plus the standard distribution costs are higher than what the farmers currently pay as average prices for water. Therefore adequate arrangements to ensure that farmers are compensated for the higher prices they have to pay by a subsidization scheme that is non-distortionary is essential. This we have argued before. It is far better to implement such a scheme at the level of the farmer directly or at the WUA (less preferable) leaving the water distribution and production entities free to behave in a way that promotes efficiency.

Let us suppose that farmers today pay effectively *PFo* for a unit of water. This is based on the cash payments that they have been actually made and not on the billings that have been made on them. This multiplied by their consumption of water *CFo* is the lower bond of what they should pay for the same level of consumption. The current level of subsidy therefore is

$$Subsidy = (PWo - (CASH/CFo))*CFo$$

where *PWo* is the regulated price based on costs being considered assuming depreciation over the life of the asset. This is the maximum level of subsidy that should be provided for in money terms. In terms of water their entitlement would be

$$E = Subsidy/PWo = CFo - (CASH/PWo)$$

which is the upper bound of their entitlements. If this is fixed upfront in a reform programme that involves farmers' groups and is well communicated to them, then there is no need for them to oppose reform that involves price rationalization. Price rationalization in order to be fair to the farmer should correctly estimate *PWo*. This cannot be by loading the cost increases on account of delays, poor management, and design on to the project as is the current practice but by making due allowance for such overruns.[22] In any case the entitlement cannot be greater than the amount of water that he currently consumes.

Thus in the aggregate, if *R* is the revenue from a supply of *S* units of water that cost (on a standard cost basis) *C* rupees, then since *C* is more than *R*, the entitlement that protects the level of subsidy for the farmer would be to the extent of $S-(R/C)$. If the water supply as a result of improved maintenance is augmented, and with reform that increases the water supply by *AS*, then it would bring in an additional revenue equal to $C*(AS)$ where *C* now is also the regulated price for supply. Farmers would now enjoy an entitlement of water to the extent of $S-(R/C)$ for which they pay nothing and for any additional water they pay at *C*. Thus the marginal (allocative) prices would have moved up to their correct values. The key to the realization of this benefit of the reform is to incentivize the same by building it into the contract of WUAs/WDCs/RWCs/FCs with the bulk water entity and the state. This is best done by allowing all who can act to save and improve supplies in distribution to do so, and providing strong incentives to do so, that is to internalize at market prices the savings/augmentation of water that distribution companies can make.

[22] This has emerged as a practice in many projects (Rath 2003).

As before

$$V = \sum_{it}^{Nc} \frac{(MPW(SD\ (t) - loss - E)) - (OM(t) + Cx(t))*(1 + Inf)^t - PWo*\ (1 + Inf)^t * SD(t) + DMo*(1 + Inf)^t * (SD(t) - loss)}{(1 + r)^t}$$

$$- \sum_{it}^{Nr} \frac{R\ (t)}{(1 + r)^t} - \left\{ \sum_{-Nk}^{0} \frac{RK\ (t)}{(1 + r)^t} \right\}$$

where now

MPW: is the price of water in water markets;

OM(t): O&M cost of the distribution company;

Cx(t): capex annual of the distribution company;

PWo: purchase price of water from the wholesale company;

DMo: regulated distribution margin;

SD(t): the amount of water bought /received by the distribution company; and

Loss: distribution losses of the distribution company.

The large incentive for the distribution company WDC/RWC/FC/WUA arises from the contract that allows it to sell all water saved at the high water market prices. Similarly, all surpluses after endowments have been met are sold at the water market prices. Individual farmers too would be seeing the market prices for their endowments and so would use the same optimally since they always have the opportunity to sell part of the water that is allocated to them as their endowment at *MPW*.

The Space for WUAs in Distribution

The costs of monitoring use and upkeep of distributaries and field channels by parties other than farmers themselves are significantly large. The farmer also has strong incentives to ensure that others do not misuse, since that would increase his costs and lower his availability, especially in WUAs when they are not too large and quantities to the WUA are limited. But this incentive does not operate in all situations. Interestingly, if there is a system that is working well and misuse/overdrawl, etc. is rare, then farmers would show a larger propensity to set right the error. This is so because the misuse/overdrawl being rare would be considered as almost criminal and since the probability of success in ensuring correct behaviour is large, the farmer would not be averse to collective action or even individual action for the collective good. But in situations where misuse/overuse is rampant, the situation is already akin to a traffic jam. The low probability of anyone (without a uniform) being able to make a difference, ensures that few or none act, so that inaction inevitably sustains the jam/the optimal situation or long. Thus the equilibrium of optimal use by WUAs is stable only if the implicit behaviour and rules have been in existence without violation for long, in other words it presumes strong leadership over the formation and institutionalisation phase.

Leadership and Asymmetry

Leadership is somewhat easy to come by when the potential payoffs to leadership are increased through asymmetric benefits. This is well known from the study of industry associations. Typically these are led and funded by the large players, but the voting rights tend to give them representation less than in proportion to either their contribution or size. Thus a firm ten times larger than another may have only two or three times the vote of the other firm. Since firms range considerably in their size, the largest firm (say of size equal to a third of all industry) may be able to get as much as one-tenth of the value that is created by collective action. With a couple of such firms coming together they gain the ability to internalize a significant portion of the benefits. This could render leadership as rewarding means to lead to better collective outcomes. In situations where there is far less concentration, effective associations are difficult to take root without the efforts of self-sacrificing leaders (or highly parasitic leadership), because internalization can begin only when many have got together. In other words, the need to come together in a major way is priority for the effectiveness of the association.[23]

In the situation of asymmetry though the transition path of a few taking the initiative to form the association and of others joining them is possible, others even if they do not bring in significant additional benefits to the existing members of the association are graciously admitted since members realize the (negative) value of keeping them out and as dissenters. Among farmers there is a less wider variation in unit sizes that one observes in an association of industries. Some natural asymmetry emerging out of differences in the land ownership may have been attenuated by the insistence on one member–one vote without due recognition of land owner- ship or assigned access rights to water. WUAs have a better chance if the natural asymmetry is allowed to work. Equally important, the formal codification of rules and behaviour that are adopted or that evolve after struggle with ready formats of punishment for non-adherence would over time reduce the total costs of monitoring. It is difficult for a group that has come together to go ahead and work as a WUA when most others are still not in—given the tree-like structure of distributories. Thus there is a near all-or-none situation and no transition path as such exists.

Improving Upon WUAs

A formally separate identity of the WUA with its own accounts would go someway to reduce the individual cost of continuous cooperation. One option that seems to have much potential is the model of sugar cooperatives that are not only cooperatives but have a certain flexibility vital to their success and ease of administration (Shah 1996). Essentially, a cooperative sugar mill's share is held by cane farmers who have the right to sell cane to the mill in proportion to the stock they hold. Such share holdings (in small denominations) are bought and sold. The value of the share capital in the market arises not only on account of the profitability of the crushing and sugar refining business (the mill as such) but on the higher returns that farmers make in selling cane to the sugar mill than in a competitive market to the gur industry. The flexibility is important since the (high) value of the farmer's right to sell to the sugar mill is reduced enough. Additionally if in a particular year the crop is below the farmer's access right then he has the ability to sell the surplus access right. Since the access right has a definite value in the market, there would hardly ever be a situation (except in severe drought) where these are underutilized. Since the capacity of the plant is limited, overproduction of cane that kills the cane prices is also avoided.[24] Compared to other places where the sugar mills are privately owned, the farmers' risks are reduced and returns are considerably enhanced. If WUAs move to FCs with an independent legal identity and share-holding (restricted to those owning a minimum amount of land in the ayacut/command area of the distributory main), and the share holding is proportional to the access rights, then such share holding would have a market in the command area that is reflective of the value of the assured water that the access right gives.

Bringing in Private and User Financing

A new large irrigation project, for example, can be self-financing[25] in the following way. Once the

[23] This is observed for instance in the case of small industries in India, Their extreme numerosity has led to formal distanced associations that are able to at best generate political voice. Few association have evolved to offer services of interest to their members or even to effectively lobby for policies that are favourable. Activities that involved significant cost are rarely taken up so that they are at best reduced to lobbying for lower duties and taxes, an activity that needs little effort and few costs to be borne.

[24] Cane being non-storable has to reach the plant quickly, and too many plants cannot be set up since their capacities would be utilized only in the crushing season. This gives rise to the need for some regulation/self-regulation, which in the Indian context was sought to be done by licensing of sugar mills.

[25] Except to the extent of the difference in the rate at which the private party recovers its capital charge and the

broad contours of the project are known and the same is consistent with basin/transbasin level optimality, and with water sharing treaties, the state government could invite bids for certain capacity of storage with specified flows during he seasons *K* and *Qmin(t.s)* respectively with a regulated price of water *PW(t,s)*. The project goes to the bidder who bids lowest combination of concession period *Nc* and *annuity(t)* support . If the project has positive value (as would be the case if the depreciation period is less than the tenure of the market and/or the return that was the basis of the pricing is large), then the criteria would be the lowest *Nc* and no support. Of course there would be due safeguards of design check, independent engineer's approval condition, bank guarantees etc.

Simultaneously smaller water distribution companies are invited on DBFO basis for the distributories from the mains. Farmer-owned water companies are given a preference in the bids to a pre-specified extent but they do not have a monopoly. Again they bid for a concession period *Nc* given the distribution margin *DMo(t),* norms regarding allowed losses *loss*, and endowments of water *E*. The excess of *Q(t)* over Σ_s*Qmin(t,s)* is appropriable by the water distribution company at expected water market prices *MPW(t,s)*.

Farmers' companies could in turn raise the funds construction by selling the share capital of the farmers distribution companies to farmers thereby guaranteeing a certain 'purchased' *E,* with the value of the share capital reflecting the linked right to water at no cost. Not all of the expected water flow through a particular distribution company's territory should be so sold, so that bids for the water companies are positive based on the distribution margin. Such bids should be bankable so that farmers can—anticipating the future rise in productivity of their lands and, hence, incomes—participate in the project (the distribution side of the business).

Distribution organization that are not farmers' cooperatives would need to incur higher cost in monitoring than farmers' companies. On the other hand, farmers' cooperative companies including those structured on more egalitarian principles than the WUAs, would need to have leadership, the latter more than the former, since the individual's work for the collective is not appropriable in the latter. On the whole it is difficult to say whether the farmers cooperative company/WUA would need some bid preference. It would be necessary to start with all options and let the system evolve. WUAs have the potential to handle the situation of positive externalities from surface flows better, since the members could take a collective view on the economies of supplying water and residually charging for the groundwater. It would also be socially meaningful when the aquifers are local and access to the same is possible for one and all in the command area, but not to outsiders.

TAKING TANK IRRIGATION FORWARD

We have already outlined the problem of traditional community-managed water assets such as tanks. Here the problem is particularly severe because the external effects of the surface storage and flows from the tank are large, and users and non-users of the tank derive benefits from such externalities. The controllability that groundwater provides in its use without having to worry about collective processes and costs towards maintenance further highlights the difficulties in collective maintenance of the tank.

The economics of letting the tank fall into disuse and deriving value merely from its external effects (as is the case when nearly all water being ground extracted) versus that of proper maintenance of the tank and tank-based irrigation to the maximal extent and conjunctive use of groundwater is incomparably in favour of the latter,

government does. With regulated prices *PWo* being allowed to be higher than the long run marginal costs (LRMC) even this annuity is in all probability not called for. Support for this contention comes from the observation that the water market prices are way above the cost of production of the same in large public schemes, so that even say a 50 per cent increase in the regulated price over the LRMC can make the majority of the irrigation projects self-financing, that is not depend on government support.

so that there is a need to move to the latter from a point that is close to the former today. The problem is made severe by the HP-based tariff for irrigation pumpsets, which artificially reduces the private cost of extraction of groundwater. The incentive to therefore worry about the common resource (in itself not very strong) is hit very hard indeed.

Necessity of Electricity Price Reform

Therefore, the first step would be to move to correct prices for electricity that reflect the cost to serve the farmer. Current subsidies on account of electricity can be given as direct subsidies through the institution of an entitlement and annual/monthly issue of coupons which can be used in lieu of cash by the farmers to pay for electricity. Tradability of such electricity coupons outside the ayacut and indeed outside the basin should be allowed so as to realize the gains of more optimal surface water development and judicious use of water. This change is absolutely necessary. But that alone does not address the special problem of management of the tank.

We would think that the complete solution would lie in further constructing a framework for action that recognizes the peculiar features of the situation and alters suitably the definition of property rights. Let us suppose that the entire ayacut shares the same aquifer and yields of all wells, the existing and the potential and of the same type and depth, are similar.[26] Let us also imagine an ayacut management company in which all farmers have shares proportional to the value of their rights and assets. Traditional rights to water and land holdings would have to be incorporated. If they are entirely separate only the rights to water from the tank need be considered. This would define the share ownership of the tank cooperative.

Bidding to Reveal Internal (Value) Prices

Individual farmers give their bids in rupees for rights to use/extract water from a well of say standard depth operating for $X1(s)$ hours in the year. So would bids be invited for a standard quantity of water $S(s)$ from the tank over the year. If there are more than one standard well type similar bids can be invited for that well type $X2(s)$ too. Farmers pay in IOUs. The actual indicative price for the right of using the well that year is determined by the clearing bids at which all wells are currently in use and planned available quantities of water are fully allotted. The surface supplies from the tank have a built-in risk aspect. A prior formula to allocate the shortfall over the period s and proportionately over the current holders of the allocation would be the default mode of operation of tanks' surface water. The positive variance over the planned availability of the tank's surface water may be assigned to the cooperative/joint stock water company which is free to sell the same at actual market prices for the water in the command area to members. A local exchange for intrafarmer trade of water can operate every fortnight. The problem of interperiod sales is an issue that can be dealt with in the following manner. Farmers wanting to consume more in a certain period than what they had contracted for would have to buy the excess requirement in the market. Assume that the price would rise above originally bid prices as a result. If the water company now decides that it is in the collective interest to release more water during this period than in a later period it could do so by buying up for a price future access quantities equivalent to the same in the market. If that price is higher than the price today then there is no incentive for the company to do so. Thus with this condition the collective well being would be ensured. Since profits of the cooperative/company belong to the same farmer members the system should not have perversities.[27]

[26] This can never be true but at the second stage we would relax this assumption to consider the more realistic but involved case.

[27] A lot would depend upon the concentration of share holding within the WUA. There would have to be safeguards that limit share holding to farmers within the ayacut and ensure limits to holdings by any individual, caste group, etc. We have no idea of these details but with adequate information on these and the marginal product of water which would determine the price elasticities of demand, and the relative economics of groundwater to

Would the company make losses? This is most unlikely since the clearing prices would be way above the small cost of maintenance and operations. The large notional profits of the company would in reality be distributed to the owners. Farmers settle their IOUs with their share of profits from the company. Any difference is settled in cash either way. At the end of the day there would be very strong incentives to conserve water to sell to others outside the member group.

The same can be achieved but with somewhat lower flexibility by assigning rights to the surface water of the tank and the right to draw underground water (with an appropriate equivalent as proposed before) being distributed in proportion to share holding. And trades between farmers would allow some of the unanticipated variability to be taken into account. Both designs could be tried out on pilot basis for their functionality.

ENSURING OPTIMAL OPERATIONAL PRINCIPLES

The activities of water distribution involve a certain complexity that has to be recognized. Water in a certain month when, say typically, little or no rain is expected but is an important month for growth has high value relative to water when the crop does not crucially demand the same. Similarly, the value of water in an unanticipated dry period is very valuable since it has a high marginal value in being able to save standing crops over which so much effort has gone in.

Complexities

These are all difficult to visualize and estimate ex-ante. (A planner attempting to do the same would always find significant variance of the realizations from his projections.) For the bulk water company or the distribution company (if it has storage or could draw water more flexibly) there are issues of intertemporal optimality.

surface water from the tank, the total supplies in relation to the actual land which can use the water, it should be possible to simulate the best rules and design of a bid-based ownership and allocation of water from the tank.

To bring some of these aspects into play it is better if a certain entitlement (share holding) allows the farmer to obtain coupons for water for each of the fifty-two weeks in the year, which he can then use or trade, so that weekly spot prices are formed. In the aggregate, interperiod trade could only be allowed if the optimal release strategy for the reservoir has changed due to unforeseen events, and without trade across the periods it is not possible to get to optimal release.

Who should determine the optimal release plan and in what manner? This is a crucial question. Ideally an organization with adequate technical expertise and with information about crops and water requirements and represented by all WUAs, water companies in the entire command would be the correct one. If no flows are expected after the monsoon then the problem is relatively simple. It involves working out the period requirements knowing what the cropping pattern that season is and would be in the next season/s. Can the same be organized through markets? Allowing the bulk water producer to trade in the water market for a part of his output would be one way, but since he can influence the water market prices, this is fraught with dangers unless carried out with safeguards.

Bulk water prices should therefore be regulated as outlined earlier in the discussion of financing and organization of the bulk water business, so that the bulk water company irrespective of release and storage period gets the same revenue per unit of water.[28] In cases where there is ample

[28] Some allowance (higher price) can be given to the bulk water company to late releases over early releases in the case where post monsoon little or no flows are expected. This is to cover the costs of holding water. The matter is a little more complicated when significant flows are expected over the year as is the case of those areas that have flows due to melt water, the north east and off seasonal rains. When DBFO kind of contracts are being specified, either seasonal demands (or capacities to make available) can be specified or seasonal prices that reflect costs of storage and demands arrived at through detailed studies can be incorporated into the price cap. Then the price cap $PWo(t,s)$ along with a minimum capacity to supply $Qmin(t,s)$ would have to be specified. In order to incentivize the response of the bulk water company to the unanticipated needs of

groundwater and the cost difference between using ground and canal water is not large[29] the farmer's countervailing power is sufficiently large for the experimentation of the bulk water company being allowed to respond to price variability in the water market, for a small part of its revenue. This has the potential to allow the planned releases as worked out in advance to the starting solution and the optimal solution for releases to emerge. Alternatively, bulk water company's revenues could have an added notional component which is inversely related to the inter-period variation in the water market prices.[30]

CONCLUSION

The issues related to pricing, water rights, subsidies, and financing are deeply interlinked, and the correct pricing would have to recognize the financing implications. Being often enough a scarce commodity with major composition and coordination economies in its use water pricing cannot be discussed without a consideration of the rights (implicit or otherwise).

More than a diagnosis of the problem we have been led by the need to find solutions to a fast deteriorating situation: rising implicit subsidies, movement away from optimal use in a major way, huge distortions, and resulting social costs in the use and misuse of water. The environmental effects of such inappropriate use and waste increase by the day. A large part of the electricity subsidies arise on account of irrigation needs. Moreover the distortionary effects of such price-based subsidization of electricity destroys, through the incentive for corruption, the very organization that produces electricity. They also make conventional reform approaches to electricity meaningless. The government's resources to add to the stocks of water generation and storage assets is declining sharply. Large cost and time overruns in projects constructed under public management, besides the general situation of fiscal stringency, are the problems.

Our approach to the problem calls for a strategic shift insofar as we argue that reform is not possible if the present approach to work around major policy and design infirmities rather than remove them in the first place continues. This is because the distortions have been so deep rooted as to have fed back into the governance and institutional structure of water management in the country. We also argue for solutions that are incentive compatible in the sense that the designs for pricing and regulation and financing (within the appropriate policy and rights framework) are internally consistent and would work without depending continually upon political commitment, administrative initiatives, and managerial energies.

By incentive-compatible we mean that the policy and design meet the criteria that the actors, civil servants, proposed water companies and cooperatives, electricity companies, farmers have

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the farmer, which can be accommodated by adjusting the intertemporal releases from their planned levels. An operating rule that releases more when the prices are high could be adopted, but without any benefit on that account to the company.

[29] This is not a common situation, but is possible if bulk water in the Ganges basin is also generated from storage and not just through barrages. There are reasons from the point of view of national optimality to add storage for the Ganges basin rivers. Today the extensive irrigation in the Ganges basin arises largely from the diversion of rivers than from storage. As the lean season flows of these waters have fallen considerably there is increasing need to store more water if the full potential of the Ganges basin in agriculture is to be realized. The problem of interseasonal variation of prices of water for bulk water companies is of crucial importance in this regard, since thereby the plan objective of storage of Ganges basin waters can be translated to a regulated or market determined premium price in the lean season to which private and commercially oriented bulk water companies can respond.

[30] Unless the actual numbers with regard to supplies, costs, and demands, and flexibility in demands that different crops entail are available, and there is first-hand experience, it is difficult to work out what is best a priori. Except in dry areas where cultivation as such is entirely dependent upon the canal—an extreme example of which is the Ganganagar area of the Indira Gandhi Canal—some experimentation to arrive at the rules and the pricing mechanism is called for. As farmers are able to make investments in groundwater extraction and even afford to keep them 'idle', the option in this direction is bound to become interesting.

the correct incentives to do what is right for efficient production, management, allocation, and consumption of the resource without administrative direction or urging or demanding the presence of persons with exceptional morals or leadership qualities. Similarly, policy change should be politically viable so that in the pursuit of reform politicians do not lose the support of their constituency, but are actually able to enhance their support base. Reform should also be fiscally sustainable. This is ensured when the other aspects are right. Typically the distortions that have been in place for long have created much waste and leakages from the system. The recovery of these as well as the future efficiency economies ensure that with appropriate instruments and mechanisms, the exchequer also gains out of the reform.

Key elements of our recommendations are:

- The right to water of a state should include the right to trade, that is, to sell the water. This would be consistent with the fact that the bulk of the water is for commercial use today. A formal perhaps constitutional basis of sharing the waters of interstate rivers rather than national-level optimal use being perused weakly through agreements as is today, is important.
- The irrigation sector at all levels is open to the private sector through frameworks for various kinds of private finance initiatives including the DBF /DBFO type initiatives. Rather than cost, it would be far more useful to institute regulation which is incentive in approach and price cap in form, though uniform caps across large regions would not be possible nor desirable
- All subsidies whether for electricity or water have to be direct subsidies delivered to the farmer. An identification exercise done once that allows the endowments of a farmer to be fixed, so that he can be issued electricity coupons and water coupons periodically, is necessary. This ensures the political commitment of the farmer since now he has nothing to lose but a lot to gain. Without such commitment, and certainly with their hostility, no reform is possible.
- With all subsidies going direct, there need not be restraints on commercial behaviour and orientation for all participants in the market. The productive organizations—bulk water companies, retail companies, and distributors, including WUAs, and farmers can all relate to the regulated bulk and retail market prices.
- Current subsidies in irrigation are converted to endowments in units of water and provided to the farmer in the form of coupons with which (as also with cash) he can buy water and even sell the same, subject to certain constraints. Thereby prices are allowed to perform their function of ensuring allocative and use efficiency. Since water supplies may be limited (because of natural factors, and because of limited existing capacity to produce/store) bulk water rates are regulated, with only small opportunity for water companies (bulk and distribution) to gain out of the (high) retail water market prices. Regulated prices could be LRMC, in which case the difference between the commercial viability prices and the LRMC prices is made up for the private/commercial bulk water producer through annuities in an appropriate PFI deal.
- The benefit of the difference between the regulated retail prices at which water is supplied to the farmer and the retail water market prices in the command area/ayacut is to the account of the farmer. Since the farmer is able to internalize this benefit with reference to the price, there are strong incentives for judicious use and optimal trade, and depending upon the situation, for even investments in water saving technologies. A little of the same benefits is designed to be internalized by the water distribution entity so that it has the incentive to save water in distribution,

recover losses, and make investments for repairs, rehabilitation, and augmentation

- Tradability across an entire command is a desirable objective, which can come as experience is gained of the system. Cross-command tradability should also slowly emerge subject to certain safeguards against the monopolization of access rights to water.
- Water distribution companies are ideally WUAs but are cast as cooperatives with some allowed asymmetry in shareholding. But they ought not be limited to WUAs or even to farmers' companies. Bidding for distribution business should be open to entirely private companies too.
- For entirely new projects requiring construction of new distribution assets, the access rights can be sold at prefixed prices/ market prices but strictly limited to farmers with operational/own holdings of land in the command area/ayacut, to raise the capital to construct the distribution system.
- Tanks systems would also require a certain recasting with formally defined rights and prices for use of groundwater and surface irrigation. The need here is to minimize the free-rider problem that is inherently a barrier in the management and judicious use of tank irrigation (a common resource in many ways).

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10

Water Rights and Entitlements

R. MARIA SALETH

INTRODUCTION

With increasing water scarcity and frequent occurrences of water-related conflicts at macro and micro levels, the institutional arrangements needed for orderly water allocation and efficient resource management are becoming more and more important. Allocation-oriented institutional arrangements require a formal system of water rights and entitlements (WR&E) applicable both at the macro level of regions and sectors as well as at the micro level of users and uses. These rights and entitlements need not be ownership rights as they can be equally effective just as usufructuary (or use) rights. Such institutional arrangements are obviously urgent for countries such as India where an overall supply gap is expected in the very near future. The symptoms of supply gap are already evident in many pockets in the country with serious livelihood threats and fierce political conflicts. The water demand of the country is growing fast due to population growth and economic expansion. As currently developed resources of 644 billion cubic metres or thousand million cubic metres (TMC) represent only 57 per cent of the utilizable potential (1122 TMC), certainly, there is a technical scope for supply augmentation. But, supply additions are getting increasingly constrained by investment bottlenecks, environmental concerns, and political and legal snags. Even if this potential is realized by overcoming the fiscal, environmental, and political challenges, the supply would still be inadequate as the total water needs of the country are projected to be in the range of 694–710 TMC by 2010, 784–850 TMC by 2025, and 973–1180 TMC by 2050 (GOI 2000). Such a demand–supply gap can have devastating social, economic, and political consequences for a monsoon-dependent and rural-based economy such as India, unless remedial measures are undertaken urgently.

As the diagnosis identifies institutional bottlenecks as the epicentre of most problems facing the water sector, the policy prescription obviously calls for a radical change in development paradigm and urgent reforms in water institutions. A paradigmatic shift is needed for seeking durable solutions rooted in economic and institutional approaches such as those based on a system of WR&E applicable both at the micro and macro levels. While there is consensus on the need for developing the WR&E system, there is also a somewhat distorted perception as to the technical and political feasibility of establishing such a system in the Indian context. Certainly, the introduction of the WR&E system will not be easy as it entails heavy financial, technical, and political costs. At that same time, it is also not that difficult or costly as it is often made out to be. WR&E are very much a reality as they exist in implicit and informal form both at the macro and micro levels.

Water Rights and Entitlements: An Overview of Issues

For a monsoon-dependent country like India, water remains the dividing line between poverty and prosperity for millions of people. Efficient, equitable, and sustainable use of water requires the widespread adoption of desirable practices such as conjunctive use, supplemental irrigation, water-saving technologies, water transfers, and water recycling. But this cannot happen in an economic and institutional vacuum. The WR&E system can fill this vacuum to alter the incentives and behaviours by setting the quantitative and qualitative limits for water availability for regions, sectors, and users as well as the economic and legal conditions for water sharing and allocation among these entities. If properly designed and implemented, the WR&E system can also be a policy instrument that can simultaneously address the goals of economic efficiency, social equity, and environmental security. Unfortunately, with narrow approaches, the WR&E system is often misconstrued as a prelude to water privatization and commercialization. Contrary to such a perception, the WR&E system can be the cornerstone of a new governance structure that can permit social control and public decisions at the stage of allocating initial water rights and entitlements while allowing decentralized private decisions at the stage of reallocation and actual use of water. The WR&E system is also essential for providing water security as well as generating food and livelihoods for the poor through an efficient and equitable allocation, use, and management of water resources.

Incentive Issues

The rapidly approaching physical scarcity of water, which is already a reality in a growing number of basins in India, calls for far reaching changes in water resource allocation and radical improvements in water use efficiency. This applies particularly to the irrigation sub-sector with a dominant share in total water use. The persistence of the 'incentive gap' or the 'efficiency gap', that is, the gap between the real economic value of water and the low value of water being perceived or assumed by users is a major threat to efficient water use in irrigated agriculture (see Box 10.1). The extensive damages of this incentive problem are already visible in the forms of aquifer depletion, water logging, and soil salinity. The incentive problem has legal roots in the colonial policy of separating resource ownership from resource usage and such policy has continued till today. The dichotomization of ownership and usage eliminates the incentives for resource use efficiency and conservation, as the users cannot claim the benefits from their efficient use. Unless this legal condition and its behavioural consequences are corrected, it will not possible to influence resource use efficiency and conservation.

Box 10.1 What is Incentive Gap?

The 'incentive gap' or the 'efficiency gap' may be difficult to define in the absence of information on the real value or the opportunity cost of water. In simple terms and as lower bound values, it can, however, be approximated by the gap among water productivity, supply cost, and water rates.

In the context of canal regions, for instance, water productivity is reckoned in the range of Rs 714–5812/hectare (ha) and supply cost is estimated to be in the range of Rs 90–603/ha. But, water rates are in the range of Rs 6–1000/ha (GOI 1992b). While groundwater use is more efficient, it is not free from the incentive problem as the groundwater rates of Rs 3–48/hour (Shah 1993) are far lower than both the supply costs and created benefits.

The incentive gap indicates not just an economic pricing but also the absence of the institutional conditions needed for volumetric allocation such as water rights and the organizations basis for their enforcement and cost recovery.

The failure of regulatory policies ranging from water pricing and user participation to well spacing and power tariff demonstrates not only their poor design but also the institutional vacuum within which they are implemented. Unless some form of physical limits and use rules are set at the level of individual users, regions, and sectors to make the level and nature of access to water transparent and accountable, many of these regulations cannot be effective in achieving their goals. In the absence of such limits, emergent institutions such as groundwater markets with significant efficiency and equity benefits (Shah 1991, Saleth 1994) can degenerate into instruments for rent-seeking, aquifer depletion (Janakarajan 1993, and Saleth 1993, and 1994) and water monopolies. When individual users see their water constraint, they have the incentive to use water efficiently and such incentive will increase when they have the option for an economic exchange of the saved water. In view of this incentive effect and the equity and ecological safeguards possible when determining the overall allocation of rights and entitlements, the WR&E system will have inherent self-regulating properties. These properties have the potential to obviate the administrative pressures and regulatory failures associated with a plethora of ineffective regulations. The WR&E system can also fill the current legal and institutional vacuum surrounding groundwater markets, water-user associations, and basin organizations.

Technical, Legal, and Organizational Issues

Complete physical control over an object is not at all necessary as it is rights not objects that are owned (see Coase 1960, Dales 1968). Although rights can imply physical aspects, they are not a physical entity but a legal entity implying a bundle of user rights with correlated duties. Similarly, the experience in countries such as Chile shows that these rights and entitlements need not be ownership rights and it is enough for them to be just as usufructuary (or use) rights. However, the issues of defining and enforcing such rights in the context of water with its fluid and fugitive characteristics require additional technical, organizational, and infrastructural requirements. The most immediate technical requirement for a water rights system is to establish water balance for each appropriately defined hydro-geological unit under use and source-wise disaggregated conditions as well as alternative scenarios. Meeting this requirement is not difficult for most areas in India given the information availability and technical expertise (Pathak 1988). While the establishment of the WR&E is also likely to generate new demand for additional and more refined information (World Bank 2004), the existence of the necessary technical capacities and organizational preconditions can enable most states in India to meet such information needs.

The real challenges are in the definition, allocation, and enforcement of water rights. In this respect, three issues need to be answered: unit of measurement, criterion for rights distribution, and enforcement and monitoring mechanisms. It is ideal to define WR&E in volumetric terms so that the same amount of water is implied across time and space. But, even this ideal measure also faces problems due to return flows and changes in withdrawal point. Thus, volumetric measure, though useful is not an absolute necessity. What is needed is only a shared notion of quantity to an acceptable degree of approximation. In many cases, locally developed institutions are used as substitutes for sophisticated but economically infeasible measurement technologies.[1] But, precise quantification can be possible through water metres as in the case of groundwater and urban areas or advanced measurement structures as in the case of the Majalgaon Canal Project in Maharashtra (see Box 10.2). However, as the experience of other countries having a matured water rights system such as Australia, Chile, and the western parts of the US, once the WR&E system

[1] Instances for such substitutions include the use of watermen in many canals systems in Tamil Nadu, Andhra Pradesh, and Karnataka, and the reliance on timing procedures involving local priest and community elders in the irrigations of Canary Islands, Spain (Mass and Anderson 1978, pp. 22–24).

is established, economic incentives would emerge for the development of more robust but less costly water measurement technologies.

Box 10.2 Technical Scope for WR&E System

An Example from Maharashtra

Apart from its social and political acceptability, the WR&E also requires certain basic technical and design conditions needed for volumetric delivery of water. Such technical preconditions are present in Majalgaon Right Bank Canal where a remote controlled and computer-based dynamic regulation system has been installed under a World Bank assisted projects.

Briefly, dynamic regulation involves (i) 10 cross-regulators fitted with wireless remote transmission units; (ii) volume control structures at each of about 18 distributaries; and (iii) the control centre with a computer system that monitor and record water diversions via wireless networks. The volumetric distribution possible with the PPDR enhances the technical prospects of introducing an effective WR&E system in the Majalgaon canal regions.

Source: World Bank (1998c).

The criteria for water rights allocation remain neutral for efficiency but are critical for equity.[2] While an open bidding procedure can consider for rights allocation, other need-based criteria are better to avoid monopolization of rights and address special social concerns (see Box 10.3). It is very important from the equity perspective to ensure water entitlements also to landless groups and socially vulnerable sections. A hybrid criterion is also possible where certain amount of water is allocated among landless persons using the *pani panchayat* criterion and the rest is allocated among land owners using the NCA criterion. The amount to be available for allocation to landless can be varied by using the following procedure. First, the total available water is theoretically distributed across the land owners via the NCA criterion. Then, as a form of progressive tax, the distributed water rights in the first stage are proportionately reduced to form a pool for its subsequent distribution among the landless. In this way, larger farms contribute more to the pool than small farms (Saleth 1996). Notably, the provision of water rights to landless groups presumes transferability or rental possibility. Otherwise, there are no benefits from such rights for irrigation water. This shows that apart from the economic requirements, there are also social needs for the legal provision of transferable rights and entitlements.

Box 10.3 Criteria for Allocating Water Rights

Official Proposal and Local Practice

As per the NCA proposal (GOI 1976), the available groundwater in a basin, after allowing for non-agricultural needs, will pertain to land and each land holding weighted in terms of its soil quality and access to surface water will have a legitimate right to a proportionate share of the groundwater. Apart from equity, this criterion also promotes an integrated use of land and water. But, it has the negative effect of reinforcing inequity in land ownership with the same on water.

This negative effect is avoided by the criterion actually used under the pani panchayat system being practised in parts of Maharashtra where rain harvested water is allocated not in terms of land size but in terms of family size (Singh 1991, Vani 1992). Usually, about half an acre (0.20 ha) worth of irrigation water is allocated for each person in the family.

Source: Thakur and Pattnaik 2002.

The enforcement and monitoring arrangements for WR&E system needs an enduring state–community–user partnership. The regulatory rights of the state, enforcement and monitoring responsibilities of local organizations, and the use rights of the users are to be hierarchically structured within a public trust framework (Singh

[2] This is immediate from the familiar result of Coase (1960). That is when the rights are private and transferable (or, rentable), their reallocation will correct the inefficiencies associated with the initial distribution of rights. But, from an equity or income distribution viewpoint, the criterion matters as the allocation of rights amounts to asset transfers.

BOX 10.4 TRANSITIONAL LICENSES FOR PROTECTING EXISTING RIGHTS

Country Experiences

In instituting a new water rights system, it is essential not to disturb established water usages and use patterns. In England and Wales, for instance, when the new legislation came into force, it protected existing users through the instrument of a 'license of right', once the users apply, within a year, with proof of their water use over the previous five years. Similar provision can also be found in the water laws on countries as different as Italy, Jamaica, and Spain. Another important feature of the licensing systems in effect in these and similar countries is that licensing is generally waived in respect of water abstractions for meeting immediate domestic and para-domestic uses. Such exemption is also made in the 1994 Water Law of South Africa. Similarly, shallow and low-yielding wells are exempted from licensing requirements.

Source: World Bank (1998a).

1991, Saleth 1996). The public trust framework is closely linked with the Gandhian notion of trusteeship. It provides a basis for linking social control of the state and community organizations with the decentralized decisions of private individuals and groups. In this new governance structure, the overall water allocation, regulation, and management are with the state and community organizations as under public trust whereas field level water allocation and use are under private hands and market influence. The government at the appropriate level has the responsibility to establish the overall legal framework for the water rights system including formal mechanisms for conflict resolution at the regional level.[3] But, enforcement, monitoring, and conflict resolution at the basin and local levels require decentralized arrangements such as basin organizations, local governments, community organizations, and user-based arrangements. Given the existence of a fair amount of institutional potential at the grassroots level and farmers' familiarity with the turn-based water allocation, the task of developing flexible mechanisms for the enforcement of the WR&E system should not be that difficult in many areas in India. In fact, there are institutional and operational synergies between WR&E systems and user-based organizations as has been illustrated by the experience of Chile (see Box 10.5).

BOX 10.5 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. A National Registry for Water Use Rights was established, kept alongside the National Real Estate Registry.

Given the water rights system, 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); 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 introduction of saleable water rights was facilitated by the dual facts that water use rights had already been granted on most waters and most watercourses were managed by water users associations.

Source: World Bank (1998b).

Economic and Political Issues

From the perspective of efficient, equitable, and sustainable use and management of water resources, the private roles at the stage of water use

[3] How WR&E are hierarchically structured in an operational context can be visualized in simple terms as follows. First, the total quantity of water and its priority for different sectors are established for a given area. Second, given the sectoral allocation, the amount and its priority are established for different sub-regions within the area. And, given the sectoral and regional allocations, the shares of individuals for different uses are established using criteria discussed above.

is as important, if not more, as the public and community roles at the stage of initial water allocation and subsequent regulation and management. In order to enhance efficiency and conservation at the stage of water use, the WR&E regime should ensure private and transferable or, at least, rentable rights, where water entitlements can be temporarily transferred either in part or in full. These conditions are vital for WR&E system to perform its critical economic functions. Since these conditions provide incentives for efficiency and link use decisions with market conditions, they promote optimum use of the resource. Private nature and the scope for transfer or rental of rights are linked with resource values and pricing.[4] Transferability and exchangeability of water rights are crucial to capture and reflect the scarcity or use value of water through price signal and guide water allocation accordingly. Apart from their efficiency effects, transferable private rights also have a distribution function as they can apportion the joint benefits of water exchange among concerned parties. Although the ontological status and fugitive nature of water makes the rights as a legal fiction and allows only a de facto user rights (Singh 1992), it is these de facto rights (or actual use and control of water) that are economically more relevant as transferability becomes more important at the level of use than at the level of its ownership. The requirements of private and transferable rights need not contradict the rights of the state or community essential to ensure the ecological security and social equity. As noted already, when these rights are defined within the public trust framework, private and transferable rights are consistent with social control needed to ensure equity and sustainability.

Private and individual rights are also essential to ensure the two-way accountability, that is, the accountability of individual users to each other and that between the individuals and the community (Singh 1992).[5] Inter-personal accountability is economically very important as it provides a means to address the 'externality' problem that is pervasive in water use. This is because individual water rights not just define the legal boundary but also demarcate the physical and economic boundaries of the individual's actions and their effects. Thus, by relating rights with duties, such effects can be quantified and compensated. As a result, the potential for inter-personal conflicts is minimized. From a strict legal perspective, the transferability of water rights faces problems as they are considered as natural and fundamental rights (Singh 1992). While water for drinking and domestic use can qualify to be a fundamental human right, the same for other economic uses need not have such an ethical qualification. In these case, therefore, the legal conception of water rights should be such as to allow ownership rights and hence, transferability among legal persons. Otherwise, water rights will remain just a legal notion bereft of any economic and equity significance.

The WR&E system has clear economic and equity justifications. The technical, legal, and organizational feasibility of establishing this system is also bright given the information availability, planning capability, and institutional potential present at different levels. Legal experts have noted that water rights-based legal reform is part of the charter in the Indian Constitution (Singh 1991) (See Box 10.6). Infact there are policy commitments for developing a WR&E as arrangement similar to that have been advocated by various government commissions, committees, and documents (See for example, GOI: 1975, 1992a, 1992b). There are also legal and organizational initiatives both at national and state levels.

Despite the policy commitments and economic necessities, there is a political aversion towards the WR&E system. Many consider it to be an administrative nightmare and a political

[4] For, what is not owned cannot be priced because prices are just the payments for property rights or, more specifically, for the rights to use an asset (Dales 1968).

[5] Sometimes, communal and groups rights are also advocated (Devi 1991, 624). But, such rights can ensure only the accountability of the community/groups to the state but not that among individual members of the community/groups.

BOX 10.6: WATER RIGHTS IN OFFICIAL DOCUMENTS AND INITIATIVES

The NCA in its 1976 report postulated a correlative rights system—a land-based proportional allocation of groundwater (GOI 1976). The Model Groundwater (Control and Regulation) Bill of 1992, which was originally formulated in 1970 and also got revised slightly in 1997, has postulated a kind of licensing and permit system, especially in areas experiencing severe aquifer depletion (GOI 1992b). The Bill provides for the mandatory installation of water metres, but has not specified any withdrawal limits. Although the Bill failed to evoke much interest among the states except for some marginal legal initiatives in Gujarat, Karnataka, Maharashtra, and Tamil Nadu, it led to the creation of the Central Groundwater Authority in 1997. Similar arrangements at the state level are also being created.

Despite its bureaucratic nature and regulatory orientation, this arrangement provides a formal mechanism both for creating permit-based private groundwater rights as well as establishing public rights in their regulation. As this arrangement becomes more and more decentralized and participatory and when the private use rights are quantified and metered, the allocative role of this new arrangement can be enhanced to complement its regulatory functions.

Source: World Bank (1998d).

impossibility while others argue that it will lead to the commercialization of a life-supporting resource. But, these views are not based on full information as the WR&E system being proposed will have social and environmental safeguards and is subject to public regulation and control. It is not intended to reduce the water availability to any individuals or groups, but rather to ensure the tenure and certainty of already available water. As this system creates a basis for reallocating water through compensating current claimants, it does have scope for equity-oriented reallocation needed to empower poor users (Rosegrant and Binswanger 1994). As we will see later, the WR&E system is also not new for India as various forms of implicit, informal, and rudimentary system resembling water rights exist in different parts of the country. Thus, what this proposed system does is only to formalize such arrangements in the interest of all concerned. Such institutional potential reduces the costs of creating the WR&E system whereas growing scarcity and conflicts exacerbate the social costs of the institutional vacuum. The costs are also likely to decline further with the two important institutional initiatives: administrative decentralization through panchayat system and management decentralization through water user associations (World Bank 1998a).

EVOLUTION OF WATER RIGHTS AT DIFFERENT LEVELS

India does not have any explicit legal framework specifying water rights, even though various acts have a basis for defining some form of such rights. However, additional changes are needed to move from the present conditions of informal, implicit, partial, and unclear arrangement to an improved legal and institutional framework for promoting the kind of WR&E system needed for meeting current and future requirements of the water management in the country. Both the nature and magnitude of these changes vary considerably across contexts, regions, and sectors. For understanding the existing potential and needed changes, it is necessary to see the evolution and status of water rights at the local, sectoral, state, regional, and national levels.

When revenue needs and technical possibilities allowed the colonial administration to develop and control the water resources on a large scale, fundamental changes occurred in the economic and legal basis of water allocation among users. A series of legislations were enacted to establish the state's right over water resources and to specify conditions for users to have access to them. Early British legislations did recognize the customary water rights of individual and groups. However, with the Easement Act of 1882 and the Madhya Pradesh Irrigation Act of 1931, the state's absolute rights over all rivers and lakes were firmly established.[6] While state's absolute rights can affect the development and managerial aspects of water, from the perspective of water use, it is the de facto control over water by actual users at the micro level that is more important. For canal irrigation, water rights can be obtained only by express grant and on payment. Time and outlet-based turns (for example, *Warabandi*, *Osarabandi*, and *Varvaram* systems) were developed to physically allocate the water rights (Ahmed 1991). But, as these rights neither involve any legal document nor specify the entitled quantity, users lack recourse to protection. Private rights to groundwater were recognized, but only through land rights.[7] As a result, from a strict legal sense, they cannot be transferred apart from land. While there is a legal security for groundwater rights, the entitled quantities implied by them are not specified, except for the stipulation of an obtuse concept of 'beneficial use'. This system of water rights developed and consolidated during the colonial era has continued after independence. It is this system that exists today with some adjustments reflecting changing market and technology.

With the expansion of rural electrification programmes, emergence of improved pumping technologies, and changing economic and resource realities, some notable changes have occurred in water rights and allocation both at the micro and macro levels. Although groundwater rights lack transferability in a legal sense, de facto water transfers have become extensive through groundwater markets in many regions in the country (Shah 1993). In view of this possibility, farmers are also able to establish de facto rights that are much larger than those implied by their farm size. The quantities of water implied by such rights are indirectly defined by the interactive effects of farm size, well depth, pumping capacity, and water selling possibilities (Saleth 1998). Notably, such rights have social recognition as they are often implicitly recognized by other farmers either willingly or otherwise and the governments are unable to regulate them for political reasons. In Gujarat, even farmer groups have also established such rights through more formal arrangements such as water companies and elaborate underground water conveyance networks (Singh and Bhallab 1996). In some cases, these de facto water rights are linked with land and labour contracts (Shah 1993, Janakarajan

Box 10.7: Water Rights in Water Companies and in Other Rural Contracts

New forms of water rights have also emerged with changing organizational and contractual arrangements, especially in groundwater regions with severe water scarcity. For instance, in the case of water companies observed in Gujarat, there is an implicit form of group rights. These companies, which are formed both by a voluntary cooperation among farmers as well as by the turn-over of the state-owned public tubewells, also sell water to non-members besides meeting members' water needs. In many cases, elaborate pipeline networks are also constructed to link many contiguous farmers.

In parts of Andhra Pradesh, Gujarat, and Tamil Nadu, the inter-linked nature of groundwater markets with other markets for land, labour, and farm inputs and outputs suggest that the de facto water rights of landowners has a leverage with other contractual arrangements involving land leasing, labor contracts, and agreements on input supply and output sales. There are also water-based tenancy contracts based on different rules for sharing labour, other inputs, and outputs. In these cases, since water rights form an integral part of the whole arrangement, they have an effect far beyond the water resources.

Sources: Shah (1993), Janakarajan (1993), and Saleth (1998).

[6] Notably, this position was also reflected even in the irrigation and water supply Acts enacted after independence. But, the Madras High Court in 1936 and the Bombay High Court in 1979 have declared that the government's sovereign rights do not amount to absolute rights (Singh 1991).

[7] As per the 'dominant heritage' principle implied in the Transfer of Property Act IV of 1882 and the Land Acquisition Act of 1894, a land owner can have a right to groundwater as it is considered an easement connected to the dominant heritage, that is, land.

1993, Saleth 1998). Box 10.7 provides few instances for these forms of group-based and linked water rights in groundwater regions.

In canal regions, the water rights, by law, are fixed-tenure in nature as they are restricted to groups having access to land in canal regions (Saleth 1996). They are only 'access rights' and offer no guarantee for any quantity or its certainty. Due to the physical features of distribution networks and spatial considerations in distribution rules, these rights are also biased against tail-end farmers. Moreover, these rights also lack transferability apart from land as canal water cannot be transferred to non-canal regions. But, there are some notable adjustments in canal water rights in recent years. Not only do farmers transfer their water and turns to others within the commands but also they move canal water to non-canal regions indirectly through groundwater withdrawals in canal regions. Originally, groundwater extraction in canal areas has emerged to supplement canal supply and meet irrigation needs during canal closure periods. But, in recent years, it is being increasingly used to transfer water through pipelines to non-canal regions.

Notably, some of these transfer projects are also funded by formal credit from rural commercial banks as observed in parts of Tamil Nadu (Dinar and Saleth 1997, Dinar et al. 1997). These transfers also redefine and create new sets of water rights (see Box 10.8). In Madhya Pradesh, an Asian Development Bank mission has observed the widespread practice of pumping water directly from canals for irrigating non-canal farms (Breckner and Saleth 2001). Although laws and administrative rules restrict canal water rights only to those paying water charges, such restrictions are not strictly enforced as indicated by the magnitude of water charge arrears in many states (see GOI 1992). Water charges are, in fact, only a small portion of the real values of canal water rights that are captured immediately by productivity and ultimately by capitalized land values. But, with irrigation management transfers, water allocation, cost recovery, and system maintenance have all improved (Vermillion 1997, Oblitas and Peter 1999, Joshi and Hooja 2000). With their greater involvement in water allocation and management, farmers have also begun to realize the value of having water rights. This, in fact, suggests the synergy effects between user organization and water rights.

Box 10.8: Private Water Transfer Networks and Informal Groundwater Rights in Canal Regions

In Periyar–Vaigai basin, Tamil Nadu the farmers have constructed elaborate pipeline networks for transferring groundwater both from the canal commands as well as from the downstream of newly constructed small dams constructed across the Shanmuga River. The investment costs of pipelines with average length of 3 to 4 km range between Rs 50,000 and 200,000.

What is notable of these privately initiated water transfer networks is the involvement of bank loans in the construction of some of them and the emergence of water markets and informal water rights system. With supply of water in previously rainfed regions, land productivity and farm income have increased up to 20 times creating economic and technical conditions for water markets. As the groundwater is moved from aquifers away from actual water use, an informal intra-regional water reallocation has occurred also with the creation of water rights disconnected with land.

Source: Same as Box 10.5.

At the macro level, there are also both implicit and explicit water rights. In this respect, the broadest form of rights is implied in the constitutional division of power between the central and state governments over water resources itself.[8] These are essentially legal rights to

[8] As per Entry 17 in the State List under the Seventh Schedule of the Constitution, it is the states that have jurisdiction over water resources within their borders. But, the powers of states are subject to Entry 56 in the Union List that allows the central government to regulate and develop interstate rivers and river valleys when this is declared by parliament as a matter of public interest. The central government also has regulatory roles in the water

develop, regulate, and manage water resources. Although such rights heavily favour the states, the states' rights are under an increasing pressure in recent years. This is partly due to the emerging need to devolve water rights to the basin and local organizations and partly due to increasing rights and responsibilities of the central government in environmental protection, conflict resolution, and national coordination. As the country is approaching the physical barriers for freshwater expansion, these roles of the central government are bound to grow. It is these larger responsibilities of the central government that justify the need to move water resources from the state list to the concurrent list (Singh 1991, World Bank 1991 and 1998b). At the same time, the devolution of rights and entitlements to basin and local levels are essential not only to strengthen the regulatory rights of the states, but also to minimize their involvements in day-to-day water allocation and management functions. The initiatives of many states in creating basin organizations and water-user association are likely to redefine further the existing pattern of macro management and regulatory rights over water. Thus, the new institutional paradigm or governance arrangement involves three key elements, that is, water rights system, user organizations, and state and community regulations, all of which are indispensable both individually and collectively.

There are also some important developments in the evolution of water rights at the macro level. Explicit and implicit forms of water rights also exist at the macro level of sectors and regions. For instance, use prioritization specified in the National Water Policy of 2002 and the same implied in the Constitution[9] provide a basis for establishing the priority of sectoral rights and entitlements. But, these priority rights are not absolute in view of their correlated condition of respecting the individual and group rights over which they are defined. Similarly, they are also not to be misunderstood either as a basis for confiscating individual rights or as a basis for developing rights through state fiat within a command and control framework. Thus, the priority rights can only be a form of general guidelines for instilling social control over macro level water allocation but not a firm rule to obviate the role of economic conditions and market requirements.

On the other hand, the current sectoral pattern of water allocation at the national, state, and local levels can directly be interpreted as de facto rights as they represent the economically and socially accepted pattern of actually observed water use. In this sense, these allocations can be a basis for establishing more formal and flexible sectoral rights and entitlements at appropriate regional and resource contexts. In this respect, the most preferred arrangement requires both the physical context of river basins and the organizational framework involving the networks of stakeholders of those basins (see Box 10.9). For inter-state (or inter-regional) water rights, negotiated agreements on water sharing form a natural basis for developing regional and state water rights.[10] But, in other cases where negotiated settlements have been difficult, the awards given by concerned tribunals established by the central government under the provisions of the Inter-state Water Disputes Act of 1956 can be used as a starting point for developing water rights at the state level (see Box 10.10).[11] Although the

sector vide Article 252 related to interstate water projects as well as in terms of the Forest Conservation Act of 1980, which requires the states to get central clearance for executing ecologically sensitive water projects. The central government also has an important role in resolving interstate water disputes as per the provisions under Article 262.

[9] For instance, the constitutional provisions relating to the fundamental rights to life are used as a basis for assigning top priority for drinking and domestic uses as well as irrigation and ecological water needs.

[10] There are 58 independent water-related agreements among states concluded in the past—39 related to joint projects and 19 related to sharing of river waters—and all of these are under heavy pressure for renegotiation due to the increasing water requirements of concerned parties (World Bank 1998b). See Iyer (1999) for a review of some of these agreements.

[11] Under this Act, the central government has so far set up five tribunals and three of them have come out with

Box 10.9: Basis for Sectoral Water Rights

An Instance from Philippines

The procedure being followed in the case of the Angat Dam in Philippines for allocation of its water among irrigation, urban, and power generation provides an instance for the practicability of establishing sectoral water rights. The rights to the waters of the reservoir with average annual inflow of 60 cusec are allocated as follows: (a) 36 cusec or 60 per cent of the average annual inflow is allocated for the National Irrigation Agency (NIA) for meeting agricultural water needs; (b) 22 cusec or 37 per cent of the average inflow is allocated to the Metropolitan Water Supply System (MWSS) for meeting urban water needs; (c) the remaining 2 cusecs or 3 per cent of the flow is reserved for meeting in-stream and ecological water needs. Since water use for power generation is non-consumptive, the National Power Corporation can use the 58 cusec or the total allocation of MWSS and NIA. While the ecological water allocation is strictly ensured, other allocations are flexible as it is based on actual use. For instance, the MWSS claims an additional 15 cusec from the unutilized allocation of NIA. The inter-seasonal and inter-sectoral conflicts in water releases are minimized through the use of 'rule curve' showing the minimum water level requirement in the reservoir at a specific time to meet a particular need. But for administrative orientation and uncompensated adjustments, this case shows how practically applicable sectoral rights can be specified.

tribunal awards settle the dispute by quantifying the water claims, they involve a lengthy process to reach a final settlement.[12]

Box 10.10: Basis for Developing Regional Water Rights

Practical Instances

The Upper Yamuna River Board provides an instance for developing regional water rights from negotiated agreements. This board allocates the Yamuna water among Haryana, Uttar Pradesh, Rajasthan, Himachal Pradesh, and the National Capital Territory of Delhi within the overall framework of the Memorandum of Understanding (MOU) singed by the Chief Ministers of the co-basin states. In contrast, the 1976 award of the Krishna Water Dispute Tribunal provides an instance of settlement-based framework for developing regions water rights. The award, which is based on a 75 per cent dependable flow Krishna River and its distributaries, set quantified water entitlements of 560 TMC for Karnataka, 700 TMC for Maharashtra, and 800 TMC Andhra Pradesh.

Source: Same as Box 10.5.

Besides, since the implementation of tribunal awards can be contested in the Supreme Court, it is crucial to provide legal binding to final awards. New and more formal organizational arrangements are also being created to tackle interstate water sharing issues.[13] While the tribunal awards can be a basis for developing regional water rights, they have a major limitation in view of their duration as set by the time period for the review of the award. In the case of Krishna award, for instance, it is set as 25 years. This creates the undesirable effects of competition among the states with uncoordinated and disjointed investments for establishing claims before the award

amicable decisions (Krishna in 1976, Godavari in 1979, and Narmada in 1979). These include also the tribunal dealing with the politically most sensitive Cauvery River dispute where only an interim award was given and even that is strongly contested by one of the concerned states.

[12] Since the Act has failed to specify the authority to implement the decision as well as the time limit for tribunal decision, it was amended twice—first in 1980 for authorizing the central government to establish the implementation authority and then, in 2002 to specify a six-year time limit for tribunal decision (Salman 2002, Richards and Singh 2002). Many experts argue that even the six-year time limit specified by the 2002 amendment is too long for resolving such a sensitive issue as water sharing.

[13] For instance, the Cauvery River Water Authority has been created to deal with the allocation conflict among the basin states. This entity—patterned after the Murray–Darling River Basin Organization of Australia—is unique in the Indian context as this is the first time that a basin organization is chaired by the prime minister with the chief ministers of all the concerned states as members.

comes for review. To avoid this, it is essential that the award, once given, should be treated as final, but the concerned states should be encouraged to negotiate for reallocation based on market conditions. As we extend the regional rights to a still higher level, we can also find the basis for national water rights implied in international water treaties such as the treaty between India and Pakistan over the Indus and the same between India and Bangladesh over the Ganges.

While market or negotiation-based arrangements are not tried much in India, there are some evidences for their actual occurrences as well as indications of their future potential. Arguably, these arrangements can be a basis for developing mutually beneficial water rights systems at relevant contexts. For instance, the case of Krishna water transfer for Chennai can be considered as an implicit interstate water market.[14] As the Tamil Nadu has paid for the entire project costs that also has some significant benefits to Andhra Pradesh, the transfer implicitly involves a payment for the water. While this is relevant instance for implicit regional water trade, it also shows how the operation of such markets is constrained by incomplete specification of the rights such as the lack of the time and the amount of water to be delivered and the liabilities and recourse to address the failure of meeting the obligations. The potential for similar forms of implicit and explicit inter-regional water markets is also vast in India as states can be encouraged to purchase and sell water either on a payment basis or on a barter basis (that is, exchange of water for power or foodgrains). But, such potential exchanges remain dormant essentially due to the absence of a legalized system of interstate water rights.[15] There are also evidences for large scale intra-state and inter-sectoral water transfers that are mainly from agriculture to urban areas (for example, Palanisami and Easter 1983, Briscoe 1997). Such transfers are undertaken not only by private water-selling groups but even by state governments and municipal water supply agencies.[16] Although such transfers are beneficial to the middlemen, urban consumers, and water supply authority, the farmers of the urban fringe agriculture are heavy losers as there are no water rights to enable them to claim economic compensation for their water.

Environmental laws and regulations have emerged since the 1980s to establish more clearer rights over water quality. These rights are administered by the central and state pollution control boards through a system of pollution permits, penal actions, and treatment responsibilities. While precise legal specification and transferability are lacking, these rights are often judicially handled in terms of the fundamental rights to life and environment enshrined in the constitution. Such rights are, in fact, used in many public interest litigations filed against polluting industries along the Ganges.

[14] This relates to the Telugu Ganga for transferring 15 billion cubic feet (BCF) of water from the Krishna River (with an equal pledge of 5 BCF each from the three coriparian states of Maharashtra, Karnataka, and Andhra Pradesh) to meet the drinking water needs of Chennai. Under this project, Krishna water stored in Srisailam Dam in Andhra Pradesh will be brought by a canal for storage at Kandaleru reservoir and then to be taken to Poondi reservoir in Tamil Nadu near Chennai through a 150 km-long canal. The project got, however, embroiled in a controversy as the clearance from the Central government was not forthcoming. More importantly, the water flow to Chennai is also minimal as the 150 km-long canal had become dilapidated requiring a literal rebuilding of the entire canal. The Satya Sai Trust, a philanthropic religious organization, has now taken up the responsibility for funding canal reconstruction as well as storage improvement in Kandaleru (Parsa 2003).

[15] The remarks of the former Chief Minister of Bihar and the present Union Railway Minister Laloo Prasad Yadav show how inter-state water rights can the political problems associated with inter-state and inter-regional water transfers. He told that he will not allow water to be taken away from Bihar. But, when royalty (or compensation) is paid (and hence, the state's rights over the water is recognized), he will consider water transfers from Bihar.

[16] For instance, in Chennai, in the mid-1960s, the then government bought water rights from ayacutdars of the Red Hills and Cholavaram tanks. In recent years, the city is also considering the transfer of groundwater from the Araniar–Kusaithaliayar aquifer area that holds an enormous promise for providing Chennai with a low-cost supply of high-quality water (Briscoe 1997).

Opportunity Costs of Missing Rights

The opportunity costs of missing or unclear water rights and entitlements at different levels can be reckoned in terms of the potential economic, social, and political benefits being foregone as well as the social and political costs being borne. The overall significance of a water rights system emerges from the following simple arithmetic of costs that can be saved and benefits that are forgone under the current system of water allocation. There is an increasing recognition of the socio-economic and political costs associated with water sector mismanagement. Such costs are attributable mainly to inappropriate water management institutions, especially the absence or lack of clarity on water rights and water entitlements at various levels. While it is difficult to estimate these costs in precise terms, it is certainly possible to indicate their magnitude indirectly through other economic and fiscal losses from different perspectives.

The opportunity costs of lack of water rights are rather serious given the high proportion of the investment being absorbed by the water sector. While the water sector used to account for about 6 per cent of the total plan expenditures, the subsidy for the irrigation sector alone was nearly 0.30 per cent of GDP in 1994–5 (World Bank 1996). But, cost recovery is an endemic problem in the canal-based irrigation sector leading to a heavy financial loss to the tune of 22 billion rupees as of 1989–90 (GOI 1992b). Delay in project implementation and resource utilization due to inefficient planning and lack of farmers' cooperation also causes severe erosions in the value and benefit of irrigation investment. For instance, India has spent some Rs 325 billion during the Eighth Plan on irrigation development. Even if as little as 10 per cent of this expenditure is subjected to the problem noted above, it can mean a loss of 32 billion rupees (World Bank 1997). With the creation of powerful incentive among farmers for an efficient water use through the institution of WR&E system and economic pricing procedure, even if we succeed in effecting just a 10 per cent improvement in water use efficiency, it is possible to add easily an additional 14 million hectare of irrigation potential. Notably, the additional irrigation potential emerging from water use efficiency is very close to what is achieved in an entire five-year plan period with so much of investment of money and time.

The financial gap in the water sector can be approximated by the difference between the total investment costs and total revenue in the canal irrigation sector. The total investment in canal irrigation during 1951–2000 is estimated to be Rs 790 billion at current prices (GOI 2000). As we assume even a simple rate of 8 per cent to account for both interest and depreciation, the annual financial cost of canal irrigation provision comes to about Rs 63 billion. Although we do not have published information on the revenue from the canal sector, going by the estimate of the Committee on Pricing Irrigation water (GOI 1992b), we can reckon that the total revenue at present can be in the range of about Rs 3–5 billion. Such a huge financial gap clearly shows that the institutional aspects such as the water pricing policies and organizational mechanisms involved in water-charge collection are performing rather poorly. From an institutional perspective, poor pricing policies and weak organizations can be directly attributed to the absence of a WR&E system essential to provide both a technical basis for volumetric water pricing and an organizational basis for linking user groups.

Considering some of the fiscal, health, output, and resource impacts under existing institutional arrangements governing water allocation, use, and management of water resources, there are some rough and ballpark estimates both for the aggregate and problem-specific magnitudes of the opportunity costs of inappropriate water institutions in India. Table 10.1 gives these estimates, which are obviously partial and also pertain to the early-1990s.

As a result, the costs associated with inefficient resource use and the health impacts of insufficient water provision are directly associated with the

TABLE 10.1: Opportunity Cost Estimates for Inappropriate Water Institutions

Item	Problem	Impact (Year)	Average Cost (Billion US$)	Per Cent of GDP
1	Urban and rural water pollution	Health impacts (1991–92)	6.60	3.00
2	Soil degradation	Loss of farm output (1991–2)	1.90	1.00
3	Fiscal costs	Revenue deficit, poor services, and use inefficiency (1994–5)	0.70	0.30
4	Fiscal costs	Power subsidy, groundwater depletion, and pollution impact farm output (1994–5)	4.10	1.50
	Total		15.9[a]	4.8[b]

Note: [a]1991–2 figures for items 1 and 2 were converted to 1994–5 prices using the India GDP deflator (World Bank 1997), and added to the 1994–5 figures for items 3 and 4. The relevant exchange rate or these periods has been US$=Rs 36.

[b] All the figures in the column were added to give a ballpark lower bound, abstracting from likely changes in percentage shares between 1991–2 and 1994–5.

Sources: Brandon and Hommann (1995) and World Bank (1996).

absence of WR&E to regulate water withdrawal and ensure water supply. While the creation of WR&E system involves both heavy capital investments and real political costs, the opportunity costs associated with their absence are far higher given its present magnitude and future growth. Although the estimated opportunity costs in Table 10.1 represented about 5 per cent of GDP in 1994–5, their present reckoning can be still more alarming. If one considers the interest costs and accounts for the negative effects of urban water scarcity and groundwater depletion that has happened since 1994–5, the costs of inaction can be as high as 10 per cent of current GDP. What is notable is the fact that these costs can be close to, if not higher than, the total water sector investment in India. Apart from their monetary component, the opportunity costs also have an unfathomable social and political component associated with water sharing conflicts that are now becoming an expanding phenomenon both at the local and regional levels. In some cases (for example, Cauvery water dispute), water conflicts have even created major political changes, besides loss of life and property due to frequent local water conflicts and political protests.

ESTABLISHING WATER RIGHTS: POTENTIAL AND PROSPECTS

From an institutional perspective, considerable potential exists for developing the WR&E system by building on the water allocation and distribution arrangements such as the *Warabandi*, *Shejpali*, and *Pani Panchayat* systems. The existence of informal rights and institutional mechanisms provides opportunities for creating the WR&E system for sectors, regions, and individual users. Interestingly, despite its informal and imprecise nature, the prevailing water rights system is able to even support the emergence and growth of local water markets, especially in the groundwater areas. There are also many contexts where the WR&E framework can be used to address pressing water problems.

Existing Institutional Potential

While a user-managed water rights system is ideal for inducing efficient water use, promoting accountability, and resolving conflict, many would agree that its creation is not an easy task in the Indian context. The existence of many small farms, poor conveyance structures, political risks in creating the legal and organizational apparatus, and conceptual/information problems in defining water rights in physical and legal terms remain as major challenges. While the technical and investment needs are truly tremendous, one cannot underestimate the institutional potential for building more formal WR&E systems in many parts of India. Informal water rights—both individual and group—have existed in India since the ancient times (Siddiqui 1992) and continue even today, albeit in a much weaker form, in many tank irrigation systems of south India (Box 10.11). The existence of these implicit and informal water rights clearly suggests that the WR&E system is neither new nor incompatible with Indian ethos. More importantly, there are also a variety of more formal and semi-formal water rights that exist as part of formal institutional arrangements having the rudiments for developing formal and full-fledged WR&E systems (see Box 10.12). The Pani Panchayat is notable for its equity properties and land-water separation (Vani 1992, Ahmed 1992). Since water rights are provided to landless, there is an implicit recognition of transferability as the landless cannot benefit from such rights otherwise. This feature of water rights allocation in the Pani Panchayat system (also observed in the Sukhomajri system in Haryana), is very important for both equity and efficiency. On the other hand, the Shejpali system is designed to encourage efficient water use through an agreement with the farmers for secure water allocation to sanctioned area and crops (Ahmed 1991, p. 596).

Box 10.11: Practical Instances of Water Rights

In the delta regions of the Gangetic and Mahanadi in Orissa, West Bengal, Bihar, and Madhya Pradesh, there are officially granted non-transferable long-term water leases with the express purpose of encouraging farmers to use surface water (GOI 1976, p. 65). In few south Indian irrigation systems, there are informal but prioritized rights for different distributaries (Vaidyanathan 1985). A similar form of priority also exists in the case of water rights in Periyar–Vaigai basin where the water rights from Periyar are treated as senior over the same from Vaigai and separate records are kept for both in departmental office. In the groundwater regions, it is well known that de facto individual water rights exist and also enjoy a large degree of social acceptance. The amount of water implied by them is determined by factors such as farm size, well yield, and pumping capacity. In canal regions, water rights take the form of access rights under fixed tenure as they are limited to those owning land in canal regions.

Box 10.12: Cases of Rudimentary WR&E System

Two cases observed in Maharashtra have the rudiments for building formal WR&E systems. The Pani Panchayat is a user-managed system for sharing harvested water in terms of 'needs' as determined by family size than by farm size. The *Shejpali* (water distribution roaster) system is a state-managed water allocation system where canal authorities issue 'water passes' to farmers. These passes with duration varying from an irrigation season to six years have priority that varies directly with their duration. But, they lack quantification and transferability (Gandhi 1981, Rath and Mitra 1989). There are also a variety of other forms of user and community-managed systems ranging from lift irrigation and water harvesting schemes (Datye and Patil 1987, Sengupta 1993, Singh and Bhallab 1996) having the social and organizational basis for developing decentralized and locally managed WR&E system.

The currently practised formal water allocation procedures in canal regions such as the Warabandi, Osarabandi, and Varvaram also offer additional possibilities for building the WR&E systems on a wider scale (Box 10.13).

There is, however, a need for major investments on the modernization of distribution networks, installation of water measuring devices, and creation of enforcement and management organizations. From a technical and organizational perspective, the need for developing new legal systems, additional organizations, and technical capacities is also extensive. New investments for the modernization of water delivery networks, installation and upgradation of water measuring

Box 10.13: Warabandi as a Basis for WR&E

Warabandi, Osarabandi, and Varvaram are all time-based rotational water distribution procedures practised in different parts of the country. They provide a basis for developing formal WR&E as the time- or flow-based water entitlements allow the definition of water quantity. Besides their scope for quantifying water entitlements, these systems also assume significance in view of the long tradition, experience, and organizational capacity that the farmers have gained from the turn-based water allocation. These aspects assure the social and organizational conditions essential for the development of formal WR&E systems. However, the legal and technical conditions such as the volume-based rights, measurement systems, and the modernization of water delivery networks are yet to be satisfied in all contexts.

and accounting systems, and the creation of organizations at various water allocation levels are all essential. But, the capital costs of upgrading the technical and organizational basis of the systems are likely to decline due to scale economies emerging from large area coverage.

The informal but growing practice of groundwater trade among farmers widely observed across the country provides another more direct instance not only for the existence of de facto rights in groundwater but also for the emergence of markets for such rights. Although groundwater cannot be legally transferred apart from land, groundwater transfers do occur through the groundwater markets observed, at least, since the 1920s. Despite their localized nature and uneven pattern across regions, groundwater markets are growing in magnitude. Their characteristic features are that they occur without any formal water rights system and involve no sacrifice of self-irrigation. Although groundwater markets have significant efficiency and equity benefits, they still remain sub-optimal essentially due to the legal and institutional vacuum, that is, absence of legal status and quantity limits, within which they operate at present. A formal WR&E system that can legalize the existing de facto rights and set water quota for these rights could avoid the serious problems associated with the water markets such as water monopoly and aquifer depletion. Thus, a legalized and quota-based WR&E system can eliminate the negative effects while magnifying the positive benefits of water markets.

Emerging Scope for Establishing Water Rights

There are many cases where the establishment of WR&E framework can provide practical solutions to pressing water scarcity problems, that too, with both immediate economic and equity benefits as well as long-term institutional conditions for better water allocation and management. For demonstration purpose, two of these cases are described here.

The Chennai Case

Chennai has a perennial water scarcity problem as its traditional supply sources are unable to meet the growing water needs of the city. As a result, water supplywise Chennai has been the lowest served city among the metros in India.[17] The average domestic supply of 47 litres/capita/day (lpcd) remained far below the Indian standard of 70–100 lpcd for urban users with connections and 50 lpcd for stand pipe users (World Bank 1995). Although the water supply situation has improved with the arrival of Krishna water transferred from Andhra Pradesh, the demand gap continues to be grim as all existing sources are fully exploited and no additional transfer can be expected from Krishna sources (Briscoe 1997). The costs of moving additional water from sources outside the city region such as the transfer of Cauvery water through the Veeranam tank are prohibitively high.[18] It is for this very reason that this scheme

[17] Before the arrival of Krishna water, the per capita water supply in the city was just 70 litres/capita/day (lpcd) inclusive of all domestic and non-domestic water use whereas the corresponding figures for other cities are 253 lpcd for Mumbai, 220 lpcd for Delhi, 190 lpcd for Kolkata, and 125 lpcd for Bangalore (World Bank 1995).

[18] The capital costs of the Veeranam scheme involving an annual transfer of 66 MCM of water are estimated to be about $300 million. With the annualized cost of about $30 million for this 66 MCM implies a cost of 45 cents (or

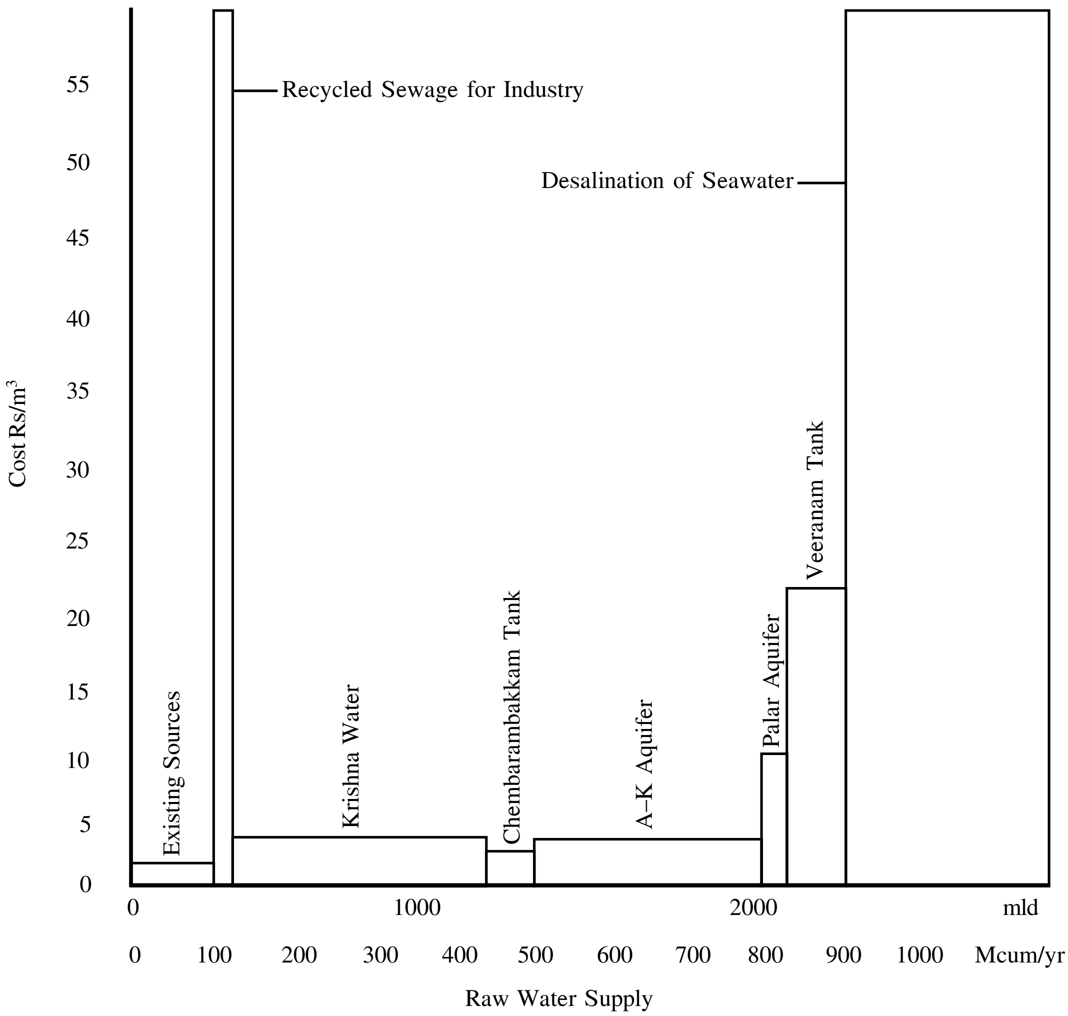

Figure 10.1: Relative Costs and Supply Potential of Water Sources, Chennai

Source: Briscoe (1997).

has been shelved permanently. Cost considerations apart, there is also a sustainability question as these outside sources cannot meet the full water needs of the city both at present and in future. Fortunately, the city has additional and affordable sources with a virtually unlimited supply of raw water within and around its own borders. But, this involves a reallocation of irrigation water from tanks and groundwater aquifers around the city and requires the establishment of tradable water rights for concerned farmers.

Compared to the costs and supply potential of existing and proposed schemes, the reallocation option is economically sound and supplywise sustainable. As can be seen from Figure 10.1, the costs of reallocated irrigation water from sources

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Rs 16) per cubic metre. Since there are also other operating costs including those for pumping, the cost can be still higher then this figure (Briscoe 1997).

such as Chembarambakkam tank and Araniar–Kusaithaliayar are only a minute fraction of the alternatives such as Verranam, seawater desalinization, and treated waster water. In contrast, the supply potential of the reallocation option is tremendous as well as immediate as compared to the costly alternatives with long gestation period. Notably, the city has relied on the reallocation option periodically to tide over serious water shortage. For instance, the city has purchased farmers' water rights from the Red Hills Reservoir in the 1960s (Ramakrishnan 2003) A groundwater team of the United Nations Development Program that assessed situation in 1988 has recommended that 'consideration should be given to the feasibility of buying water from farmers' (World Bank 1995). The World Bank mission has also recommended the same proposal in 1996 and the Metrowater informed the mission that it intends to rely on the option and also initiated the necessary procedures (Briscoe 1997). In 1996, the proposal was pilot-tested when Metrowater started purchasing small quantities of water on a temporary basis from farmers in the A–K aquifer.

As there is a strong case for buying irrigation water to solve the city's water problems, there is also a still stronger case for developing formal water rights for farmers to protect them from uncompensated encroachment and least compensated exploitation from private water vendors. This is very important from the perspective of farmers as the loss of irrigated farm land due to urban expansion is already cutting their rights to water without any additional compensation. As there has been a 40 per cent loss in irrigation, there has been an implicit and uncompensated transfer of about 18 mcum/year of irrigation water to municipal supply (Briscoe 1997). Moreover, unscrupulous private water vendors, who organize water transfers from irrigated areas to the city users at exorbitant rates, often exploit the water rights of farmers with no or only a marginal compensation. Thus, the development of a formal mechanism of WR&E is critical not just for benefiting urban consumers with low cost but good quality water but also for protecting farmers with the legal recognition of and the economic compensation for their rights.[19]

The Maharashtra Case

Maharashtra has taken some bold and innovative actions in 2002 and 2003 that have facilitated conditions for the introduction of a system of transferable water rights on the scale of the entire state. Under the currently ongoing Maharashtra Irrigation Improvement Project supported by the World Bank, the state has displayed its commitment for sectoral restructuring and policy reforms with a series of far reaching legal, policy, and organizational changes.

The most fundamental element underlying the reform initiatives of Maharashtra is the creation of the basic legal and organizational preconditions for promoting a state-wide system of WR&E (Box 10.14). Conditions that prompted these initiatives include the fiscal and economic implications of brewing water crisis, existence of considerable institutional potential (for example, Shejpali and *Pani* Panchayat systems), and commitments of state leadership, and technical and funding support from the World Bank.

Role of the World Bank

As articulated in its new Water Resources Sector Strategy (World Bank 2004), the World Bank has a major role as well as stake in promoting the WR&E system both in India and elsewhere because this is a key institutional means for ensuring water access to the poor, creating incentives for use efficiency, and enhancing food security. The Bank aims to promote a WR&E system based on the principle that 'water is public

[19] Rough calculations suggest that the value of water in irrigation in Tamil Nadu is less than Rs 0.5/cubic metre. Even if Metrowater had to pay several times this amount, it could obtain additional water from the Tank and the A–K at a unit cost of around Rs 1.70 and Rs 2.0/cubic metre, respectively, which is less than, or comparable to, the costs of Krishna and Veeranam sources. In comparing these costs, it should be noted that residents and industries of Madras have long paid vendors between Rs 25 and Rs 45/ cubic metre of water (Briscoe 1997).

Box 10.14 Feature of the Water Entitlements System

The Vision of the Maharashtra Bill

The creation of water entitlements system is at heart of the MWRRA Bill. The bill clarifies the legal issues and contemplates the establishment of the institutional arrangements needed for the distribution, enforcement, and monitoring of the entitlements. While establishment of individual and transferable water rights is the long terms strategy, the Bill adopts a politically and administratively pragmatic intermediate strategy of establishing bulk water entitlements for entities such as water user organizations, urban and rural water supply agencies, and industries. Notably, water rights and entitlements are not ownership rights but only usufructuary rights defined in volumetric sense. Such entitlements cover both surface and sub-surface water sources. The water quota implied in the water entitlements can be transferred, sold, and bartered either in part or in full. This provision protects poor users as it ensures that the entitlements remain with the users while the water quota is being transferred. Water entitlements also carry with them the correlated duties including payments, efficient use, and quality maintenance. The bulk water entitlements will be defined and implemented within a basin and sub-basin framework. While the MWRRA will allocate bulk rights, the basin organizations and user organizations at lower level will have responsibility of day-to-day monitoring and enforcement. Adequate provisions are also made for resolving conflicts and grievances both at the local and regional levels.

Source: MWRRA Bill.

owned and that a water right is usufructory—it is right to use, not right to own' (World Bank 2004, p. 16). Importantly, while the Bank advocates such rights to be tradable, it fully recognizes the need to avoid the unhealthy effects of commodifying water with deep cultural significance and to overcome the difficulties associated with the fugitive nature of a fluid resource (World Bank 2004). However, the development of WR&E framework is still essential in view of its central role in the overall Bank's strategy for poverty alleviation as well as for food and livelihood generation.

It is important for India and the World Bank to work together in creating one of the most critical institutional requirements of sustainable development. The success of this partnership depends clearly on building on the framework of mutual responsibility and comparative advantages. It is in this larger context that the specific role of the Bank has to be approached and assessed.

Since the Bank supports some of the important components of water resource development and management in India, it still has considerable influence in the direction of water sector policies. Over the years, the Bank has contributed both to the debate on water sector reforms, including the need for developing allocation mechanisms based on formal WR&E system, through its investment programmes and technical assistance. These contributions were significant, especially since 1993, when there has been a radical shift in the Bank's policy from project and engineering focus to sectoral and resource management focus (Pitman 2002). With such a changing focus, the Bank has become increasingly involved in Indian policy debates on institutional reforms both within and outside the water sector. Meanwhile, the fiscal crisis of the late 1980s and the onset of the New Economic Reform of 1991 have also created more conducive policy environment for undertaking more general fiscal and economic reforms. These reforms have both direct and indirect effects on the water sector as well.

Against the backdrop of the reform debate witnessed during the early to mid-1990s, some of the Bank-funded projects (for example, Water Resources Consolidation Projects in Andhra Pradesh, Tamil Nadu, and Orissa, and Water Sector Restructuring Project in Rajasthan) have also promoted some of the basic conditions for water allocation and management such as the organizational reforms, system improvements, creation of basin and user organizations, capacity building and data generation, and technical upgradation of water management. Notably, the Andhra Pradesh Irrigation Act has established the water rights of both farmers as well as water user associations (Oblitas and Peter 1999). Although practical translation of these rights has not yet occurred, this is still a positive step in the long process needed for the real institution of a WR&E system. Besides the favourable policy environment created by the economic crisis of the late-1980s, there has also been a new generation of reform-minded political leaders and administrators who enabled the Bank's dialogue to move from state-line agencies to the larger body politic (Pitman 2002). The policy debate on WR&E system was mainstreamed by the 1991 Irrigation Sector Review carried out jointly by the GOI and the World Bank. More specific reform agenda including the legal, organizational, and technical conditions for the development of WR&E system has been outlined in the Water Resources Management Sector Review jointly conducted by the GOI and the World Bank during 1996–8.

The sector review has proposed one of the most comprehensive and forward-looking reform agenda for setting right the institutional foundation of Indian water sector over an agreed time frame within which the Bank will work closely with the GOI and the state governments. The heart of the reform agenda lies in the creation of a WR&E framework applicable at the regional, sectoral, and user levels. But, this fact could not be mainstreamed, as this critical institutional reform component was shadowed by a lengthy list of recommendations—over 170 reform components of which 82 cover national and state-level reforms—identified in the document (World Bank 1998a). As a result, the reform agenda, though comprehensive and important, is an overwhelming challenge to both the Indian government as well as for the Bank (Pitman 2002). This is actually a case of setting priorities on too many items causing no priority and hence, no outcome on all fronts. What the Bank can do in the immediate future is to work with the GOI and the state governments to rework the reform agenda to make the WR&E system as the central components around which other reform components are rallied within a 'pragmatic but principled' framework. For initiating this process of policy dialogue and reform formulation, there cannot be a better time than at present as the country is still reeling under the socio-economic effects of the serious droughts and the political effects of a number of interstate water conflicts.

Although the reform agenda has been agreed to in principle by the central and state governments, the technical and investment requirements for its implementation are beyond their means as is the development and sustenance of the political will to implement them. However, as the reform components are specified with appropriate prioritization and sequencing, it is possible to implement them in a phased manner. While the Bank can provide critical investment and technical support, it is important to understand its abilities as well as limitations in supporting the implementation of such a politically sensitive subject as the WR&E. Thus, the major task of marshalling political support as well as ensuring the political and administrative commitments for carrying forward the reform process largely rests with the Indian political leaders, policy-makers, academics, and more importantly the media. What roles the government and the Bank can play in creating the WR&E system are amply demonstrated by the Maharashtra initiative under the currently ongoing Maharashtra Irrigation Improvement Project. In this case, the Bank has provided technical inputs and funding support while the state government has marshaled the political will and kept its commitment to undertake the necessary legal and organizational arrangements for creating the WR&E framework. In fact, Maharashtra's case provides an ideal example on how the comparative advantages of the state and the Bank can be used well to promote the institutional change.

While state-wide initiatives for promoting WR&E systems are very relevant where conditions are ripe, the Bank can also play a role in supporting the states to create some of the preconditions for an eventual creation of more formal water allocation systems. The experiences of states such as Tamil Nadu, Andhra Pradesh, and Orissa under their respective Water Resource Consolidation Projects show how the Bank's investment and technical support can be used to create the policy, technical, and organizational conditions for developing WR&E-based allocation arrangements at various levels. Besides its support to state-level initiatives, the Bank can also support the experimentation and development of water rights systems at grassroots level, especially on a pilot scale. Existing informal systems such as the local water harvesting structures in states such as Rajasthan and tank systems in states such as Tamil Nadu as also the formal water user associations in the canal regions of Andhra Pradesh and Madhya Pradesh provide opportunities for piloting local-level WR&E system.

Options and Strategies

The recently adopted Water Resources Sector Strategy of the Bank (World Bank 2004) provides a new direction for the Bank's engagement in the water sector. As this strategy reflects the changing economic and resource realities of water sector in developing countries as well as the Bank's own learning from its investment experience, it is more focused as well as strategic in its objectives and approach. As per this new strategy, the poverty alleviation objectives of the Bank-supported water-based interventions are articulated within a matrix framework and the overall approach is guided by 'principled pragmatism' necessary to deal with the political economy aspects. As water resource development possibilities are becoming thinner and costlier, many countries including India are requiring strong institutional arrangements for the allocation and management of their limited water resources. At the same time, these countries also require to develop additional water resources, wherever it is possible. In line with this changing requirement, the Bank's investments have to be directed more towards institutional development projects with slower changes and gradual returns rather than water development works with more risk and high returns. As a result, the emphasis on political economy aspects and context-specific, prioritized, sequencing, and 'patient' approaches becomes indispensable.

The options available for the Bank to support the development of WR&E in India are generic in the sense that the same options can be applied in a variety of other countries displaying similar economic, political, and resource realities. These options are based on three key instruments that the Bank has in influencing reforms, that is, funds, policy levers, and technical inputs. The past, ongoing, and future investments of the Bank are the major tools for supporting state governments in creating WR&E systems at various levels. Investments can be an effective tool only when the political environment is propitious and technical support is available for developing the necessary legal and organizational arrangements for underpinning the new allocation mechanisms. Although building the political consensus is the task of the state undertaking the reforms, the Bank can play a catalytic role in mainstreaming the issues and promoting reform dialogues. The Bank can also use the option of providing technical support in areas such as information base and capacity building.

Other options involve a multi-track strategy with medium- and long-term approaches. Thus, in states such as Tamil Nadu, Andhra Pradesh, Orissa, and Uttar Pradesh, the medium-term option of creating the basic conditions needed for the WR&E system can be created gradually within a phased and sequential manner within a well-planned medium-term framework. In fact, under the ongoing or recently concluded Bank-funded projects, these states have undertaken significant organizational reforms, including the creation of outlet and basin-level organizations. It is now time to consider the possibility of piloting the WR&E systems at the basin and local levels. Such pilot schemes can be a part of a larger water sector projects and can include not only irrigated areas but also urban areas. One area where the system can be experimented with greater effectiveness and benefits is Chennai.

While the multi-track options suggest different paths for different states, it is necessary to pursue them within the framework of area prioritization as determined by relative institutional potentials and political willingness for reforms. Although the strategy of the Bank in working with 'focus states' is often criticized by the Indian media and academics as sidestepping the needs of other states (OED 2001), there are powerful arguments for concentrating the resources for attaining consistent progress in key areas (Pitman 2002). The focused strategy is particularly relevant for promoting critical institutions such as the WR&E system that needs a 5- to 10-year period for its creation and consolidation. This is particularly so as this institutional reform has to be sequenced with and packaged within a larger investment package for sectoral and state-level development. It is necessary to reward the institutional reforms and consolidate the social gains rather than fritter away the limited resource and energy on a larger canvas.

From an overall perspective, the general approach of the Bank is to follow a sequential strategy both in covering the states as well as in promoting institutional components necessary for the WR&E system within the state. Obviously, the states and areas with felt demand and expressed commitment for reform are to receive priority over others. Similarly, the reform components receiving top priority are the creation of the legal and organizational arrangements both at the macro and micro levels, the development of technical information, and system upgradation for volumetric water delivery. The establishment of bulk water rights for sectors and sub-regions has to precede that of the local and individual rights. In promoting the WR&E system in particular and water institutional reform in general, it is necessary to recognize some key rules (Briscoe 2002). The practice of picking the 'low-hanging fruits' is less costly and it provides more incentives for reforms, as 'nothing succeeds like success'. Similarly, the contextualization of reforms is important as there is no unique recipe for universal application. The new water sector strategy of the Bank, in fact, underlines these principles in terms of its emphasis on reform prioritization, sequencing, and principled pragmatism. A recent analysis of water institutional reforms across countries also provides empirical evidences for the way these reform design and implementation principles are actually used by countries to promote reforms (Saleth and Dinar 2004).

Finally, the Bank also has a major role in the policy discourse on the WR&E system at the national level. While the joint sector review has elaborated various options for reforming the water sector both at the national and state level, it is necessary now to rework these options to rally them around the WR&E system. The central government, especially, the Ministry of Water Resources, has to be taken into confidence and be involved in the exercise of reformulation of these options. Mainstreaming the issue involves more effective use of the policy, academic, and media communities. There is also need for a change in the strategy to sell the idea to policy-makers and user community. There is a strategic error in over-emphasizing use efficiency and market allocation to the point of eclipsing the very crucial equity and poverty alleviation effects of the WR&E system. In fact, the market allocation is easily distorted to project the system as a precursor to water privatization and commercialization. The media has to be involved in discussing the issue and in presenting why and how this is indispensable for the water future of the country. One critical area where the Bank can support pertains to a long-term program of education, dialogue, and public relation to sell the idea to all the key players in the country.

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11

Institutional and Policy Reforms

TUSHAAR SHAH

Responses to Water Scarcity

Water scarcity has emerged as an important theme in discussions on India's future. Indeed, by 2025, by many accounts, much of India is expected to be part of that one-third of the world which is expected to face absolute water scarcity (Cosgrove 2003, Cosgrove and Rijsberman 2003, Rosegrant et al. 2002). The intensification of water scarcity is expected to play out in myriad different ways. A major implication will be for the capacity of the country to produce food for its growing population. Another is the escalation of conflicts around water at local as well as river basin level amongst user groups, sectors, rural, and urban areas. A third is the growing competition for water between man and nature, and the concern about productive uses taking too much water away from nature.

Global analyses and discussions about ways to cope with and overcome water scarcity in the developing countries have resulted in a widely shared consensus over three aspects:

- slowing down investments in water infrastructure, especially, irrigation which is increasingly seen to be in competition with nature;
- honing the social capacity of communities and societies to adapt to water scarcity (Ohlsson and Turton 1999, Wolfe and Brooks 2003); and
- Integrated Water Resources Management (IWRM).

IWRM has been subjected to a variety of definitions; however, it is centrally about building capacities and institutions at different levels in a society for direct management of sectoral and aggregate water demand, something which is completely or mostly absent in many developing countries. This is particularly so in agricultural water use, which often is the prime cause of water scarcity as in India. Since the 1950s, the supply side focus of public policy action in the water sector—of governments as well as donors—has been on 'developing' the resource by investing in infrastructure. IWRM discussions emphasize the need to focus on 'managing' the resource by turning attention to the demand-side approaches. In particular, IWRM includes:

- pricing water, especially outside life-line uses so that it is efficiently used and allocated to high value uses;

- appropriate legislative and regulatory framework for coordinated action for sustainable water resources management;
- creation of appropriate property rights so that negative externalities of 'open access' are mitigated;
- participatory Resource Management so that 'water becomes everybody's business';
- river basin as the unit of water resources management and creation of river basin organizations in place of territorial/ functional departments to improve basin level water productivity; and
- enunciate a clear water policy so that there is a cohesive, well-understood normative framework to guide all decision-makers in the sector.

The IWRM discourse also jives well with emerging global discussion on improving and strengthening the governance of river basins through Integrated River Basin Management (IRBM). This, it is hoped, will help alleviate water poverty by improving access to water and minimizing environmental ill-effects associated with current patterns of water resources development in developing countries like India (Lawrence et al. 2003). Improved governance of river basin involves working on three pillars of the water institutional framework: water policies, water laws and water administration (Bandaragoda and Firdausi 1992, Merrey 1996, Frederickson and Vissia 1998, Holmes 2000, Saleth 2004, Saleth and Dinar 2000).

Water Poverty and Economic Development

A Water Poverty Index (WPI) covering 147 countries published by researchers from Keele University and Centre for Ecology and Hydrology, Wallingford, UK in 2003 was constructed by combining five component indices that cover water resource endowments, access to water, human capacity, water use efficiency, and quality of water environment (see Annex Table A11.1). Each of the five component indices was given equal weight to generate the (WPI) that takes values in the range of 0 and 100, the higher the value, lower the water poverty.

What determines the level of a country's water poverty? The authors of WPI are clear about the direct relationship between water scarcity and WPI when they say their aim was to 'express an interdisciplinary measure which links household welfare with water availability and indicates the degree to which water scarcity impacts on human populations' (Lawrence et al. 2003).

It might be argued that the real indicator of water poverty is 'Water Access Poverty (WAP)' which, unlike WPI, does not have any of the HDI components in it. WPI is strongly related to HDI. The higher the HDI, the lower is the water poverty, regardless of the countries' water endowments. Laos, Nicaragua, Cambodia, Bangladesh, and Sierra Leon have much higher per capita water endowments compared to Egypt, Saudi Arabia, UK, and Mauritius; yet the former are far more 'Water Access Poor' than the latter.

In exploring the relationship between the quality of environment and levels of economic development, researchers have already postulated and tested the 'Environmental Kuznet's Curve' which would suggest that as countries begin from low levels of economic growth, the quality of their environment first declines as intensive growth uses natural resources as 'factors of product-ion'(Bhattarai and Hammig 2001). However, as levels of living improve, growing demand for 'environmental amenity' generate pressures to seek avenues for economic growth that are light in the demands they make on scarce natural resources—what Gleick (2002) calls 'soft water path'.

Table 11.1 shows multiple regression results. The data set for 147 countries used is the one compiled by Lawrence et al. (2003). The regressions use the WPI and component indices as dependent variables; HDI as well as PPP-adjusted GDP are from UNDP 2003. Figures in brackets below B-coefficients are standardized B-coefficients and represent the relative significance

TABLE 11.1: Multiple Regression Results of WPI and WAP

	Dependent Variable	Intercept	B-Coefficient for				
			Index of Water Resource Availability (0–20)	Human Development Index (0–1)	Index of GDP/Capita (PPP Adjusted in '000 US$) (0–1)	Square of GDP per Capita in US$)	R^2
1	Water Poverty	17.761	1.086	43.283			0.842
	Index (0–100)	(12.261)	(0.433)	(0.796)			
			[13.048]	[24.022]			
2	Water Poverty	20.646	1.205		39.574		0.788
	Index (0–100)	[12.765]	(0.482)		(0.764)		
			[12.508]				
3	Index of access	–3.491	0.037	24.307			0.754
	to water (0–20)	[–3.743]	(0.029)	(0.867)			
			[0.691]	[20.95]			
4	Index of access	–1.862	0.103		22.22		0.691
	to water (0–20)	[–1.845]	(0.080)		(0.831)		
			[1.721]		[17.863]		
5	Index of Water	7.215	0.138		3.804		0.227
	Environment	[12.331]	(0.292)		(0.388)		
	(0–20)		[3.962]		[5.273]		
6	Index of Water	15.09	0.149		–23.778	21.638	0.387
	Environment		(0.314)		(–2.425)	(2.842)	
	(0–20)	[10.806]	[4.773]		[–5.191]	[6.082]	

of included explanatory variables in explaining the variations in the dependent variable.[1]

In regressions 1 and 2, besides HDI and GDP, respectively, water resource endowment is statistically significant and has a large standardized B-coefficient, likely because water resource endowment is a component of WPI. In regressions 3 and 4, however, water resource endowment turns insignificant and its standardized B-coefficients are very small, too. In these regressions, HDI and GDP per capita emerge as the key determinants of Water Access Poverty with large t-ratios as well as standardized B-coefficients. Regression 5 suggests resource availability as well as GDP are significant determinants of water environment; but the overall fit of this regression improves greatly (as suggested by the increase in R^2 in regression 6) when the squared value of GDP is added.

This analysis suggests, in the extreme, that in the long run, there may not be any such thing as physical water scarcity. A more balanced conclusion however is that economic development is a critical 'adjustment variable' in the process by which societies reduce their 'water poverty'. Societies 'manufacture' water scarcity as they

[1] Figures in parantheses are values of the t-ratio; for the sample size of 147, any value of t-ratio above 2.0 might be considered significant.

grow in demographic and economic terms, and gradually adapt themselves and restructure their economic systems to fit their endowments of natural resources. The focus of science and action should be on understanding the barriers to this adaptive process.

IWRM in an Informal Water Economy

Many people feel disturbed by these results because it apparently leads them to conclude that low-income countries have little or no scope to improve their water resources management, and that economic growth is the only path for them to reduce their water poverty. Nothing could be farther from the truth.

A more appropriate and logical conclusion to draw from this analysis is that in order to be effective, water resource management strategies of nations have to be context-specific; and the defining aspect of the context that matters is the position of a country in the evolutionary process of economic development rather than its water resource endowment. This analysis raises questions about the usefulness of the one-size-fits-all frameworks—such as IWRM—that dominate global discussions about how developing countries can put their water sectors in order. Use of economic pricing to encourage efficient allocation and use of water, transforming irrigation bureaucracies into river basin organizations for Integrated River Basin Management, enforcing effective laws to regulate groundwater over-exploitation, river pollution, waste-water re-cycling, wet land protection are some of the stock policy reforms that are commonly recommended and which generally fail to take off.

The constraint developing countries run into in implementing these arises from the highly informal nature of their water economies; and this has nothing to do with their water scarcity or abundance but it has everything to do with their being at early stages of overall economic development. Take the case of India. India's Tenth Five-Year Plan claims that protected water supply covers 95 per cent of the country's rural habitations; yet a large nation-wide survey in 1998 that reached out to some 130,000 rural and urban households showed a different picture as Figures 11.1 and 11.2 show. Nearly 80 per cent of India's rural households self-supply their domestic water requirements and are not in contact with any service provider or public agency in the formal sector. For urban households, the opposite holds, which suggests that as India urbanizes, growing proportions of its population would come into contact with formal water service providers. Comparing the data across states suggests that in poorer states like Bihar and Uttar Pradesh, all or most rural households self-supply their domestic water, whereas in somewhat better-off states such as Haryana, Punjab, and Goa, domestic water supply gets increasingly 'formalized', suggesting that even rural households begin getting hooked up to some public supply system as village economies grow, regardless of water resource endowments. IWMI–Tata studies in six Indian cities during 2003 showed that economically strong households were much more likely to be connected to public water supply systems and poorer ones either self-supply or rely on informal sector service providers.

The picture with irrigation is no different. Many researchers have shown that although under the control of government bureaucracies, at the grassroots levels, India's canal systems are barely functioning anarchies, with informal norms ruling the roost. Even so, if we assume that farmers served by canals are in some sense connected to the 'formal' system, a government survey in 2003 of 4646 villages throughout India showed that over 80 per cent of sample villages used irrigation mostly from wells but also from tanks, and streams without being connected with, or under direct administrative influence of, either the irrigation bureaucracy or any other formal agency. This is village-level data; but much other evidence can be adduced from household level surveys in support of the fact that there is a great deal more irrigation going on in India than is acknowledged; and over four-fifth of this is in the informal sector. For instance, the NSS 54th round of survey (NSSO 1999, report 452:46) in 1998 of 78,990 rural households in 5110 villages throughout India concluded that only 90 per cent of water infrastructural assets used by survey households were self-managed (and owned) by households; only around 10 per cent was owned and/or managed by government or local community organizations.

This predominantly informal nature of India's water economy raises questions about the reach

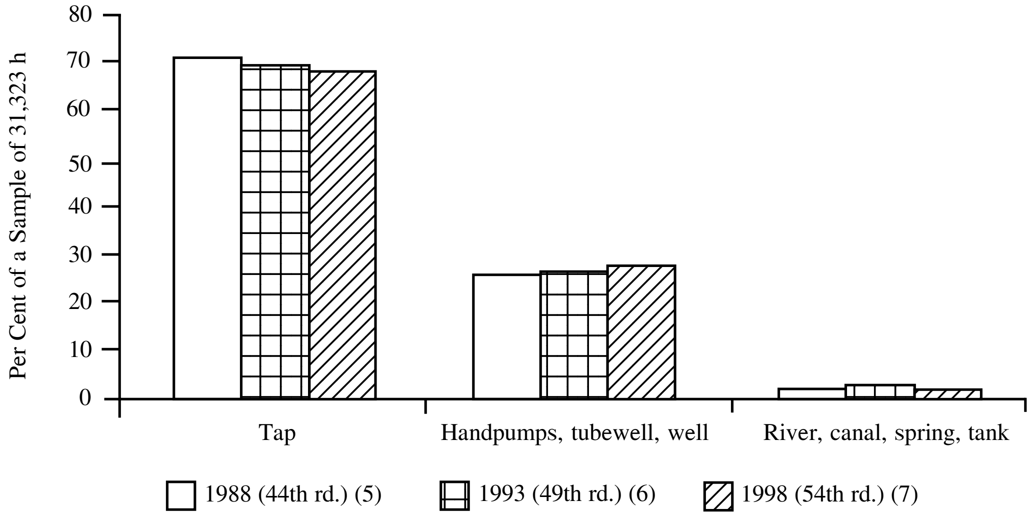


Figure 11.1: Urban Households (%) Dependent on Alternative Sources for Drinking Water

Source: NSSO (1999), report 449.

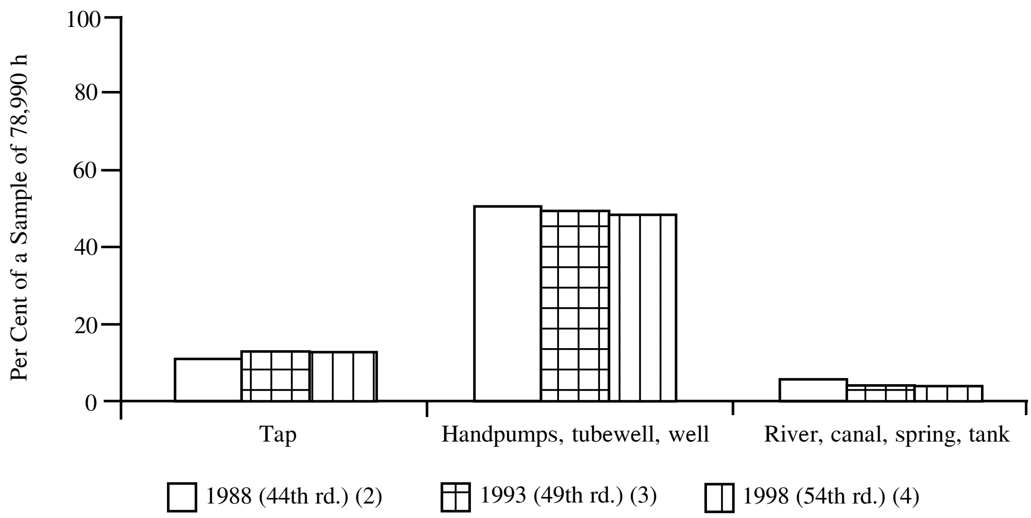


Figure 11.2: Rural Households (%) Dependent on Alternative Sources for Drinking Water

Source: Same as Figure 11.1.

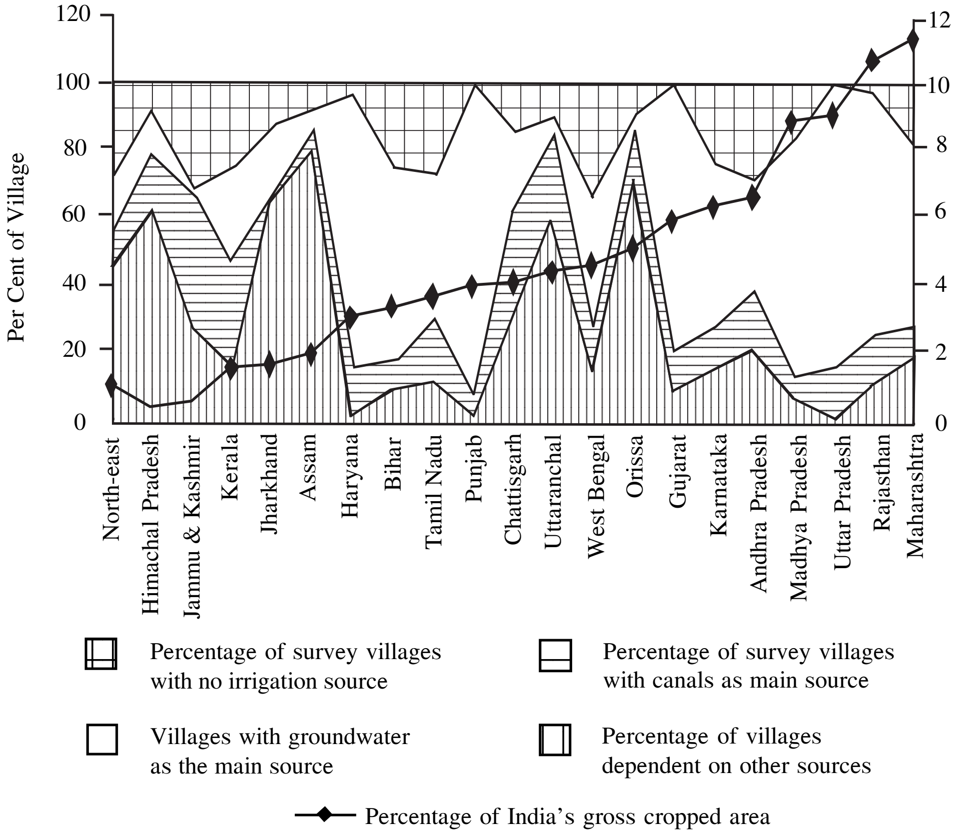


Figure 11.3: Villages Dependent on Alternative Irrigation Sources (%) (Survey of 4646 Villages)

Source: NSSO (2003), report 487.

of the three pillars of water governance: policy, law, and administration. It also raises questions about the practicality of implementing water pricing, basin-level water allocation, and water legislation. How to collect a water price or use river basin agencies to allocate water amongst sectors and users if by far the majority of users self-provide their water needs without being connected to any formal agency? Likewise, how does any administration effectively enforce a groundwater law if 20 million farming households owning irrigation wells are strongly opposed to it, and the rest are indifferent or weakly opposed to it, especially when the administration is an instrument of a state that styles itself as a democratic welfare state?

The Nature of the State and Informal Water Economies

The nature of the state also enters the picture here. China's rural water economy is nearly as informal as India's. However, the Chinese state has greater wherewithal to rein in its informal water economy than India's in three respects:

- Under China's single party political organization, it has strong village-level authority structures that are largely absent in South Asian countries (Shah et al. 2004). Like India's *gram* panchayats, China too has elected village development committees whose chairman enjoys popular support. These, however, when it comes to enforcing regulatory instruments, would be as toothless as India's gram panchayats but for the village party secretary who is nominated by the upper echelons of the party hierarchy. The party secretary enjoys formidable coercive power and is a potent instrument for implementing government policies at the village level.

- Then, the Chinese water bureaucracy is several times larger than in South Asia and has a wide reach and deep presence right to the village level. In India, for example, at the village or even taluka level, there is no government functionary in charge of water resources other than a public tubewell operator or a canal *chowkidar.* China has at least one but often more functionaries at the village level exclusively in charge of water resources management; and the town, country, and prefecture level water bureaus are like nothing we find in other developing countries. Pakistan has retained the institution of *numberdars* who play some role in collecting irrigation fees (Shah et al. 2000); but most other countries including India have none.
- Finally, Chinese farmers have dense financial transaction with the state; they pay a wide range of taxes and levies, including the salaries of village-level functionaries. It may well be that the Chinese farmers pay more taxes than they receive as subsidies and other financial support from the government. In India, the financial relations between the state and the farmers has become a one-way traffic; the state provides all manner of subsidies but hardly collects any taxes or even user charges.

With its greater reach and coercive authority as well as politico-administrative apparatus going down to the village level, one would think that China should be able to potentially enforce regulations on its informal water economy more effectively compared to the Indian state or most South Asian states. However, if controlling groundwater abuse is taken as a litmus test, then the success of the Chinese state in dealing with groundwater depletion in North China plains has been only marginally better than in South Asian countries. Indeed, there are no examples anywhere in the developing world of effective regulation of groundwater use that have worked on a significant scale for a reasonable period of time. Oman, is perhaps the only example (van der Gun, personal communication); here the popular sultan has been able to use his authority to significantly regulate groundwater use for irrigation. Saudi Arabia too has been able to reduce agricultural use of groundwater but only by paying farmers an attractive price to divert their pumpage to urban water supply schemes. Mexico has been trying local groundwater user associations (called COTAS); these have performed useful educative role, but are far from proactively managing groundwater use in agriculture. Indeed, when one probes them deeper, one finds that the western Uttar Pradesh success stories in groundwater management often involve supplying newly developed imported surface water to farmers in lieu of groundwater pumping. But this is no demand management.

In predominantly informal water economies where most users self-provide their water needs by directly diverting it from nature, pricing of water to move it to higher value uses has proved as difficult to implement as regulating groundwater draft in India and China through permits and quotas. Indeed, the only case I have come across of a recent large-scale success, that of Tanzania, is interesting in order to understand what it takes to make IWRM paradigm work in an informal water economy and whether it was worthwhile. Soon after independence, Tanzania declared free water as the fundamental right of the people. Since then, however, its development philosophy has been swinging from one extreme to the other. During the 1990s, however, it embraced the IWRM paradigm; and its Water Law of 1997 provided for universal pricing of water, the formation of Water User Associations in every village, and their nesting into Catchment Committees and Basin Organizations. This looked like a make-believe reform that would be well nigh impossible to implement in India. However, in a recent field trip to a few of the 24 villages falling in the Mkoji river catchment (in Rufiji basin) in south-western Tanzania, we found this was actually working there (van Koppen et al. 2005). The villages we visited seemed poor, backward, and under-capitalized even by Bihar and Jharkhand standards. However, each village had a (nearly registered) Water User Association with a written constitution that mandated compulsory universal membership of everyone above the age of 18. There was hardly any public investment in water infrastructure in these villages; all households drew water from the river; irrigation was done through small diversion structures farmers made and operated themselves. There seemed nothing the government offered which justified a water fee; yet, in Inyala, one of the larger villages we probed in some detail, over 80 per cent of all men and women above the age of 18 were paying since 2000 an annual water fee of 500 shillings each (about US$0.5). The Inyala WUA contributed sh 50,000 (US$50)/year to the Catchment Committee as annual membership fee; and sh 146,000 (US$146) to the Basin office towards the use of water. At a half-day's earnings of an able-bodied person, the money involved is small; the issue is what they get in return. When the Basin Office first came to Inyala in 2000 to sell IWRM, people of Inyala were promised new infrastructure, more donor funds, and better resolution of their constant conflict with upstream irrigators through the Catchment Committee. However, if anything, Inyala people felt worse off. At peak irrigation times, upstream villages modified their earthen diversion structures to appropriate more water, leaving less for downstream Inyala. Once Inyala began paying water fees when upstream villages were not, its WUA asserted its superior right to get water. Thereupon, upstream villages too began paying; but they now asserted their right to keep the entire river to themselves, leaving even less water for Inyala than they did earlier. Much to their chagrin, instead of disciplining upstream villages, the Basin office commended to Inyala a rotation of canals to achieve more equitable distribution of such water as was available. This Inyala irrigators did to their benefit; but this meant that channels which earlier always had some water for domestic users now began to remain bone-dry for several days; and households which had long depended on them for their domestic water needs now have to go much farther. While paying the same water fee as irrigators, domestic users felt cheated by IWRM. Despite all these, we came out of Inyala convinced that the reforms so far implemented can continue because Tanzania has the institution of *mgambo*, or village government militia, the like of which few other countries have. Although originally created as an institution for civil defense, the Mgambo has now emerged as a powerful enforcement mechanism for village as well as national government.

My impression from the villages we visited was that the Mgambo are quick and efficient in securing compliance with the Village Committee's decisions. Mgambo are the reason why every Tanzanian, rural or urban, regardless of his/her income, was made to pay an income tax until it was abolished for farmers last year; why every adult of Inyala forks out sh 2500/year to finance the primary school. They are also the reason why 80 per cent of Inalya's adults pay sh 500/year by way of water fees; the remaining 20 per cent are so poor that the Village Committee exempted them from paying fees.

Tanzania's Mgambo, Oman's sultan, and China's village party secretary are exceptions that prove the rule that regulating the behaviour of water users in a predominantly informal water economies require authority structures of the kind India has eschewed. In designing water governance strategies for India, it seems more sensible to take the 'nature of the state' as well as the nature of the water economy as given in the immediate run rather than assume that the nature of the state will change to resolve water sector problems. Failure to do this produces reform that results in a maze of distortions without producing any more effective water governance.

IWRM in Africa: Lessons for India

With the onset of the 1990s, many African countries took to IWRM wholesale. Almost everywhere, thinking about improving the functioning of the water economy involved little effort to understand reforms to the local reality. Almost everywhere, water reforms declared water as state property, instituted water withdrawal permits, made water pricing mandatory for all but domestic uses, resulted in formation of river basin organizations in water economies where the bulk of the water diverted and most of the water users are in the informal sector with little or no direct contact with formal water agencies. Institutional reforms take a long time to sink and produce desired impacts; in Africa, however, evidence is already piling to suggest that IWRM reforms seem to have done little to usher in effective IWRM in most countries that tried them. A recent African Water Law Workshop (See Shah and Van Koppen 2005) identified four problems:

- the aims that the water reforms seemed designed to achieve did not reflect the water sector priorities of the countries as viewed by national policy makers and citizens;
- the reforms touched only a small segment of the water economy and a tiny proportion of water use and users; as a result, their impacts on the water sector were neither deep nor broad;
- they posed serious threats to customary laws and institutions evolved and used by communities; these are never ideal, but they are time-tested, robust, and perform their basic functions well; and
- they also created serious distortions, threatened disenfranchisement of larger numbers of poor, and created new vested interests; these potentially deleterious impacts were limited only by the fact that almost everywhere reforms failed to stick, laws remained largely unenforced, water prices remained uncollected.

What, then, went wrong with Africa's water reforms? Several things, it seems. Many countries just copied laws made elsewhere, just as several states in India have blindly copied Andhra Pradesh's law on participatory irrigation management, and Pakistan Punjab has copied the water law of the state of Colorado. In Africa too, Tanzania has almost blindly followed water reforms Ghana has been implementing for the past 8 years. Without consultation, public participation, and a serious attempt to fit reforms to the context, the impact of these reforms was bound to be negative if at all. And now, Ghana is having second thoughts on its reform strategy and going back to the drawing board.

Another major influence seems to have been of international agencies and global thinking. Tanzania is a case in point; its 1999 water policy identified water development and provision as a key national policy goal and argued for more water storage creation. However, creating new storage and infrastructure was anathema to international donors; so, as we saw earlier, Tanzania ended up doing what donors would support: IWRM, which included legal institutional reform, river basin organizations, WUAs, but no attempt to get what its people need most, better and more infrastructure. One researcher commented that Tanzanians all along had plans to build storages but were secretive about it for the fear of donor reprimand. In implementing the first phase of the World Bank project, however, the political leaders figured that what Tanzania's rural communities need are domestic water supply systems, improved irrigation water control, and better hydraulic infrastructure. Apparently, the water resources minister wanted the phase II of the project to do more of these rather than IWRM, Mgambo style.

The only country in Africa where water reforms have produced improved governance of the water resource is South Africa, which has emerged as a model, exemplifying best practices for IWRM-type water sector reforms in an emerging economy context. South Africa is interesting because of its first-world–third-world duality. In terms of income inequality, South Africa is next only to Brazil. Fifty-four per cent of South Africa's water use is in agriculture and 95 per cent of its farm lands are owned by a small minority of white commercial farmers. In general, 90 per cent of its water use is in the formal sector; but 90 per cent of its water users are in the informal sector.

South Africa's path-breaking water law (chapter 4 of the Act: section 21) specifies following uses and brings them within its IWRM mandate:

- taking water from a water resource;
- storing water;
- engaging in a stream-flow reduction activity, such as forestry;
- control activities, for example, irrigating with wastewater; and
- discharging of wastewater into a water source through a pipe, canal, etc.

All those using water for the above purposes have to obtain a permit, pay water tariff as well as water resource fee. South Africa has all of 62,000 authorized, billable water users (or registered primary diverters) that account for 11 billion m^3 of water allocation for (mostly commercial) agriculture, 5 billion m^3 for industry and municipal, and 9 billion m^3 for forestry. The Government of South Africa generates around 2 billion rand/year as income from water tariffs. Managing these users has presented unique challenges: it is difficult to ascertain actual volumes used; some users did not register and some registered use could be unlawful under existing water law. This has impact on tariff determination and collection. There are serious problems of tackling unlawful water users. Many commercial farmers have extended their irrigated areas unlawfully. When confronted, they argue they are using their water allocation more efficiently. A critical issue for officials is whether to rely on voluntary compliance or evolve a system of policing.

Interestingly, however, the South African IWRM leaves 95 per cent of its people out of its ambit. All of 2.3 billion m^3—about 10 per cent—of total water use is allocated to the so-called

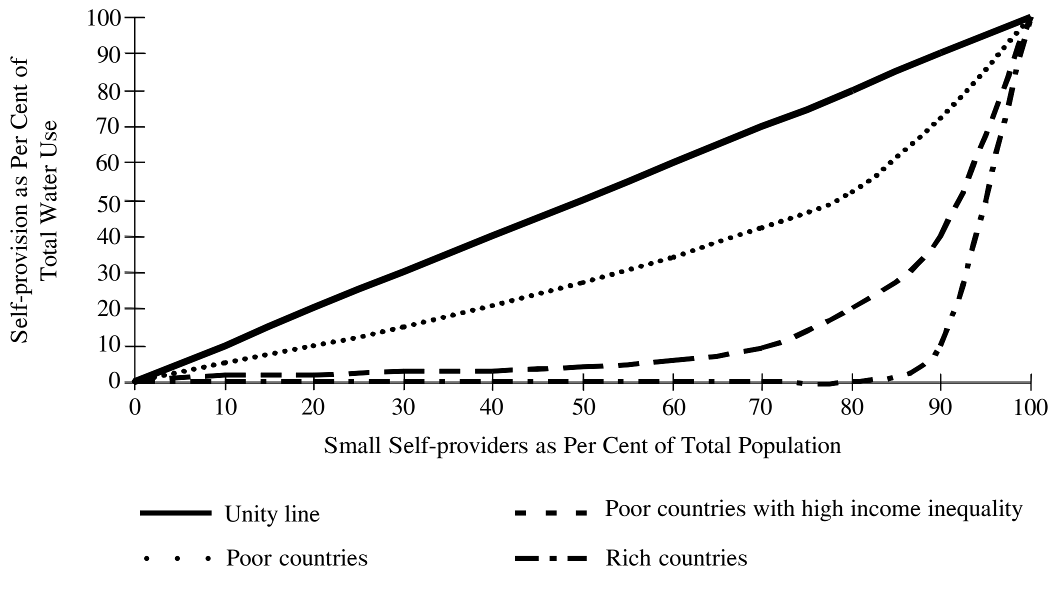


Figure 11.4: Levels of Water Intermediation in various countries

schedule-1 users, mostly rural black South Africans, who include some 18 million primary diverters of water for domestic use and gardening. Their water use is neither subject to permits nor billable. If anything, everyone agrees, the crying need is to increase the access to and productive use of water by these users; yet the entire rubric of IWRM interventions is finding it hard to meet this need.

Not that South Africans are not trying, but they are only now embarking on the hard part of doing IWRM in an informal water economy. An excellent case study on rural South Africa—18 million people ruled by 800 chiefs and 13,000 village headmen, complete with their customary law and traditional institutions—found their water economies predominantly informal; water law does not reach here. Under the National Water Policy of 1997 and Water Act of 1998, the entire rural South Africa was to be covered by 19 Catchment Management Agencies (CMAs). All these were to be formed and operational by now; but only one has been formed so far; and that too is far from assuming the variegated roles it was expected to perform. Formation of Catchment Management Agencies, turning over of small-holder irrigation systems to Water User Associations, reform of rural water services—all central to improving the lives of the vast majority of South Africans—remain major challenges that the country's water reforms are yet to begin to meet. These are also the challenges facing India, Bangladesh, Nepal, and numerous poor countries. IWRM is working in European South Africa, but the African South Africa has to begin from the beginning.

The lesson India needs to learn from the experience of the African Law Workshop is centrally about the gap between the precept and practice of IWRM. There can be little questioning the basic IWRM premises such as that water should be priced to reflect its scarcity value, that it is best managed at basin level, and that reform of property rights will promote its efficient and sustainable use. The question is how to make these stick in India or in much of Africa whose water economies are predominantly informal. All the evidence from around the world suggests that these work easily and produce the desired impact in highly formalized segments of water economies where:

- primary water diverters are large, body corporates and few in number;
- most water users are supplied by organized service providers; and
- capital accumulation in terms of infrastructure creation is already high.

On the other hand, no matter how carefully designed and implemented in a participatory manner, IWRM reforms prove difficult to implement and produce uncertain outcomes in highly informal segments of national water economies where:

- most of the country's households are primary water diverters;
- most self-supply their water requirements directly from source; and
- capital accumulation in water infrastructure is very low.

There was little discussion also of the distinct possibility that whether or not water economies are formal or informal has little to do with their water endowments or their water management institutions but it has, in general, a great deal to do with their level of economic development.

The IWRM paradigm neither responds to the priorities of the poor in poor countries nor does it resonate with their ground conditions which makes implementing water pricing, reform of property rights, allocating water at basin level work. The key factor often ignored is the numbers of primary diverters of water from nature. IWRM deflects attention of policy-makers in these countries from what ought to be their key priority—which is to deliver improved and better managed water infrastructure and services. In poor countries like India, a majority of rural and a sizeable proportion of the urban population self-provide their water needs by diverting water from nature. A core value of IWRM is people's participation in water resources management: its popular slogan 'make water everybody's business' is illustrative. A condition necessary and sufficient for effective implementation of IWRM is that diversion of water from nature is the business of relatively few, large users and service providers who can be brought within the ambit of public policy with relative ease.

THE 'THREE PILLARS' AND THE PEOPLE

The IWRM paradigm, which places all the burden of water sector reform on the 'three pillars' of law, policy, and administration, overlooks the notion increasingly influential in the new institutional economics (NIE) of institutions as 'formal rules, informal constraints (norms of behaviour, conventions, and self-imposed codes of conduct) and the enforcement characteristics of both'; and also the notion that 'if institutions are the rules of the game, organizations are the players' (North 1990). NIE provides a useful distinction between institutional arrangements (IAs) and institutional environment (IE). Thus, the 'three pillars' represent, mostly, IE in NIE except for the operating levels of IE (irrigation department chawkidars, operators of public tubewells) which sometimes interact closely with IAs. Outside the IE, however, there lies the vast world of Institutional arrangements (IAs), which 'are the structure that humans impose on their dealings with each other' (North 1990). In the particular context of the Indian water economy, by institutions or institutional arrangements (IAs), we refer to things like groundwater markets, tubewell cooperatives, water user associations, Rajendra Singh's *johad* movement in Alwar, groundwater recharge movement in Saurashtra (Shah 2001), tank fishery contractors in Bundelkhand (Shah 2003), emergence of defluoridation plants in cottage sector in North Gujarat's towns (Indu 2002), and such like.

As Figure 11.5 caricatures, the difference between the water economy of a rich industrialized country and a poor, agrarian one is the relative scale and significance of the informal sector. In the former, the formal sector includes all or most of the water economy; in the latter, the informal

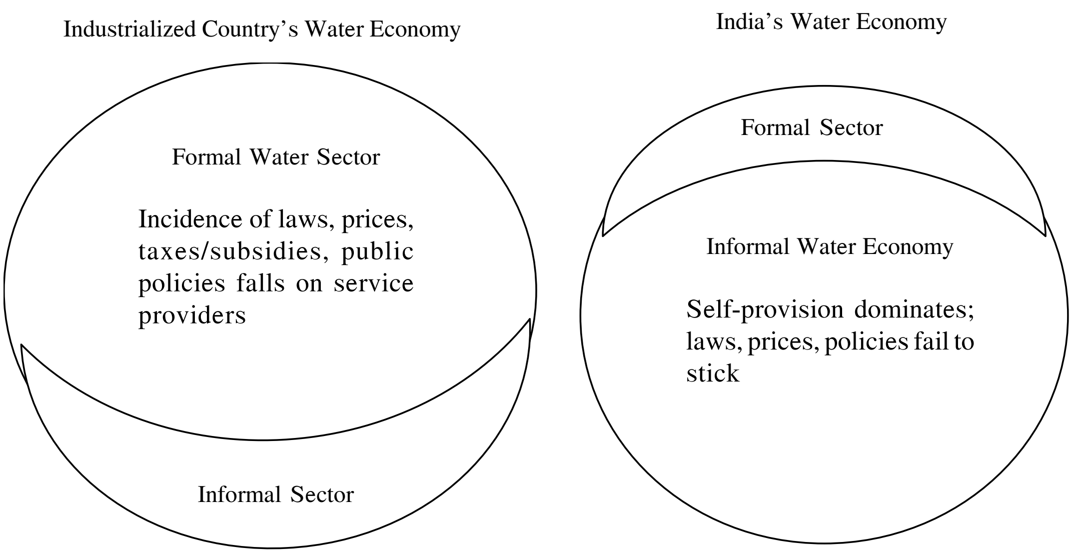


Figure 11.5: Structure of Water Economies of Rich and Poor Countries

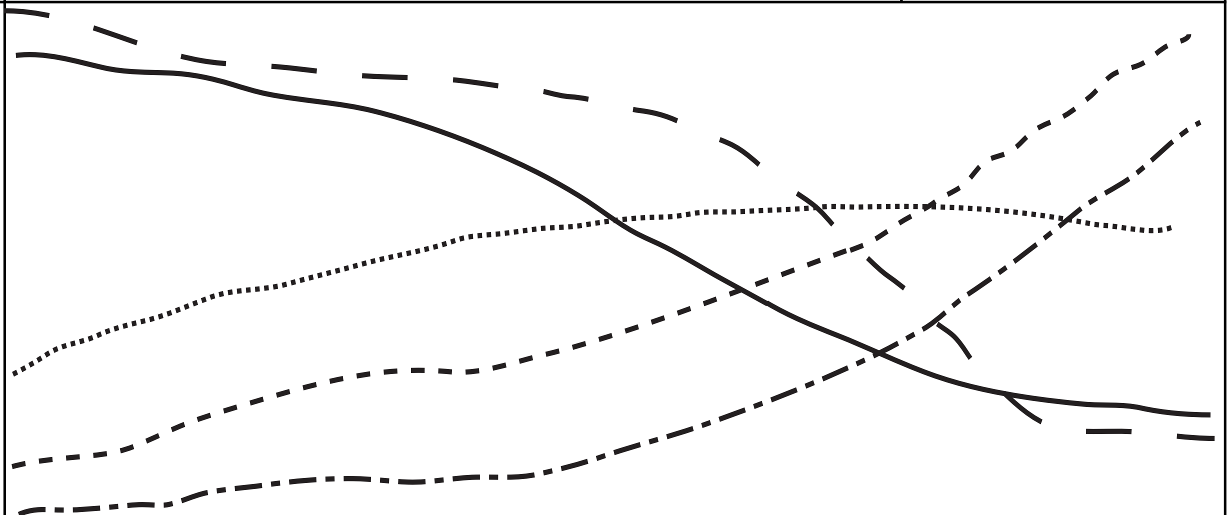
	Stage I: Completely Informal	Stage II: Largely Informal	Stage III: Formalizing	Stage IV: Highly Formal Water Industry
% of water users in the formal sector	<5%	5–35%	35–75%	75–95%
Examples	Sub-Saharan Africa	India, Pakistan, Bangladesh	Mexico, Thailand, Turkey, Eastern China	Mexico, Thailand, Turkey, Eastern China
Dominant mode of water service provision	Self-supply and Informal mutual-help community Institutions	Partial Public Provisioning but self-supply dominates	Private-public provisioning; attempts to improve service and manage the resource	Rise of modern water Industry; High intermediation; self-supply disappears
Human, technical and financial resources used by water sector % of total water use self-supplied Rural population as % of total Cost of domestic water as % of per caput income Cost of water service provision				
Concerns of the Governments	Infrastructure creation in Welfare Mode	Infrastructure and Water services, especially in Urban areas	Infrastructure and service in towns and villages; Cost recovery; Resource protection	Integrated mgt. of water infrastructure, service and resource; Resource protection
Institutional Arrangements	Self-help; mutual help and feudal institutions dominate	Informal Markets; Mutual help and community management institutions	Organized service providers; self-supply declines; informal institutions decline in significance	Self-supply disappears; all users get served by modern water industry.

Figure 11.6: Transformation of Informal Water Economies in Response to Overall Economic Growth

sector rules the roost. The defining feature of an informal economy is that it is outside the ambit of the 'three pillars'.[2] The level of formalization of a country's water sector is best indicated by the low level of interface between its water IAs and its water IE—or by what North (1990) calls the 'transaction sector'.[3]

The transition of nations from predominantly informal to formal water economy has little to do with their water abundance or scarcity but everything to do with the pace and pattern of growth of its economy. Water institutions that exist or can be externally catalysed in a country depend, besides several other factors, on the stage of formalization of its water economy which in turn depends upon the overall economic evolution of that country as outlined in Figure 11.6. As the economy of a nation develops, the proportion of rural and agrarian population declines, self-provision of water is increasingly replaced by service providers, financial cost of water service increases although labour used in water acquisition declines, scientific and economic resources devoted by the society per km^3 of water diverted increases. Along with these changes, water institutions too undergo profound change. Water IAs which we find in India, Pakistan, and Bangladesh—such as, say, pump irrigation markets, urban tanker water markets—are unlikely to be found in Australia or Spain because they would serve nobody's purpose there. Likewise, water IAs that are standard in industrialized countries—high net-worth water companies managing a city's water supply system—would not begin to work in Dhaka until the city as a water service market evolved, at least, to Manila's or Jakarta's level.[4]

Does this mean that little or nothing can be done to improve the working of India's water economy? This is certainly not the case; however, to understand what would work and what would not, it is imperative to understand how things actually work—'warts and all'. In NIE, the most interesting aspect of study of institutional change is about 'why economies fail to undertake the appropriate activities if they had a high pay-off' (North 1990). Transaction costs of institutional change are often the answer. India's water sector is replete with situations where appropriate activities can potentially generate a high pay-off and yet fail to get undertaken; in contrast, much institutional reform being carried out will likely not work because it entails high transaction costs and low pay-off.

Examples abound of institutional initiatives that have failed to produce broad and deep change in the functioning of India's water sector. Five situations are seen:

- A reformist measure is proposed, discussed, and shelved. The draft Groundwater Regulation bill is the case in point. It is

[2] Formal and informal economies are a matter of elaborate study in institutional economics. Fiege (1990) summarizes a variety of notions of informality deployed by different researchers. According to Weeks (1975) cited in Fiege (1990, footnote 6), 'The distinction between a formal and informal sector is based on the organizational characteristics of exchange relationships and the position of economic activity vis-à-vis the state. Basically, the formal sector includes government activity itself and those enterprises in the private sector which are officially recognized, fostered, nurtured and regulated by the state.. Operations in the informal sector are characterized by the absence of such benefits'. According to Portes, Blitzer, and Curtis (1987) cited in Fiege (1990, foot note 6), 'the informal sector can be defined as the sum total of income generating activities outside the modern contractual relationships of production. According to Portes and Saassen-Koo (1987) cited in Fiege (1990, footnote 6) in formal sector activities are 'not intrinsically illegal but in which production and exchange escape legal regulation.' To most researchers, an informal economy is marked by the 'absence of official regulation' or 'official status'.

[3] North defines the transaction sector as 'that part of transactions that goes through the market and therefore can be measured' and according to North, rapid growth in the transaction sector is at the heart of the transformation of a traditional economy into a modern one.

[4] If recent accounts of the travails facing global water companies like Vivendi and Thames Water who are forced to wind up even in these increasingly affluent east- Asian cities is any guide, we must conclude that South Asian cities have a long way to go before they can afford water supply systems of European or North American quality (see, *The Economist*, 15–21 August 2004).

tossing around for 35 years; yet has found few takers because few political leaders are willing to absorb the transaction costs (including political costs) of seriously implementing it.

- A bold reformist measure is proposed, discussed, and diluted by removing all difficult-to-implement elements, resulting in paper reform. India's Water Policy announcements of 1987 as well as 2002 are good examples. Nothing in the way India's water sector functions has changed as a result of these.
- A bold reformist measure is proposed, discussed, and launched but cold-stored in the face of popular opposition or insurmountable difficulties in implementation. Efforts by many chief ministers to meter electricity supply to tubewell irrigation during recent years is a good example. So are Maharashtra's ten-year-old law to protect drinking water wells from groundwater overdraft by irrigation wells, and Andhra Pradesh's more recent land, water, and trees Act.
- A bold reformist measure is introduced and enforced to produce desired outcomes. Examples of this are rare; Chennai's groundwater law, which has begun to bite, is an example. Another is West Bengal's enforcement of permits for new electricity connections for irrigation wells (Mukherjee, personal communication). In Chennai's case, extreme water scarcity has likely created popular support for strong measures. In West Bengal's case, restrictions began to be enforced long before well irrigators organized into a powerful political force.
- Finally, there are examples of reform ideas that refuse to die despite recurring evidence of their failure to deliver. Participatory Irrigation Management is one such; India has been trying farmer management or irrigation for nearly 150 years. While there are islands of excellence, there is no evidence of WUAs having produced sustained performance improvements on a significant scale. Similar communitarian models have dominated for decades institutional discourse in culture and capture fishery, watershed management, water supply systems. Countless studies show that fishermen cooperatives are almost always fronts for contractors, that watershed associations seldom maintain structures after funding runs out.

Against these depressing examples, there are groundwells of spontaneous institutional formations which have erupted and sustained to create value for water users. Informal, decentralized pump irrigation markets today serve one-third of India's gross irrigated areas (Mukherjee 2004), as much as the share of all public irrigation projects. There is a booming culture fishery in the making in small common property ponds and tanks throughout India providing livelihoods and improving nutrition of millions of rural households. New technologies and stocking material created the potential for a boom; however, it is the myriad changes that have occurred in the institutional arrangements for leasing of small water bodies that have energized the boom. Where state governments dogmatically adhered to the communitarian ideal, the boom has remained muted; where they have adopted an entrepreneur-friendly approach, the culture fishery economy has swollen. In the famous Sardar Sarovar Project (SSP) on river Narmada, it was planned that the government would build lined minors going up to each village service area commanding 200–600 ha; a water-user association will build sub-minors and distribution network within each Village Service Area (VSA) by mobilizing local resources. As has turned out, planners proposed and farmers have disposed. Of the 1100 odd VSAs so far covered, not one has a WUA that built the distribution system. However, this has not stopped irrigation in SSP command; thousands of farmers have invested in diesel pumps and rubber pipes; pump irrigation markets have sprung up everywhere. It is certainly not the best solution; planners do not like this irrigation anarchy; but then farmers do not like to lose precious farm land and invest own funds for building a distribution system (Talati and Shah 2004). Groundwater depletion is one of the most complex challenges India's people and water Institutional Environment (IE) face. However, the responses of the two groups of players have tended to differ and remain mutually exclusive: the IE thinks primarily in terms of ways to reduce groundwater draft; people have steered clear of demand restriction but have mobilized resources to increase supply. Rural communities in western India—notably, Saurashtra and eastern Rajasthan—have taken to water harvesting and decentralized groundwater recharge in a big way as a mass movement. In southern states, there is growing tendency to convert irrigation tanks into percolation tanks by sealing the sluice gates of tanks.

In sum, as Figure 11.7 illustrates, both the Institutional Environment (IE) and the Institutional Arrangements (IA)—the people sector—are responding to the same class of consequences of increasingly intensive water use in India. However, the former is struggling with change that entails high transaction costs and low perceived pay-offs for the people. The latter is in search of ways to efficiently perform activities that have a high pay-off by reducing the transaction costs. The big problem—and a potential opportunity—is that the two do not meet.

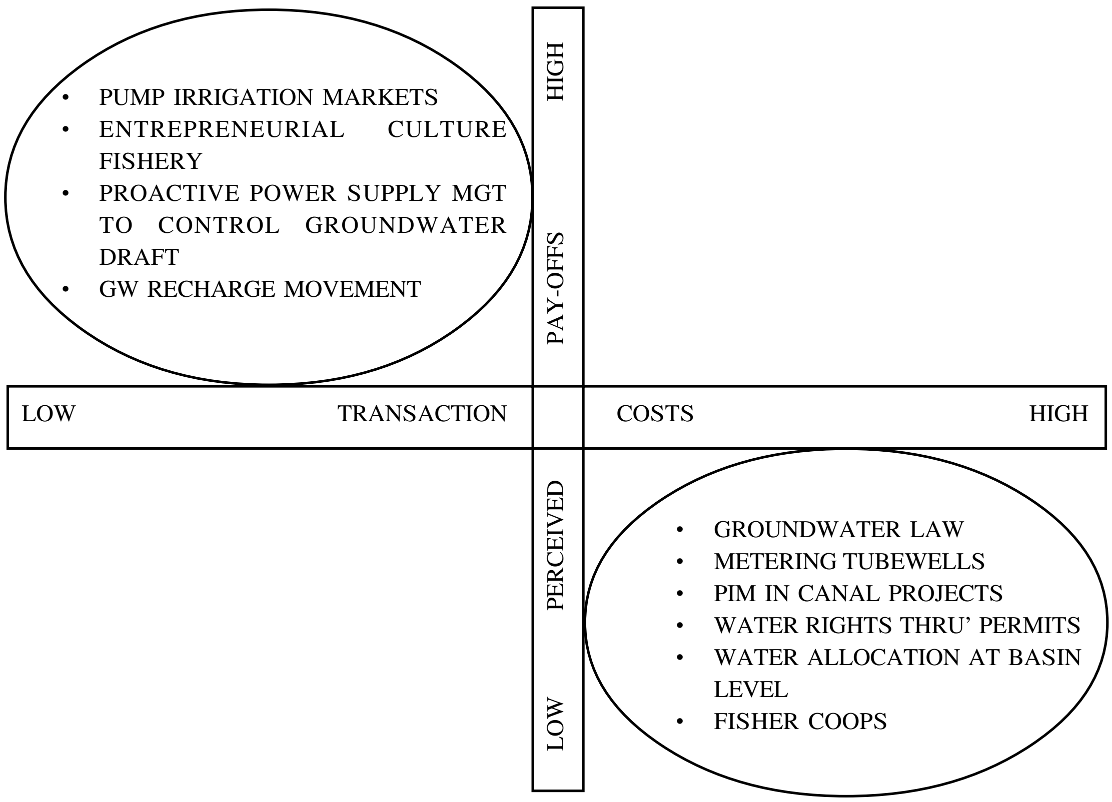


Figure 11.7: Matrix of Perceived Pay-offs and Transaction Costs

CONCLUSION

Water sector reforms in IWRM paradigm are best viewed as a long-term goal than a quick-fix to water sector problems of developing economies. That this essay does not aim to create a paper-tiger out of IWRM and shoot it down is evident in that dozens of countries in Asia, Africa, and Latin America have used formulation of water policies and laws to implement IWRM principles; and the results have been disastrous, to say the least. Above all, they have diverted attention of national governments from doing patient work on their hear-and-now problems. We have shown that the IWRM paradigm becomes relevant and useful in water economies which have achieved high levels of formalization and that the pace and pattern of formalization of water economies is linked to the overall development of the economy of the country rather than its water endowments.

So, if not IWRM, what should be the water sector priorities for India? This is a valid question; and the response to it should grow out of a careful assessment of nature of India's water economy and its problems, and an intelligent reading of the experience of dealing with similar problems elsewhere in the world.

Infrastructure

Investing in creating appropriate water infrastructure should remain a critical priority for India for decades to come. What would be appropriate is a big question that would require ongoing assessment of past projects; however, it is a question that has begun to fade out of the water policy discourse. However, there can be little doubt that India needs to invest in more storage, more urban and rural water supply infrastructure, in wastewater treatment.

A related priority is developing new models for managing water infrastructure and services. Water bureaucracies in most states are shrinking. And the experiments to transfer irrigation systems to user associations are not doing nearly as well as was expected. A key priority is to promote broader institutional experimentation with greater focus on performance-linked incentives as is being tried out in China for better project management, O&M, and cost recovery.

We need to recognize that self-provision of water is the best indicator of the failure of public water supply systems. Tubewells proliferate in canal commands because public irrigation managers are unable to deliver irrigation on demand. Urban households want their own borewells because municipal water service is inadequate and unreliable. In the ultimate analysis, the only way India's water economy will get formalized is by improving public/community water infrastructure and services so that water users have no need to divert water from nature.

India's Groundwater Challenge

Groundwater management is India's unique challenge. No country depends as much on groundwater for all its water needs as India does; and yet, the groundwater economy is one of the most under-managed segment of India's water sector. The designation of the Central Groundwater Board (CGWB) into Central Groundwater Authority (CGWA) has changed neither the character of the organization nor its effectiveness as the strategic player entrusted with the governance of this economy. The CGWB clamours for strong groundwater laws and their stronger enforcement; however, for a long time, this will be easier said that done. The Chinese, with stronger state commitment to groundwater regulation, with a more elaborate reach and local authority structures have still found it impossible to regulate groundwater overdraft in North China plains (Shah et al. 2004). Nor have the Americans been able to implement real groundwater demand management with their elaborate structure or water rights and groundwater districts, or have Spaniards and Mexicans with their efforts to promote groundwater user associations.

Wherever we come across success in reducing pressure on groundwater, imported water supplied in lieu of groundwater pumping is invariably implicated. The Chinese have been able to control urban groundwater depletion by sealing urban tubewells; but they managed to do this only after importing water supplies (Shah et al. 2004). The governments in western and central US have succeeded in reducing or controlling groundwater pumping; but only through programmes like the CAP (Central Arizona Project) which imported water to substitute it. It is only in small totalitarian states —such as Oman where the sultan's word is law—that there is evidence of genuine groundwater demand management.

Groundwater constitutes over half of India's total water use, 70 per cent of its irrigated areas, and 80 per cent of its domestic water supply; and yet, managing groundwater gets less than 10 per cent of public funds at central and state level devoted to water resources. Central- and state-level groundwater bureaucracies need to be reinvented; they still style themselves as in charge of monitoring water level fluctuations which was their mandate during the 1960s. India needs a coherent strategy, an administrative apparatus, some of the best groundwater science and technology the world has on offer, and a commitment to invest resources commensurate with the role of groundwater in India's water economy.

Indirect Levers of Strategic Management

The core argument of this paper is that direct management of water demand—through water pricing, water rights, permits, administrative control—is well nigh impossible in India because by far the majority of water users self-provide their water needs rather than depend upon formal service providers such as water companies or municipalities. Doing this will be a pipedream until India's water economy gets formalized; but this is not going to happen in a hurry. Meanwhile, India needs to develop and hone a range of indirect levers of managing aggregate water demand. One such indirect lever that is already being used with some effectiveness by NABARD is restricting institutional credit for private investments in well irrigation in areas where groundwater resource is over-exploited. Electricity supply to irrigation pumps is another even more potent indirect lever. In response to growing burden of power subsidies, many states have, during the 1990s, begun restricting hours of power supply to agriculture. However, doing this in a more rational manner than at present can reduce subsidies even further, making farmers better off and reducing the waste of water (Shah et al. 2005). It is common knowledge that much pressure on groundwater in north western India—Punjab, Haryana, western Uttar Pradesh, Rajasthan—can be eased if they can be weaned away from the rice–wheat system which is sustained primarily by the public foodgrain procurement system. In contrast, eastern India which is singularly well-suited to be India's new granary is suffering from poor input and output markets and near-absence of public foodgrain procurement system. Shifting the incentives for rice–wheat cultivation from north west to eastern India can produce aggregate incentive structures that are more consistent with relative regional endowments of water which is far more binding a constraint today than it was during the days of Intensive Agricultural Development Programme. Moreover, new farming technologies and practices appearing on the horizon too can help ease agricultural water demand. A case in point is a new way of growing rice known as the System of Rice Intensification (SRI). For thousands of years, we have viewed rice as an aquatic plant which can grow only under ponding. SRI experiments have shown that rice survives—but does not need—ponding. India uses 250–300 km^3 of water every year just to grow rice. And the new clutch of rice cultivation practices—SRI, semi-irrigated rice, double transplanted rice, rice under alternate wetting and drying, aerobic rice—not only offer much higher land productivity, but also drastic reduction in seed and input costs, and a promise of more crop-per-drop. Realizing this potential gains, China has already embarked on SRI as a national programme; in India, SRI is hardly known amongst water policy-makers.

Managing the Water Economy in a Mission Mode

We often overlook the fact that NABARD, Rural Electrification Corporation, and State Electricity

Boards have done far more to promote irrigation development in India than irrigation departments. Or that the agricultural research establishment under the ICAR can play a powerful role in managing agricultural water demand. Yet, our administrative structure for managing the water economy does not encourage coordinated action that involves public agencies holding powerful indirect levers of water demand management. CGWB seldom thinks of linking up with the Electricity Boards to regulate groundwater draft; MoWR and Central Water Commission seldom show interest in horizon technologies like SRI for their potential in water demand management. Precisely to achieve such coordinated action, Prime Minister Rajiv Gandhi successfully experimented with the 'mission mode' of sectoral administration. Each mission, set up for a priority sector with well-defined targets and a time-bound programme, was run by an empowered committee represented by the top-most officials of all public agencies involved and usually headed by the cabinet secretary.

Worldwide, the tendency is towards functional integration of agencies dealing with water. In China, for instance, surface irrigation, reservoir management, groundwater, water supply—all have been brought under water bureaus at different provincial, prefecture, and county levels. In India, too, we need to move in this direction, especially at higher echelons of decision-making that give primacy to water-sharing and water-allocation questions amongst administrative/political units. However, it is even more important to establish mechanism for coordination between the holders of indirect levers of water demand management as we discussed above.

Tightening Up the Formal Segments

Malfunctioning in public systems—such as municipal bodies and irrigation departments—is resulting into informalization of formal water economies. This is true of many Indian towns and cities where evidence suggests growing tendencies for households and housing societies to depend increasindly on captive tubewells for supplying domestic water needs. This trend can only be reversed through a massive and rapid improvement in the functioning of urban water utilities. There is hardly any city in India today which provides 24-hour piped water supply. Achieving such improvement, mobilizing capital for much-needed investments is only one aspect of the challenge; and the recent GOI announcement to make more central resources available for improving urban infrastructure will certainly help. However, also involved are questions of institutional reform, building public–private partnerships and experimenting with service contracts with corporate water service providers.

Another sector which is informalizing rapidly is canal irrigation. During the colonial era, the authority of the state as well as transactions between irrigation bureaucracy and farmers in canal command were far stronger than they are today. This thinning of the state's presence is on an increase in most states as irrigation departments shrink their staff-strength at the grassroots level. It was expected that WUAs created under PIM programmes would take over some of the roles so far performed by irrigation department staff. However, nowhere is there evidence to support the view that WUAs are effectively filling the institutional void that canal commands are experiencing. Here too, early work is needed to create an institutional arrangement for improved local management of irrigation water, for effective and timely O&M, and for cost recovery.

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APPENDIX 11.1

TABLE A11.1: Water Poverty Index

WPI Component and Its Weight (%)	Sub-components
Water resource availability (20)	Internal freshwater flows
	External inflows
	Population
Access to water (20)	Per Cent of population with access to clean water
	Per Cent of population with access to sanitation
	Access to industrial water relative to the need
	Access to irrigation relative to the need for irrigation
Human capacity (20)	PPP adjusted per capita income
	Under-five mortality rates
	Education enrolment rates
	Gini co-efficient for income distribution
Water use efficiency (20)	Domestic water use in litres/day
	Share of water use by industry adjusted by sectoral share in GDP
	Share of water use by agriculture adjusted by its share in GDP
Environment (20)	Indices of:
	Water quality
	Water stress (pollution)
	Environment regulation and management
	Informational capacity
	Biodiversity based on threatened species

Source: Lawrence et al. (2003).

12

Scaling Up Water Infrastructure

NIRMAL MOHANTY

INTRODUCTION

Halfway to the 2015 deadline of the Millennium Development Goals (MDGs), the progress in India has been limited and halting in the case of most goals including the water-related goals. In addition to MDGs, India has, under the Tenth Five-Year Plan, set for itself goals for various sub-sectors of water.[1] Here again, the progress has been sluggish. While scaling up is clearly the need of the hour, it is an enormously challenging task in a country where several million people live on less than 1$ a day and are perhaps not in a position to make a contribution toward developing water services.

Scaling up can be defined as 'adapting and expanding development experiences in space and time'. In other words, it involves adapting successful approaches to new areas on an extended scale (by moving to a higher plane) and sustaining them over time. This requires learning from past experiences—mistakes as well as successes—and an understanding of the issues and constraints of the new circumstances, where the approach is to be used. The implementation framework for scaling up has three important dimensions. First, it means achieving outcomes commensurate with the challenges at hand, using instruments and resources that are available. Second, scaling up has to be seen in the context of the development goals set up by country, state, or region. Third, optimal developmental outcomes derive from working in partnership and hence, there is a need to think of scaling up as a whole and not individually.

[1] For example, a key element of the MDGs is to halve, by 2015, the proportion of people without sustainable access to safe drinking water supply and sanitation. Similarly, the Tenth Plan goals include (i) providing all villages sustained access to potable water by 2007 and (ii) cleaning of all major polluted rivers by 2007 and other notified stretches by 2012.

REVIEW OF WORLD BANK FINANCING IN INDIA

The India Water Portfolio

The World Bank has been involved in India's water development for more than four decades. The Bank's involvement grew steadily from the early 1960s to reach a peak in 1987. Until 1992, India was the Bank's biggest borrower for water and water-related investment. But, compared to

India's total water investment, the World Bank lending has historically accounted for less than a tenth (Pitman 2002). Even this amount has been dispersed over as many as 16 states.

The water sector has accounted for a relatively larger share in the World Bank's lending portfolio in India than worldwide. Total amount of World Bank lending to the water sector in India at current prices during 1993–2004 was $2.5 billion, accounting for 11.4 per cent of total Bank lending in India, as compared to 7.8 per cent globally. It may be noted that within the World Bank lending to India's water sector, the IBRD's share has fluctuated widely from 21 per cent in the 1970s to 100 per cent in the 1980s to 46 per cent in the 1990s, with the balance being accounted for by the IDA (World Bank staff estimates).[2]

Historically, irrigation has accounted for the bulk of the Bank lending in India. During 1993–2004, irrigation accounted for 54 per cent of the Bank's total water lending in India, as compared to 26 per cent worldwide. On the other hand, the Urban Water Supply and Sanitation (UWSS) projects got a much smaller share in India (13 per cent) as compared to the world average (36 per cent). Within the irrigation portfolio in India, a much larger share of the lending was for 'services' than for water resource development, while in the UWSS segment, it was the other way round. Since 1992, there has been no Bank lending in India to the hydro-electric sector.

TABLE 12.1: Component-wise Lending to Total Lending, 1993–2004

(per cent)

Component	World	SAR	India
Irrigation	26	45	54
UWSS	36	17	13
RWSS	7	16	19
Hydro	7	8	0
WR (stand-alone)	24	14	14
Total	100	100	100

Note: SAR: South Asian Region; UWSS: Urban Water Supply and Sanitation; RWSS: Rural Water Supply and Sanitation; WR: Water Resources.
Source: World Bank staff estimates (Malik 2004).

Use of Instruments

The Bank has a number of instruments—lending and non-lending—to support definite programmes in specific sectors. These instruments are mainly divided into:

- investment lending;
- adjustment lending and other non-project lending; and
- World Bank guarantees.

Investment loans have a long-term focus and finance wide range of activities to create social and physical infrastructure, while adjustment loans have a short-term focus and are typically given for supporting macroeconomic policy reforms or reforms in financial sector. Additionally, other Bank Group institutions provide support to Bank programmes in developing countries. Thus, while the International Finance Corporation (IFC) finances private sector ventures in partnership with private investors, the Multilateral Investment Guarantee Agency (MIGA) encourages direct foreign investment by providing guarantees against non-commercial risk to foreign investors.

The water sector in India has primarily availed project loans, which fall within the category of investment loans. While the focus of investment lending by the Bank has been changing worldwide from 'hardware' project financing to assisting countries to alter their legal and institutional framework to attract private capital, the shift in India has been relatively slow. The bulk of the Bank's assistance to the Indian water sector has consisted of loans for specific projects undertaken either by a state or urban local body/state supported entity. Bank lending has typically augmented the state government resources to expand irrigation and rural/urban water supplies.

[2] World Bank refers to both IBRD and IDA; loan refers to both IBRD loan and IDA credits.

The Bank has also given loans for large municipal projects like the Bombay Sewerage Project.

However, very few of these projects have explored the opportunities for leveraging resources to elicit private/community participation. The SWAJAL project in Uttar Pradesh is one of the exceptions that envisaged a role for community participation. Similarly, the IBRD's line of credit to the Infrastructure Leasing and Financial Services Ltd. (IL&FS) is one of the few instances where Bank funds have been used to encourage private sector initiatives. (It may be noted that this line of credit was not specifically meant for water infrastructure.) IL&FS, a private entity set up to commercialize infrastructure projects, has floated several special-purpose vehicles (SPVs) with state governments and the private sector as co-sponsors. These SPVs have entered into concession agreements with state and local governments to build and operate infrastructure projects commercially. Tirupur Water and Sanitation Project is one such initiative supported by IL&FS to meet the water needs of the industry and the households.[3]

Bank Performance[4]

An evaluation of the Bank projects, for which annual project performance reviews were completed during 1988–99, by the World Bank itself revealed the following:

- Outcomes: In terms of project outcomes, the performance of completed Indian Bank-financed water operations is poorer than that of South Asia and the Bank as a whole, and far below that of China. Compared to South Asian and global projects, Indian performance has been poorer in irrigation, hydro, and rural water supply, and better in urban water supply projects.
- Sustainability: The Bank's track record in terms of establishing long-term sustainability has been very poor. A little over a third of the irrigation, drainage, and hydro projects and less than a third of the UWSS projects were rated as likely to be sustainable in the long run.
- Institutional Development: Only half of the UWSS, a fifth of the irrigation and drainage, and none of the hydro, RWSS, or other projects, were deemed to have had any substantial institutional impact.

Despite the recognition that most of the project-related problems in India are institutional in nature, the Bank has traditionally failed to address the institutional issues. The main implementing agencies involved in Bank projects have been state-run irrigation departments or municipal water boards or authorities. These agencies continue to suffer from a host of incentive, institutional, and political constraints.

The Bank's failure to address institutional issues is possibly due to its lack of long-term commitment, which is reflected in the Bank's tendency to 'bypass and even ignore existing institutions and create its own parallel project-specific institutional structures because it finds it easier than the difficult and time-consuming job of working with and reforming existing institutions' (Pitman 2002). By doing so, the Bank imposes high establishment costs on the existing institutions, increases their financial burden, and reduces their effectiveness in the long run.[5]

Instead, the focus has been on project works—such as project completion, maintenance of physical structures and procurement and disbursement issues—to ensure 'project success'. Even using the narrow concept of 'project

[3] The project cost is Rs 10.2 billion, of which equity is Rs 3.2 billion and debt Rs 7.0 billion. The project relies on the private sector for the project design, construction and management. The tariff is Rs 45 per kilolitre for industry, Rs 5 per kilolitre for Tirupur Municipality (TM), and Rs 3.5 per kilolitre for rural areas. The project provides for sewerage system for TM and onsite sanitation facilities for slums within TM. Mahindra Infrastructure Developers Pvt Limited, an entity with an investment by IFC, has also participated in this project.

[4] This section draws on the Country Assistance Evaluations carried out in 2002. Refer Pitman (2002) and Khatkhate (2002).

[5] An attempt to tackle institutional problems has begun only recently.

success', the Bank's track record has been dismal, with almost all projects achieving far less economic rate of return than expected at appraisal, reflecting cost overruns. Because of insufficient attention to institutional issues, most implementing agencies could not complete the projects in the time agreed with the Bank. Major problems included inadequate advanced preparation, incomplete engineering designs, insufficient staffing, land acquisition and resettlement, and procurement.

As regards ensuring long-term sustainability, the Bank's failure can mainly be attributed to its focus on short-term outcomes. Typically, when problems occur during the implementation stage, the Bank provides budgetary or supervision support to the project authorities. However, once Bank involvement ceases, these projects often become unsustainable, partly because the Bank does not focus enough on long-run financial, institutional, and environmental sustainability issues in the project design stage. Also, the Bank's internal incentives focus on number and amounts of loans processed and short-term outcomes (during Bank implementation) and not on attempts to deal with sustainability. No budget is allocated and no staff is assigned to follow up—nor is there a system of in-depth study of the long-term experience of Bank-assisted projects.[6]

An additional shortcoming in the Bank's performance relates to its role vis-à-vis other donors, such as the UK's Department for International Development (DFID), the Danish (DANIDA), FAO and ADB, which have been active participants in India's water sector. Their programmes are much smaller, more localized, and more committed to long-term involvement than those of the Bank. The Bank's work programmes do not appear to be coordinated with those of other donors and successful partnerships are rare. 'The Bank, seeing itself as the 'big player' tends, in effect to ignore other donors (and local initiatives) and fails to learn from their experience, which is considerable at the local level' (Pitman 2002).

In recent years, attempts have been made to correct some of the shortcomings, especially following the Bank management's introduction of more stringent portfolio management in 1996. The Bank's efforts to focus increasingly on water resource management and strengthening the institutional capacity is reflected in the Water Resources Consolidation Projects (WRCPs) in various states and the irrigation component in the Andhra Pradesh Economic Restructuring Project, which focuses, inter alia, on improvements in water management and pricing. Despite these attempts, there has been little progress toward management of water on a comprehensive and integrated basis.

Similarly, the Bank has attempted to engage some states—such as Tamil Nadu, Orissa, Uttar Pradesh, Rajasthan, and Andhra Pradesh—in policy dialogue over the past decade. With assistance from the Bank, Tamil Nadu (1994), Orissa (1995), and Rajasthan (1998) have issued their own water policies and Andhra Pradesh issued an Irrigation Sector Policy (1998), stressing on participatory management. These policy pronouncements, however, appear to reflect the authorities' recognition of the problems relating to the water sector, rather than their commitment to address those problems, as the policies have not been translated into action.

Financing Approaches Used in Other Countries

Although a number of innovative approaches have been attempted internationally, the following three hold important lessons particularly for India.

Transition Financing in Guinea

It is widely recognized that raising tariffs is critical to achieving sustainable water services in many developing countries; but the transition towards cost-covering tariffs has usually been difficult, under the tradition of poor service and 'no-pay' culture. On one hand, it often takes several

[6] Another reason for the lack of sustainability is the state's failure to provide adequate budgetary support over the long term.

years for the efforts to improve service quality, such as reducing leakage, expanding capacity, and upgrading equipment, and to get translated into reliable improvement in service. On the other hand, most customers resist sharp tariff increases—necessary to finance the investment programme—before service quality has been significantly improved. Institutional lenders can break the logjam by financing the revenue gap in the interim period, while water tariff is gradually increased to reflect the marginal cost. The World Bank did this in Guinea by supporting a government led programme.

In 1989, the Government of Guinea granted a lease arrangement for PSP operation in urban water services to expand the coverage of piped water connections and improve service quality. At the time, the households were paying US 12c per cubic metre (1989 US dollars), compared to an estimated cost of US 68c. The government committed to raise tariffs to cost-recovery levels, albeit gradually. To ease the transition, the government made use of IDA credit to subsidize a declining share of the operator's verified supply costs in the first six years of the contract. However, after the subsidy got phased out, tariffs continued to increase to US 83c in 1996 and remained constant in local currency for the remainder of the lease contract. This resulted in a considerable decline in new connections and a rise in inactive connections. The contract was not renewed when it expired in 1999, and the international partners subsequently left the country in 2001.

In the initial period, the contract resulted in considerable improvements, with access to piped water increasing from 39 per cent in 1989 to 47 per cent in 1996. However, the government was unable to renegotiate a reduction in the tariff level reflecting poor regulatory capacity to balance the interests of consumers and private provider interests. The lesson from the Guinea experience is that while transition financing is beneficial, to be sustainable, it must be accompanied by a regulatory regime that provides incentives for the private operator to cut costs, while passing on the savings to consumers.

Time Slice Financing in Mexico

Time slice financing approach is one where the donors can participate in an on-going development project being undertaken by a country by financing a 'time-slice' of a specified expenditure programme.

In the 1990s, the increased trade and associated high traffic growth necessitated significant modernization of Mexico's transport infrastructure along the trade corridors. The government's transport policy aimed at encouraging the private sector to supply these facilities and services. The government provided only those services, which though economically justifiable, were not financially attractive to the private sector under a concession scheme. The Bank finance was aimed at helping to modernize federal roads that fell in the latter category.

The World Bank financed a time slice (1998 to 2002) of SCT's[7] Federal Roads Modernization Programme (FRMP), which entailed expanding the road capacity and enhancing safety on the network on one hand and strengthening the institutional capacity on the other. The Bank financed 55 per cent of the total project cost of $865 million (in 1996 prices) amounting to $475 million. The Bank financing resulted in an enhanced expenditure on the FRMP, thus reducing the existing and potential constraints to economic growth caused by inefficient and costly transportation.

One advantage of the time-slice financing approach is the quick agreement on the objectives of the project with the host government. Moreover, since the donor finances a time slice of a sector investment programme that has been mutually agreed with the government, it is possible for the donor to influence the project design, and if necessary, to add a technical assistance component to build capacity within the sector.

[7] The Secretaria de Comunicaciones y Transportes (SCT) is responsible for managing the transport sector and its agencies through its sub-secretariat for Infrastructure, which handles almost all public road transport infrastructure development, and its sub-secretariat for transport which is responsible for operational, regulatory, and tariff matters.

Output-based Financing

Traditionally public funding of infrastructure service providers has focused on inputs rather than the actual services delivered. This generally results in a lack of transparency, poor or adverse incentives for the service providers, and limited opportunities for leveraging public funding. In an output-based financing structure, these weaknesses are addressed by delegating service delivery to a private company and linking financing to well-specified, measurable outputs. In this structure, public funds are channelled efficiently and transparently into a concession, thereby providing operators recourse to revenues not only from users' fees but also from the output-based payments.

In the WSS sector, for example, when the transition to cost-covering tariff tends to get protracted, forcing the government to step-by-step PSP approach (starting with a management contract, for instance), well-designed output-based aid (OBA) schemes offer the alternative to move directly to a concession contract (Marin 2002). This kind of approach has been successfully implemented in a range of sectors and implementation environments, but is at a relatively early stage in the water sector (Brook and Smith 2001).

Such an approach can provide powerful means to meet the challenges of concession design by:

- reducing pressure to take recourse to cross-subsidy arrangements;
- creating opportunities for better targeting of intended beneficiaries or results; and
- keeping performance risks with the (private) operator, thus providing much stronger accountability for performance and creating improved incentives for innovation and efficiency.

One drawback of this approach is that some outcomes are difficult to measure with precision and are subject to influences beyond the control of the service provider. In such cases making the service provider's compensation completely dependent on outcomes would be inappropriate, and the high level of performance risk involved might deter potential service providers or lead them to demand larger payments. Nevertheless, it is possible to design some schemes that link at least a part of the service provider's compensation to outcomes, so as to align their interests with those of the scheme administrators.

LESSONS FROM OTHER SECTORS IN INDIA

Power

Some states in India, such as Andhra Pradesh, Haryana, Delhi, and Rajasthan, have successfully initiated credible sector-wide reform programmes in the power sector, with the World Bank playing a catalytic role. These states have also had a demonstration effect on other states, which have taken the initial steps and are contemplating more comprehensive reforms.

The nature and source of the problems facing the water sector are in many ways akin to those in the power sector. While the reforms in the power sector have begun to show results, the reforms in water sector have yet to begin in earnest. There are several lessons to learn from the power sector, but we will focus on two sets: one is general, outlining important components of a comprehensive reform strategy and the second is the profile and experience of a successful scaling-up programme, Accelerated Power Development and Reform Programme (APDRP).

General [8]

- There is a need to establish well-defined policy goals and reform programme (including implementation strategy), that are endorsed by the government and discussed widely.
- The difficult reform programmes require strong political leadership and a small group of reform champions who understand the complexities of reforms and manage the implementation. Support for the reform process from the state chief

[8] See World Bank (2000).

minister, power minister, and top bureaucrats in the power ministry is essential.

- Legal, financial, and institutional aspects need to be properly sequenced. The first step is to establish a facilitating legal framework for reforms. This is to be followed by sector restructuring, which would allow further reforms. This step includes the establishment of an independent regulatory regime and an attempt to deal with the past financial liabilities of the newly created utilities.
- An important component of restructuring is unbundling, which allows the private sector to do some of the services more efficiently and the public sector to maintain its role in certain areas.
- The reform programme is usually accompanied by rapid tariff adjustment and substantial financial support from the government.

APDRP

The GOI's Accelerated Power Development and Reform Programme (APDRP) aims at using the fiscal leverage of the GOI to encourage reforms. Under the programme, grants, and loans are distributed to states on the basis of progress in installing meters, creation of independent State Electricity Regulatory Commissions (SERCs), reduction of transmission losses and other specific, measurable milestones.

Funding under the APDRP has two components: the investment component (for up-gradation and modernization of sub-transmission and distribution networks) and the incentive component. As part of the investment component, the GOI provides an assistance of 50 per cent of the project cost, of which 25 per cent is a grant and 25 per cent a loan. The balance 50 per cent is to be arranged by the utilities either through internal resource generation or as counterpart funding from financial institutions such as the Rural Electrification Corporation and Power Finance Corpora- tion. The incentive component rewards the utilities for actual cash loss reduction by way of grants.

The programme has picked up momentum. In the first two years, the GOI has sanctioned funds for 410 sub-transmission and distribution projects across 60 distribution circles. The total cost of these projects is estimated at Rs 166 billion. The amount released to states has risen from Rs 17.6 billion in 2002–3 to Rs 23.6 billion in 2003–4. The states leading in the reform process (Andhra Pradesh, Maharashtra, Karnataka, and Rajasthan) have accounted for a substantial share of the APDRP funds. A number of states have also earned incentives under the programme.[9]

Roads

In scaling up the road sector, the National Highways Development Project (NHDP), initiated in 1999, represents the most successful attempt to date. The project involves expansion (four/six-laning) and maintenance of around 13,146 km of national highways. The implementing authority of the Project is the National Highways Authority of India (NHAI), which was constituted by an Act of the Parliament. The Project has already made substantial progress. Two innovative frameworks, which have been used in the NHDP, can be potentially adapted in the water sector.

Central Road Fund (CRF)

Recognizing that there is only limited scope for tolls (user charges) to finance road construction and maintenance, the GOI has taken an important initiative of levying a fuel cess (Rs 1 per litre of petrol and high speed diesel) as proxy for user charges. The cess accrues to a 'Central Road Fund' (CRF). Allocation from the CRF is a significant source of finance for the NHDP.[10] The CRF is a non-lapsable Fund and the Government has ring-fenced the Fund, with a view to restraining itself from using these funds for other purposes. The resultant loss of fungibility has been more than

[9] See APDRP website, Ministry of Power, Government of India.

[10] The financing of NHDP is based on funds from CRF, multilateral financing agencies, market borrowing, and private sector contribution. But the CRF provides the financial foundation of the NHDP.

offset by the benefits of the Fund, which include inspiring confidence among the private contractors about timely payment and improving the transparency and accountability in road financing.

Annuity Contract

One other innovative feature of the NHDP financing is the use of performance-based annuity contracts, where the lowest bidder becomes the concessionaire and is required to provide road service in accordance with a defined set of Project Requirements (design requirement, construction requirement, O&M requirement, etc.) during the concession period (17.5 years). The annuity approach essentially involves granting a composite contract to the concessionaire, casting a dual obligation of construction and maintenance of the road facility throughout the concession period. The concessionaire is paid a fixed annuity (with no indexation benefits) during the life of the concession as price for the service, provided road services of a certain quality are made available. This is expected to compensate the concessionaires for their capital costs, operating expenses, and returns thereon.

So far, eight projects have been contracted out on an experimentation basis under the annuity route.[11] The results have been encouraging. The annuity contracts have reportedly performed better than works contracts in terms of adherence to cost schedule and time schedule. There has, however, been no scaling up yet, partly because the authorities are constrained by tradition. Also, there are difficulties in making direct comparison of annuity contracts with works contracts. This is so because work contracts do not include maintenance costs to assure quality over a period of time while annuity contracts do. Also, work contracts generally involve greater cost and time overrun, but lower costs of (sovereign) borrowing than annuity contracts.

Annuity contracts nonetheless have a distinct advantage because of a number of reasons. First, the focus is on output, as the concessionaire does not get the full annuity if performance is below a certain agreed level. Second, the concession framework ensures substantial risk transfer (design risk, price variation risk, time-overrun risk due to the contractor, quality risk, safety risk, road usage risk, etc.) to the private sector, both during the construction and operation stages. Finally, it improves accountability. This approach would be useful in the water sector, especially in bulk water projects and sewage treatment plants, where the agencies that are responsible for maintenance and construction typically blame each other, making it difficult to establish accountability for service quality.

Scaling up Frameworks: Experience and Lessons

As stated earlier, an essential prerequisite for scaling up is an understanding of the issues and constraints of the circumstances, where a new approach is to be adopted. Following is a discussion on the issues and constraints in each sub-sector, the experience in attempts to scale up, and the lessons to be drawn from them.

Urban Water Supply and Sanitation

Current services in urban areas are of low quality in most parts of the country. Millions of people do not have access to safe drinking water or sanitation. Quality of water for household use has deteriorated over time, leading to widespread diseases. Environmental degradation is occurring due to over-exploitation of water resource and insufficient treatment of wastewater. Despite the resource crunch, the preference has been for high-cost projects and not the feasible, less expensive alternatives (such as purchasing water from

[11] They are Panagarh–Palsit (West Bengal, 65 km), Tuni–Anakapalli (Andhra Pradesh, 59 km), Tambaram–Tindivanam (Tamil Nadu, 93 km), Belgaum–Maharashtra border (Karnataka, 77 km), Rajahmundry–Dharmavaram (Andhra Pradesh, 53 km), Dharmavaram–Tuni (Andhra Pradesh, 47 km), Durgapur–Expressway (West Bengal, 64 km), and Nellore bypass (Andhra Pradesh, 17 km). Annuity contracts account for a relatively small part of the NHDP. There have been some BOT (direct tolling) contracts too. Most of the implementation of NHDP, however, is through construction contracts.

farmers). At the same time, tariffs have remained low, mainly because of political reasons. The viability of the sector has thus been affected by high cost of delivery and poor cost recovery.

Private Sector Participation

It is now being increasingly recognized that the main obstacle to sustainable expansion is the inefficiency in the government-managed delivery systems and that a feasible solution lies in seeking greater private sector participation (PSP). This recognition is reflected in the recommendations of several state finance commissions. So far, however, there have been only a few attempts to involve the private sector, although a number of options such as service contracts, BOT contract, management contract for O&M, etc. are available (see Box 12.1).

In the utility market, the Indian experience suggests that the focus on bulk water supply (currently under government initiative) has to be complemented by a major emphasis on improved management of distribution systems, where the private sector can play an important role by controlling unaccounted-for-water, improving the system of billing and collection, and saving energy costs.

Second, and more important, successful large-scale PSPs require certain pre-conditions, such as stakeholder support and political commitment, tariff rationalization, information base about the system and regulatory framework.[12]

The third lesson is that the progression toward concession-type contracts would have to be gradual, depending on policy changes and evolution of rational tariff structure. States could begin with O&M contracts in select areas. Over time, with improvement in information base, regulatory system, and increase in political commitment in favour of private participation, there can be progressively greater transfers of risk to the private sector. The scope of the contracts can also be expanded.

Box 12.1: PSP in Water Utilities

A few cities in India have attempted PSP options in the water sector. The focus has been on bulk water supply on a BOT basis. Most of the BOT-based bulk water projects have been unbankable or delayed, since they do not address the real issue (that is, problems with distribution). Further, adding more bulk supply without improving existing distribution, with continuing gross subsidization of water, increases the financial burden on the local bodies.

Other PSP options have also been tried, including service contracts (Chennai), local body financing through municipal bonds (Ahmedabad) and joint sector company to finance and implement the project (Tirupur). The Chennai experience has been most encouraging. The Chennai Metropolitan Water Supply and Sewerage Board has signed service contracts with private operators for O&M of two sewage treatment plants and 70 out of 119 city sewerage pumping stations. The cost saving as compared to the estimated costs under Board management has been in the range of 33 to 40 per cent.

Source: Chetan Vaidya, *The Asian Journal*, December 2000.

Institutional Financing

While, earlier, almost the entire financing was through budgetary allocations, in recent years the institutional finance (mainly from government-owned institutions such as HUDCO) has been rising, albeit without any accompanying improvement in sector performance.[13] The institutional financing in its current form appears to be inappropriate for sustainable expansion of the sector for a number of reasons. First, the lack of rigour in lending has led to inefficiency in fund utilization and service delivery. Second, these institutions tend to stunt the project development

[12] Service contracts require limited information on an existing system and minimal monitoring capacity, while options such as BOT and concession require high political support, adequate information about the existing system and a strong regulatory framework (Vaidya 2000).

[13] During the Ninth Plan period (1997–2002), the HUDCO has sanctioned 101 water supply schemes for financial assistance of Rs 4828 crores. Major funding for the sector however still comes from Plan allocation through central and state schemes.

and management skills at the local level (World Bank 1999b). Finally, state governments have routinely stood guarantee to borrowings from HUDCO and have, in many instances, also undertaken to bear the repayment obligation of such loans (GOI 2002).

To scale up urban infrastructure, Tamil Nadu has created an innovative financing institution called the Tamil Nadu Urban Development Fund. The aim of the Fund is to reduce the cost of borrowing for the municipalities, while obviating the need for state government guarantees. In addition, the Fund contributes to building capacity at the municipality level. The Fund has grown substantially over the years and has remained financially sustainable (see Box 12.2).

Box 12.2: Tamil Nadu Urban Development Fund (TNUDF)

The Government of Tamil Nadu (GoTN) established TNUDF (a trust fund) in 1996 with the aim of providing self-sustainable financing for infrastructure. Owned by the GoTN (72 per cent) and three private financial institutions (28 per cent), TNUDF has a line of credit from the World Bank and has also issued bonds. The Fund provides financing to municipalities and statutory boards in Tamil Nadu without using state government guarantees. Of course, special recovery mechanisms such as escrow accounts of property tax collection and water charges are generally used. In addition to lending, TNUDF provides grants to ULBs to:

- subsidize the capital cost of projects;
- provide training; and
- support project preparation and implementation.

In certain cases, debts are blended with grants to reduce the cost for ULBs.

The Fund has so far approved over 192 projects covering water supply and sanitation, roads, bridges, streetlights, solid waste plant, etc. in 90 out of 110 municipalities in Tamil Nadu and has sanctioned loan assistance of Rs 605 crores. By 2000–1, its loan recovery rate had increased to 99 per cent and has since remained at that level.

Source: http://www.tn.gov.in/policynotes/maws2004-05-9.htm.

Besides, some cities have been successful in accessing the domestic capital market and most of them without government guarantees. The total mobilization of funds from the capital market—through bonds and pooled financing—however has been very small so far (about Rs 900 crores),[14] even though the domestic capital market has been growing rapidly, with the market capitalization of listed stocks rising from 20.6 per cent of GDP in March 1991 to 52.3 per cent in March 2004 (source: SEBI) and the average maturity of government security increasing from 6.6 years in 1997–8 to 14.9 years in 2003–4 (RBI Annual Report 2003–4). The ULBs' limited ability to take advantage of the growing capital market reflects their low creditworthiness, which result from weak resource base, absence of commercially viable projects (due to poor cost recovery) and poor financial management. One remarkable initiative in expanding ULBs' access to the capital market is the 'pooled financing' adopted by Tamil Nadu Urban Development Fund (see Box 12.3).

The Tamil Nadu experience with urban development fund and pooled financing is beginning to encourage other states to follow. While Karnataka has made some progress toward replicating the TNUDF model, few other states are planning to do so.[15] Although the TNUDF has helped cut down the cost of financing for the municipalities and enabled them to access the capital market, it has not focused on user charges or efficient operation, relying instead on escrows and other security arrangements. As a result, the ULBs have been insulated from market pressure to improve sustainability.

To spread the benefits of pooled finance over the entire country, while addressing its shortcomings, the GOI is planning to launch Pooled Finance Development Scheme. This scheme aims

[14] Most of the proceeds have been used to fund water and sewerage schemes.

[15] A reforming state environment and a key set of committed bureaucrats and professionals have reportedly contributed to the success of TNUDF.

BOX 12.3: POOLED FINANCING

The concept of pooled financing is similar to that of state-level bond banks in the US, where a state-sponsored financial intermediary raises finance by issuing bonds and then on-lends to ULBs by buying their bonds.

A pooled financing arrangement has been made in Tamil Nadu by TNUDF with technical assistance from USAID, to ensure low-cost financing to smaller municipalities (by reducing transaction costs) and to provide credit-enhancement mechanisms. Under the arrangement, 14 ULBs have pooled some water and sanitation projects under an SPV called the Water and Sanitation Pooled Fund (WSPF), and raised about Rs300 million from the bond market at 9.2 per cent interest. The bonds have 15-year maturity with put/ call options at the end of 10 years and have been assigned high credit rating. The funds raised by the bond issue were disbursed to participating ULBs as loans. While the bonds were unsecured, a multi-layered credit enhancement mechanism was set up, which included a Bond Service Fund (BSF), a state-funded reserve fund and a USAID's guarantee through DCA to replenish the BSF, if needed.

Source: USAID-FIRE(D), Note No. 31, May 2003.

at providing credit enhancement (to access market borrowings on a creditworthy basis), stimulating necessary urban sector reforms, and developing municipal bond market. Under the scheme, each state/UT would designate either an existing state entity or create a new entity for execution of the scheme. The GOI would support the State Pooled Finance Entity through the Pooled Finance Development Fund (PFDF). A tentative allocation of Rs 400 crore under the Tenth Five-Year Plan has been made for the scheme. Of the funds available with the GOI for PFDF, 95 per cent would be utilized as contribution to the Debt Service Reserve Fund (DSRF) and the balance for the development of bankable projects. For each project, the concerned state government would match the GOI's contribution to the DSRF. While the GOI scheme can act as a catalyst in the scaling up process, one potential concern is that the requirement of matching contribution by the state governments can limit the usefulness of the scheme.

Scaling up Waste Water Treatment

The GOI's attempt to scale up 'sewage treatment' is instructive. In 1985, the GOI decided to launch the Ganga Action Plan Phase I (GAP I) to check the pollution of the Ganga resulting from untreated sewage in 25 Class I towns in Uttar Pradesh, Bihar, and West Bengal. The lessons from the implementation of the schemes provide important clues for designing future strategies.

Lack of timely funding: The GAP I got completed in March 2000, although the original deadline was March 1990, mainly due to lack of timely funding. Despite the delay, GAP I could create capacity for only 305 million litres of sewage a day (MLD), while the original plan was to treat 875 MLD. Meanwhile, the volume of sewage generated had nearly doubled.

Poor design: In 2001, the Central Pollution Control Board (CPCB) and state pollution control boards inspected 35 sewage treatment plants built under GAP I. The inspection revealed that some plants were 'underloaded', that is, did not have enough sewage to treat and some were 'overloaded', that is, they had too much to treat. Further, there was no sewerage in some of the towns included in GAP.

Weakness in operation: Operation and maintenance was found to be poor principally due to funds crunch, shortage of qualified staff, absence of regular monitoring of the plants and staff, and lack of uninterrupted power supply.

Lack of ownership: Urban local bodies (ULBs) had no financial stake under GAP (I), as the GOI provided all the funds for capital works. Further, for construction, the ULBs depended on parastatals, which did not involve the ULBs in the design, location, etc. of sewage treatment plants (STPs). As a result of all these factors, the ULBs never felt responsible for the upkeep of STPs. (The parastatals, operating as a monopoly, had little incentive to produce quality work.) Many times the ULBs did not have enough funds to finance even the O&M costs, with the result that assets created under the river action plans were poorly utilized.

Lessons for future strategy: Clearly, GAP I failed to achieve its objectives. Most of the problems found in GAP I still persist. The following lessons need to be considered while examining the scaling up options for the future.

- It is difficult to establish accountability when parastatals—rather than ULBs—are in charge. The problem becomes even more difficult when timely funding is not forthcoming.
- Lack of accountability can lead to not only delays (consequently cost overrun), but also design errors and sometimes insensible projects.[16]
- If ULBs do not share the capital costs and are not consulted in decisions regarding design, location, etc., the projects would lack ownership.
- ULBs lack financial resources for wastewater treatment mainly because they have failed to implement 'polluter pays' principle.

Moving forward, the ULBs need to have financial stake in what they are responsible for, which include STPs. Under GAP II, the central government finances 70 per cent of the cost, while the ULBs are responsible for the rest.[17] This is a step in the right direction. However, many ULBs do not have the funds even for the 30 per cent of capital costs. ULBs need to seriously explore the option of performance–based annuity contracts—that put together construction and maintenance of STPs—with private parties. Payments for this (30 per cent capital costs and O&M costs) can be made entirely out of user charges. A wider consultation with the ULBs would motivate ULBs to view STPs as part of their achievements. This approach would address the ownership problem as well as the resource constraint. Furthermore, parastatals need institutional change. Their monopoly needs to be broken and they need to be privatized. They can be potential bidders for the annuity contracts and their experience can also be utilized. Regardless of whether ULBs opt for annuity contracts or not, they would gain from privatization of parastatals.

Rural Water Supply and Sanitation

Rural water supply and sanitation is a state subject.[18] As per the 73rd Amendment of the Constitution, the subject of rural water supply vests with the panchayati raj institutions (PRIs). However, since PRIs are resource-poor, states have been taking up projects using their own resources. Also, recognizing the importance of safe drinking water in rural areas, the GOI has been providing financial assistance to state governments primarily under the Accelerated Rural Water Supply Programme (ARWSP) and the Pradhanmantri Gramodaya Yojana-Rural Drinking Water (PMGY-RDW).[19] It is well known that these programmes are government-oriented, centralized and supply-driven. Although a large infrastructure has been created under these schemes (with an investment of more than Rs 40,000 crores), their performance in terms of quality of delivery has not been up to mark, mainly because of two related issues: lack of community

[16] It may be pointed out that the time horizon is an important aspect of scaling up. If scaling up is not done on time, it loses a lot of its impact.

[17] GAP II was launched in 1993 and was scheduled to be completed by December 2001, but has now been extended to 2005. It is much wider in its scope (1912 mld) and geographical coverage.

[18] According to the Census of India 2001, the coverage of household having access to safe drinking water was 73 per cent for rural households, of whom 49 per cent were served by tube well/hand pump, 22 per cent by wells, and 24 per cent by taps.

[19] There are a number of other smaller schemes to provide support functions, such as (i) Sub Mission, (ii) Human Resource Development, (iii) Monitoring and Evaluation, (iv) Research and Development.

ownership and the neglect of operation and maintenance.

Recent Initiatives to Scale up

To validate the belief that a participatory, demand-driven approach can ensure that a community gets the level of service it desires, some Sector Reform Projects (SRP) were initiated in 1999 in 67 districts.[20] Twenty per cent of the annual outlay under the ARWSP was earmarked for funding of these projects. The projects were based on the principle that communities would attempt to ensure a certain minimum standard of service provision for themselves (and pay for it, albeit partially) if:[21]

- they own the assets;
- they are involved throughout the process, including planning;
- they are trained to do simple maintenance; and
- they know that the government will not maintain the systems.

Encouraged by the success of these projects, which are still continuing, the GOI has scaled up the initiative throughout the country by launching an improved version called Swajaldhara in December 2002. The principles are fixed, but the state governments have been given the full flexibility to develop their individual approaches to implementation (Ahmad et al. 2004). States' specific vision statements and clear road maps of action, endorsed by their political leadership, forms the basis of an MOU between the state and central government, where the centre would support the funding of projects initiated by beneficiary groups/gram panchayats/blocks against some pre-agreed reform milestones.[22] Ten per cent of the estimated capital cost of the schemes is to be contributed by the community up-front and the balance cost of the project by the GOI. The gram panchayat must also be willing to take over the scheme after completion, including the responsibility for O&M. The Swajaldhara Scheme is meant for only small, simple, and community-oriented schemes. (Larger schemes, involving investment of more than Rs 25 lakhs, are to be done only under ARWSP.)

Lessons for Future Strategy

The SRP projects appear to validate the principle that user participation and ownership—within an implementation framework that takes into account the local context—creates appropriate incentives for efficient operations. These projects are showing promise of greater sustainability than the traditional projects and are proving to be more responsive to community preferences. As for Swajaldhara, the GOI has so far approved nearly 4000 projects and has sanctioned Rs 450 crores. There is no doubt that its popularity is growing. Since Swajaldhara is relatively new—and there are only a few Swajaldhara projects that are operational—it is difficult to evaluate its efficacy. However, since the scheme resembles its pre-decessor (SRP), it is expected that similar benefits would accrue. According to some sector experts, Swajaldhara is likely to occupy the centre stage of rural drinking water supply within a few years.

Scaling up, however, is giving rise to a number of challenges, particularly capacity constraints and management of collective action. Many communities lack the capacity to carry out technical design, long-term training, auditing, monitoring, and evaluation. Nor do they have the capacity to manage large capital for major repairs,

[20] These projects were preceded by the World Bank–assisted Swajal Project, which was introduced in parts of UP in 1996. Swajal was one of the first major rural water and sanitation projects to transfer investment funds to user communities, enabling them to procure materials, services and works by themselves.

[21] See Swajaldhara website.

[22] MOU will be a state specific document, reflecting the local context—particularly in respect of source sustainability, water quality, and strengths and weaknesses of the institutional structure in the State. The MOU will include an agreed action framework for implementing the reform initiative in a time bound manner and for all funding arrangements with the GOI and external support agencies. Access of the state government to funding from external agencies like the World Bank, etc. would be contingent on signing of the MOU.

replacement or extension. If the scope for Swajaldhara were to be expanded to include large projects, these challenges would be particularly daunting. Capacity building within the communities can at best be a long-term goal. In the short and medium term, communities would need external support in terms of technological and managerial inputs, both during and after implementation. Further, a number of internal community dynamics such as conflicts, lack of transparency, poor leadership, theft, etc. can threaten community management. Experience shows that attempts on the part of donors and NGOs to bypass these problems by creating parallel structures in the name of efficiency have failed. So there is a need to work through the existing structures.

Irrigation

Irrigation in India is predominantly managed and financed by the government. With the deterioration of state finances over the years, the irrigation budgets have tended to be squeezed. Further, the bulk of the irrigation budget is spent on construction and rehabilitation. Out of the small amounts available for O&M, a large sum is used to cover establishment costs, with little left for actual maintenance (Table 12.2). The poor maintenance that results gives rise to shrinking of irrigation service area, inefficient and inequitable distribution of water, loss of capacity to measure and control water, and waterlogging.

TABLE 12.2: Administrative Cost in Irrigation O&M and Revenue Realized

State	Establishment cost as Per Cent of O&M expenditure	Revenue realized as Per Cent of O&M expenditure
Andhra Pradesh	38.5	73.80
Assam	99.1	0.07
Gujarat	49.8	28.20
Haryana	85.3	26.50

Source: GOI (2002).

Yet, irrigation agencies continue to neglect maintenance and instead focus on premature and recurring rehabilitation projects, mainly due to shortcoming in the current incentive system and accountability framework in the irrigation departments. For senior government officials, O&M yield low political benefits, while rehabilitation projects create high political support. For the irrigation agency management, accountability to internal hierarchy is simpler than accountability to water users. For operational staff of irrigation agencies, deterioration of the existing structure is actually rewarded by rehabilitation projects (Huppert et al. 2001). Clearly, this build-neglect-rebuild system is not sustainable, as it entails large and recurring government expenditure, while the erosion of huge irrigation capital built at a massive investment continues.

Furthermore, since payments go to general revenues, fee collections are not related to quality of maintenance or budget allocation. The institutional set-up thus appears to reduce the incentives for users to pay and irrigation departments to collect. The problem of disincentive to pay is compounded by electoral populism as well as the fact that users have little role in the management and therefore no stake in its upkeep.

How not to Finance Irrigation Projects?

Driven by (a) acute scarcity of funds, (b) compulsions to build canals rapidly, and (c) limits on their fiscal deficits, some states have created 'financially autonomous' irrigation development corporations. These corporations tap the capital markets by issuing government-guaranteed, high-return water bonds and utilize these funds for specific irrigation or multipurpose projects. To get the confidence of lenders, the state governments not only give guarantees to these bonds, but also actively persuade potential investors to buy these bonds (Raju et al. 2003). States have tended to showcase these attempts as reform initiatives by involving the general public in irrigation finance although, in reality, they are a reflection of states' resource crunch. Gujarat first used this option for financing Sardar Sarovar

Project. Other states such as Maharashtra and Karnataka have since relied on this option.

There are, however, serious concerns regarding their sustainability. The expectation that service obligations would enforce discipline in water pricing and cost recovery has generally not materialized. Both farmers and agency staff believe that the state will repay all the debt. Indeed, states have been forced to take recourse to diversion from general budgetary resources. For example, by March 2004 the five irrigation development corporations in Maharashtra had raised Rs 11,548 crores through bonds and the Government of Maharashtra (GoM) through the budget had made interest payments on these bonds totaling Rs 5045 crores, in addition to making equity contribution of Rs 3869 crores to these corporations (source: Government of Maharashtra).[23] Clearly, these 'financially autonomous' irrigation agencies have imposed a significant fiscal burden on states. That such modes of irrigation financing have failed to deliver as fiscally sustainable framework can be inferred from the following examples.

In 2003–4, for example, the GoM made interest payments of Rs 1109.64 crores and equity contribution of Rs 1496.73 crores towards the state's irrigation development agencies, while the total expenditure and fiscal deficit of GoM for 2003–4 were Rs 52781 crores and Rs 15,474 crores respectively. Thus, interest payments and equity contribution for irrigation agencies together account for 4.9 per cent of total expenditure and 16.8 per cent of fiscal deficit of the GoM in 2003–4, indicating a clearly unsustainable burden.

Box 12.4: The Case of Sardar Sarovar Narmada Nigam Ltd (SSNNL)

The SSNNL was created to 'harness the untapped water of Narmada' in terms of irrigation and power capacities. A sizeable part of the project has been completed. The main works that remain to be done include taking the dam height from the 95 metres to 128 metres, constructing the canal network for Saurashtra and Kutch, and another 70,000 km of sub-canal network to develop the command area.

The organization has got into financial trouble. SSNNL needs an astronomical sum of Rs 16,500 crore from the Gujarat government to ensure that the ambitious project irrigates an additional 18 lakh hectares of land in the next four years. The Nigam has already spent Rs 14,000 crores on the project. Liabilities of the SSNNL are rising with every passing year, forcing SSNNL to default. According to SSNNL, it would require a 'minimum Rs 3500 to Rs 4000 crore per year' to complete the project by 2007. It is unlikely that the central and state budgetary support would match the expectation of SSNNL.

Source: www.sardarsarovardam.com.

Options for Future Strategy

There are two (not mutually exclusive) ways of achieving higher agricultural growth using irrigation. The first is area expansion, as has been the case in the past. The second route is the productivity enhancement of existing irrigated agriculture, which entails higher irrigation intensity and greater use of modern farming practices. The latter option is more attractive because it not only costs less, but also increases 'crop per drop', which is the need of the hour.

In this context, as the recently created 'financially autonomous' irrigation agencies have failed to provide an appropriate framework to scale up, the practice must be given up and replaced by new strategies. Given resource crunch of states and the deteriorating physical and financial health of irrigation projects, the options to be considered must on one hand reduce the financial burden on the government and on the other, impart greater user orientation to the sector. Two such options have been suggested. One is to involve farmers in managing their irrigation systems through Irrigation Management Transfer (IMT); this has been already attempted in some areas. The second option is to involve the private corporate sector.

[23] The interest payments (Rs 5045 crores) and equity contributions (Rs 3869 crores) quoted in the paper are over the period 1996–7 to 2003–4.

Transfer of Management to Water User Associations: Evidence in countries such as Mexico and Chile shows that farmers can better manage and maintain irrigation systems than government. This is so, because they have not only a stake in the quality of service but also a better understanding of local needs and better ability to resolve water management issues than the government. In India too, a beginning has been made in some state (for example, Andhra Pradesh and Orissa) where WUAs act as organized client groups. Under this approach, while the government makes the capital investment, the WUAs are responsible for O&M.

The system, however, has three drawbacks that need to be addressed. First, the WUAs can be prone to 'captures' by political parties, which may influence the WUAs to run down the infrastructure assets by under-investment in maintenance and renewal to keep water prices low and the customers happy. Second, irrigation infrastructure has a long life and requires long term investment in maintenance and asset renewal. WUAs, however, often take short-term views on maintenance in the hope that governments will come to their assistance when they get into difficulties. Finally, most WUAs lack the technical and managerial skills and are also wanting in their intensity of participation.

Private Corporate Sector[24]*:* Private corporate sector entities that can participate in irrigation include irrigation and construction companies (through build-own-operate, build-own-sell, build-own-transfer, and lease-own-operate systems), consultancy outfits (engineering and managerial consultancy), and contracting firms. Since these private groups are vastly unequal in their financial, technical and organizational resources, they have to be brought together for integrating their critical resources within a common management framework. Although there is a need for competition within each group, a high degree of coordination between the groups is necessary to make the collaborative framework a success. Under this approach, the government's role in financing and day-to-day management will be substantially reduced.

[24] The following paragraphs draw on Saleth (1999).

For O&M of existing projects, the relevant mode of privatization would be lease-own-operate system; all others are for new projects. Under this system, a private group leases an existing project and undertakes the tasks of water distribution, fee collection and system maintenance either by itself or in collaboration with groups such as contracting/ consultancy firms and WUAs. The lease terms can influence the water rates. Lease can also be designed to create incentives for long-term views on maintenance. For example, long lease duration (fifteen to twenty years) can encourage leasing companies to invest adequately in system maintenance. Even in this mode of privatization, a well-organized WUA can be a facilitating factor for private investment, since organizing water delivery to and cost recovery from numerous farmers are unfamiliar tasks for the irrigation companies.

SWITCHING OVER TO SECTOR-WIDE APPROACH

The Concept and its Rationale

Sector-wide approach (SWAp) constitutes a departure from the traditional framework of the 'project' by shifting focus from designing and executing 'projects' by individual partners to developing effective policy and institutional frameworks at the sector level. It represents a shared approach by development partners to support programmes driven by the country's own development vision. Under the framework, aid is given to the entire sector (or a significant sub-sector) by adopting a broader process approach, which supports defining policies, making them operational, and implementing them throughout the sector. The receiving government has to control the policies and their implementation and the development partners have to make a number of changes in the practice of development co-operation. The transition is not easy and requires a lot of patience, convincing, and dialogue between government institutions and donor agencies.

The rationale for SWAp derives from two important concerns:

- The traditional project approach has not produced sustainable improvement in services. Projects initiated by aid agencies such as the World Bank and ADB often absorb scarce human and financial resources, but their impact has been on activities with limited coverage. The standards they set cannot be replicated or sustained. Further, they rely heavily on expatriate technical assistance, which stunts the development of local capacity and management systems.
- There is a problem relating to the traditional budget process and aid flows, whereby failure to prioritize leads to universal under-funding. SWAp entails a set of clearly articulated development objectives and priorities and captures all funding sources and expenditures within a realistic medium-term budget. All plans for the sector are based on realistic budget allocations that are in line with national priorities.

SWAps evolved in low income countries in Africa and the South Asian region. Recently, some elements of SWAp principles are being adapted to middle income countries in Latin America and Europe/Central Asia. They have been mainly attempted in the social sectors (health, education, etc.), but there have been some in transport and water as well. In recent years, SWAp has gained considerable ground internationally as a scaling up strategy, with an increasing number of host countries and aid agencies reporting encouraging results (Box 12.5). Over the last few years, at least 30 World Bank operations have supported SWAps or SWAp-like structures in 17 countries, but the number is growing rapidly (Kanda 2004).

Box 12.5: SWAp in WSS—The Uganda Case

As in India, the water and sanitation sector in Uganda has been traditionally characterized by low coverage, inadequate budget provision, inadequate capacity at the centre and districts, limited capacity of the private sector, and poor O&M.

In Uganda, the WSS gained priority and benefited from increased funding from the Bank because of the sector's strong links with poverty. In 2001, Uganda got a multisectoral Poverty Reduction Support Credit (PRSC) from the Bank (a development assistance instrument, supporting an IDA-eligible country's policy and institutional reform programme) to help implement its poverty reduction strategy. The Uganda PRSC builds on and supports SWAps in education, health, water and sanitation, and justice, law, and order.

In the water and sanitation sector, there has been a decentralized implementation in all 55 districts in Uganda. The capacity of districts, sub-counties, and towns has increased measurably as has the capacity of the private sector contractors and community to develop and operate safe water and sanitation facilities. The monitoring process has improved through annual joint reviews (by the Government of Uganda and donors) and annual independent technical and financial audits. Between 2000 and 2003, rural coverage increased by 9 per cent and 37 new small towns got water and sanitation systems. During the same period, bulk water supply increased from 46 million cubic metre per year to 51 million cubic metre.

Source: Richard Cong (2004).

Example in India—Sarva Shiksha Abhiyan (SSA)

SSA is GOI's flagship programme to universalize elementary education in a time bound manner, with objectives such as 'all children completing five years of primary schooling by 2007', 'universal retention by 2010', etc. The scale and scope of this programme is large. Launched in 2001, the SSA is being implemented in partnership with state governments to cover the entire country and address the needs of 192 million children in 1.1 million habitations. The programme seeks to open new schools in habitations that lack schooling facilities and to strengthen the existing school infrastructure through provision of various types of grants (such as additional class rooms, toilets, drinking water, maintenance grant and school improvement grants). The programme also aims at bridging the gender and social gaps.

Structure for Implementation

The central and state governments are together implementing the SSA in partnership with the local governments and the community. At the national level, the implementing authority is the National Sarva Shiksha Abhiyan Mission, which was constituted in November 2000 with the prime minister as the chairman. Similarly, states have to form implementation societies under their respective chief ministers. The scheme entails functional decentralization down to the school level, to maximize community participation.

Transition to an Overarching Framework

The GOI's resolve to provide universal elementary education had been spelt out in the National Policy of Education (NPE), 1986 and Programme of Action (POA), 1992 and were reflected in a number of schemes such as Operation Blackboard, Non-formal Education, Teacher Education, Mahila Samakhya, and a number of state-specific programmes. With the launch of SSA, all investments in the elementary education sector from the state and the central plans began to be reflected as part of the SSA framework. All the schemes will, however, merge into the SSA programme within the next few years.[25] The point to note here is that the SSA provides for a smooth convergence into a single framework without disturbing the existing structures in states and districts.

Central Strategies

Financing: The assistance under the programme from the GOI is to decline from 85 per cent of total cost during the Ninth Plan to 75 per cent in the Tenth Plan, and 50 per cent thereafter. The state governments would bear the balance. States will be required to maintain their level of allocation for elementary education in real terms on the base year 1999–2000. The share of states under the SSA programme will be over and above the base year allocation. Certain eligible expenditures are to be reimbursed by the external (donor) agencies to the GOI. External agencies are envisaged to fund around 30 per cent of the total project costs up to 2007–8.

Institutional reforms: States undertake to make an objective assessment of their respective education system, review the State Education Act, rationalize teacher deployment, formulate policies regarding private schools, etc.

Community ownership: The programme calls for community ownership of school-based interventions through effective decentralization. This is augmented by involvement of women's groups, village education committee members, and members of panchayati raj institutions.

Monitoring: There will be a joint review by the central and state governments. Monitoring will be community-based and with full transparency. For example, statement of expenditure in each school will be a public document.

Leveraging External Support

IDA, the EC, and DFID are pooling their funds with the GOI to support SSA, which is the first SWAp in national elementary education programme.[26] The SWAp will enable external partners in improving institutional capacity. For example, the Bank could help strengthen (i) government capacity for review, monitoring, and evaluation and (ii) important areas such as financial management, procurement, and student assessment. In addition, the external partners could draw the government's attention to national and international best practices. External assistance

[25] There is a distinction between SSA as a framework and SSA as a programme. While SSA provides a wide convergent framework for implementation of elementary education schemes, it is also a programme with budget provision for strengthening vital areas of elementary education.

[26] Bank operations were approved by Board in April 2004.

is designed to maximize GOI support, which in turn is designed to leverage state-level support. The aim of this approach is to make development assistance complement rather than substitute local efforts.[27]

Advantages

The comparative advantages of using a SWAp approach in scaling up are as follows:

Resource utilization: SWAp improves efficiency in resource utilization in two fundamental ways. First, it eliminates duplication by fostering greater donor coordination, thereby reducing the likelihood of overlapping of initiatives. Significant savings are also made, as SWAp emphasizes on

- using and strengthening government institutions, procedures and staff, rather than establishing parallel systems; and
- donors' commitment to common assessment, procurement, reporting, and auditing procedures.

Second, the integration of separate projects into a common framework can release government management capacity that is otherwise tied up in project management.

Improved management of projects: The emphasis on using the government's institutions, procedures, and staff also brings the country's capacity, systems, and institutions into reform focus. This happens at a feasible pace and contributes to sustainability. The quality of fiduciary arrangements improves as the SWAp requires generation and dissemination of timely, relevant, and reliable financial information. This helps the government to plan and implement the programme better and the donors to monitor compliance (with agreed procedures) and appraise progress. All partners use agreed appraisal, procurement, disbursement, accounting, and audit procedures. There is even agreement among development partners on procedures to resolve disagreements.

[27] World Bank (2004).

Greater accountability: Under the SWAp, the accountability of the government for the sector performance is enhanced. Here, the government is in complete control and is responsible for setting policies, priorities, and standards which apply to all public activity in the sector including that financed by donors. Further, SWAp is closely connected with the principle of decentralization, which generally yields increased political accountability given that investment decisions would be increasingly taken at the local government level. SWAp fosters local ownership by removing separate project implementation units and ensuring that a broad range of local stakeholders is involved. Finally, greater reliance on information and analysis based annual reviews under SWAp usually leads to improved quality and availability of sector wide information required by all. This strengthens the accountability framework.

Disadvantages: The SWAp may be disadvantageous for the host country in three ways. First, although it is the avowed design that the host country develops programmes in collaboration with host agencies, the country may end up playing second fiddle because of its dependence on financial assistance (offered by the lending agencies) and adopt positions that compromise their original ideas and visions. Second, under SWAp it is generally the wealthy institutions capable of making substantial financial and personnel commitment that get included. In other words, SWAp can curtail opportunities for knowledgeable, high quality, yet financially smaller organizations to participate in policy design and implementation of programmes (Maslak 2001). Third, donors may be slow to adapt (for example, adopt common procedures).

SWAp presents disadvantages for donors as well. First, it reduces visibility for donors. Second, it enhances the risk of their association with decisions they disapprove of and may compel them to compromise on ideas of best practice. Third, SWAp compels donors to relax tight control over the use of their funds. Finally, the traditional independence of NGOs (and governmental agencies) may be severely compromised and in cases where they are not invited to provide financial assistance, there is the risk of fund-cutting to that programme.

Moving Forward

There is a concern that the huge investment backlog in the water sector cannot be easily removed because the government is not in a position to commit large funds. But it is a matter of greater concern that physical assets created with large investments have been deteriorating rapidly and becoming unsustainable, requiring further investment. This has been so, because investments have traditionally been made, both by the government and the donor agencies (primarily the World Bank) without much attention to sustainability as reflected in the widespread weaknesses in the current policy, regulatory and institutional frameworks. Also, there has been little use of innovative financing instruments, which could help in tiding over the transition difficulties. Scaling up water infrastructure to meet the development goals would therefore require a three-pronged approach: first, create an overarching framework where all development partners cooperate with each other to advance a shared set of goals; second, use innovative financing instruments and frameworks—that have demonstrated success elsewhere—during the transition; and third, initiate policy, regulatory and institutional changes that are conducive to sustainable investment. This strategy would help achieve the development goals by (a) better and sustainable utilization of public resources and donor funding and (b) facilitating greater private investment in the sector.

Overarching Framework

From the earlier sections, it has been observed that there are many actors in the supply side, namely, state governments, the GOI, donor agencies, and the private sector. Within the government sector, there are numerous departments and agencies. There is little coordination among these actors and little focus on attaining clearly articulated objectives. Priorities are not set and as a result, schemes are universally underfunded. The ‘project’ approach followed in the past as well as the numerous schemes pursued by the government has led to enormous waste (due to duplication of efforts), little learning, and no sustainable changes in policy and institutional frameworks.

Experience suggests that there are substantial gains to be made in this respect by switching to SWAp. Considering, however, that water is too large and diverse a sector, a SWAp needs to be designed for each of the major sub-sectors. In rural drinking water, for example, a sector-wide approach in the form of Swajaldhara has already been evolving, which could be scaled up in the short-term to make it the flagship programme in rural drinking water. In other areas, such as urban water and sanitation, irrigation, etc., SWAps can be designed by taking into account the lessons learned from the scaling-up experience not only in the sub-sector itself, but also in other sectors such as roads and power. The basic building blocks of the design would include the development of: systems for implementation, monitoring and evaluation countrywide (or statewide), using governments’ own policies and institutions; systems for financing the sector; interpretation of institutional roles and responsibilities; and costing implementation of these programmes. To be effective, SWAp designs must involve focus on outcomes, pro-poor bias, decentralization (strengthening of local bodies), greater user participation (including cost-sharing), private sector involvement, capacity building at the local level, and trust and coordination among development partners.

There are two points to note here. First, as stated earlier, SWAps present both advantages and disadvantages for the host country as well as the donors. The pros and cons have therefore to be weighed before a decision to adopt SWAp is taken. It may not always be possible to have all development partners (or even the major ones) to agree to the SWAp approach. Similarly, the host country may be unwilling to accept the challenges of SWAps (such as 'lowest common denominator risk', capacity for coordination, etc.). Besides, it is neither a panacea nor a 'one-size-fits-all'. But the important point is that since project approach followed for decades has not yielded encouraging results and since SWAps have been successfully implemented in several countries, it is worth considering it as a serious option for scaling up. Second, it is possible for project approach to coexist with SWAp. Nepal, for example, has employed both types of approaches in their educational funding (Maslak 2001).

It may also be noted that SWAps need not always be at the national level as in the case of education in India (SSA). It is possible to implement them at a few selected states that are willing to undertake reforms. This may eventually have demonstration effect. In areas where there is substantial consensus among states, SWAps can be scaled up to cover the entire country.[28] Further, although SWAp is a government-led programme, it can and does accommodate private participation.

Financing Approaches / Instruments

There are ultimately two sources of financing for infrastructure: taxes and user charges. The financing approaches and instruments that draw on these two sources, however, need to be innovative and flexible. Changes in policy, institutions, and regulations that promote sustainability take time to implement. During the interim period, the financing approaches and instruments need to be chosen to suit the existing constraints, such as 'no-pay culture', limited capacity at local level, poor service provision, and low political will. It has been observed that time-slice financing, output based aid, and transition financing (allowing user payment to catch up gradually with costs) have worked successfully in the face of problems typically facing the developing countries. Also, performance-based annuity contracts have worked as an effective financing approach in India's road sector. In each of these options, user charges need to be stressed upon, while progressively reducing the reliance on public finance.

As far as the World Bank is concerned, in addition to the project loans, there are a host of other instruments to choose from. Given India's development objectives and constraints facing the country, the following instruments could be considered.[29] [30]

An Adaptable Programme Loan (APL) represents a package of multiple loans that are rolled out over many years to radically restructure a sector. A sequence of APLs starts with a loan to fund an initial set of activities; the progress in this phase of the programme is reviewed before the subsequent phase can be initiated and so on. Subsequent funding is provided when agreed milestones and benchmarks for realizing the programme's objectives are met. The usefulness of APLs in India's water sector is particularly high because of two reasons: (a) they support long-term development programmes and aim at sustained changes in institutions, organizations, or behaviour and (b) they build on the lessons learned from the previous loan(s) in the series.

Sector Investment and Maintenance Loans (SIMs) focus on public expenditure programmes. They aim at aligning sector expenditures, policies, and performance with the country's development priorities by helping to create appropriate balance among new investments, rehabilitation, and maintenance. The SIM is appropriate where a sector expenditure programme needs extensive coordination, as in the case of India's water sector.

Another option is to use Leaning and Innovation Loan (LIL). They typically do not exceed $5 million, and are normally implemented over

[28] It may be pointed out here that the divergence of policy views among states in education is much less than in sectors such as water resources, irrigation, and urban water supply.

[29] See World Bank (2001).

[30] To support SWAps, the World Bank has predominantly used Investment Lending (IL) instruments (Specific Investment Loan, Adaptable Programme Loan, and Sector Investment and Maintenance Loan). Among the IL instruments, the Bank has been increasingly using pooled financing over the last four to five years.

two to three years. These loans provide a flexible instrument through which pilot interventions can be financed in preparation for larger scale programmes. An LIL can be used, for example, to test new approaches, help test institutional capacity, build trust among stakeholders, and support locally based development initiatives. Potential areas in the water sector in India include ground water regulation through community participation, conjunctive management of water resources, voluntary transfer of water from farmers to municipalities, and safe water environmental management. It may be pointed out that pilot interventions can make useful contribution to the design of sector-wide approaches.

While APLs, SIMs, and LILs are appropriate instruments to attempt where SWAps are in operation, guarantees and IBRD/IFC Municipal Fund can play a useful role in other areas. Guarantees can be useful in urban WSS projects (water supply, waste water treatment, sewerage) and hydro projects. To ensure that amortization requirements do not entail excessively high user charges, these projects require loans with long maturities and grace periods, which the private lenders are generally unwilling to provide. Project-based partial credit guarantees, which cover all risks, are designed to assist government entities to access debt financing from new sources with longer maturities than would otherwise be possible. Project-based partial risk guarantees, which are extended on a limited basis to IDA borrowers, cover specific sovereign risks. They protect private lenders against debt service defaults resulting from nonperformance of government obligations agreed to under a concession, such as maintenance of agreed pricing arrangements, government payments under public service obligation agreements, etc. It should be noted that all these guarantees are contingent liabilities of the government.

The IBRD/IFC Municipal Fund, started in May 2003, provides partial guarantee facility to meet the credit enhancement needs of municipalities to facilitate their access to capital market. The IFC, for example, provided a private Mexican trust (an intermediary agency) a peso-denominated partial credit guarantee of $3 million equivalent to support the issue of $8.8 million in bonds in the Mexican capital market. The proceeds are being used to provide a loan to Tlalnepantla Municipal Water Company to finance the design and construction of a wastewater treatment plant. The guarantee allowed the project to enhance the bond credit rating. The Tlalnepantla operation represents IFC's first direct municipal finance deal. The remarkable thing about the deal is that it did not involve any federal guarantee or assignment of federal transfers. There is scope for similar deals in case of some large municipalities in India, which can secure financing for long-term infrastructure projects from local institutional investors, without depending on the government.

Supporting Initiatives

Sustainability of scaling up water infrastructure has two dimensions:

- resource sustainability; and
- financial viability.

There has been a strong growth in demand for water in recent years. So, scaling up is not possible without initiatives to ensure resource sustainability. Further, it is well known that without financial viability, no operator would be in a position to introduce innovations, expand service provision, or maintain service standards. The initiatives that need to given high priority are outlined below.

Policy Initiatives

Tariff policy: The failure to treat water (and water services) as an economic good has led to rising demand and inadequate supply. So, all policies relating to water (at the central and state level) need to unequivocally emphasize the 'economic good' aspect of water. Given the current level of cost recovery, the short-term aim of pricing should be to ensure financial sustainability by adjusting tariff gradually to reflect costs.[31] Cost estimation

[31] Even though some states have increased irrigation charges substantially, they have been reluctant to move to

needs to reflect an efficient level of operation to ensure that consumers do not pay for the inefficiency of the operators.

Interstate rivers: One factor that has deterred investment by donor agencies is protracted interstate water dispute and the resultant controversies. The tribunal process to adjudicate water disputes has encouraged states to secure interstate claims to the headwaters of rivers by building large dams regardless of the financial and environmental consequences, and impact on downstream states (Pitman 2002). Maharashtra, for example, spent heavily on the Maharashtra Krishna Valley Corporation to create storage capacity to get prior appropriation rights to Krishna water; because if it did not do so, its share (560 TMBC) in Krishna awarded by the Krishna Water Dispute Tribunal would have been subject to revision. This problem is the result of poorly established property rights and can be addressed by creating stable and predictable property rights for the states.

Regulatory Initiatives

Set up Regulatory Body: To elicit private sector participation, it is important to have independent (economic) regulator, who would act as a catalyst for reform by isolating tariff-setting from political influence, removing arbitrariness in setting service standards, and ushering in transparency, accountability, and consumer-orientation into the sector. A distinction is necessary between economic regulator and resource regulator. While the economic regulator should be entrusted with tariff-setting, ensuring a minimum service quality, getting citizens to be more closely involved, the resource regulator should provide a mechanism for sustainable aggregate water use, which would entail inter alia prevention of over-exploitation and misallocation of raw water supply. Economic regulatory authority needs to be set up at the state level (not at local level). Resource regulator, on the other hand, should be set up at the river-basin level, covering one or more states. Finally, the economic regulator has to be independent of government, while the resource regulator need not be so. Maharashtra has passed a Bill for the establishment of a regulatory authority, which would have the combined functions of resource regulator and economic regulator[32] (see Box 12.6).

full-cost accounting because it would reveal the true burden of excessive overstaffing of their irrigation departments (Pitman 2002).

BOX 12.6: MAHARASHTRA WATER RESOURCES REGULATORY AUTHORITY BILL

In December 2003, the Government of Maharashtra introduced a Bill to provide for the establishment of Maharashtra Water Resources Regulatory Authority to 'regulate water resources within the State of Maharashtra, facilitate and ensure judicious, equitable and sustainable management, allocation and utilization of water resources, fix the rates for use of water for agriculture, industrial, drinking and other purposes, and matters connected therewith and incidental thereto'.

The chairperson and seven other members of the Authority shall be appointed by the Governor of Maharashtra on the recommendation of a selection committee comprising senior government officials. The chairman and members shall hold office for a term of three years.

The authority would inter alia have the powers to establish a water tariff system and to fix the criteria for water charges at the water resource project, sub-basin, river basin, and state level after ascertaining the views of the affected public, such that water charges reflect not only the full recovery of the cost of administration, O&M, but also partial recovery of capital investment.

Source: L.C. Bill No. XIX of 2003, Government of Maharashtra.

Institutional Initiatives

Expedite the creation of water user association: Water user associations need to be created

[32] Uttar Pradesh and Gujarat are contemplating similar action.

in every state as democratic, grassroots level organizations and should not be confined to areas under canal irrigation.[33] They would bulk-purchase water from irrigation departments and would be responsible for water distribution, O&M, and collection of fees from members. In case of groundwater, they should act as self-regulatory body.

Break the monopoly of parastatals: It is important to break the monopoly of the parastatals (such as Maharashtra Jal Parishad), which are usually overstaffed and inefficient, but invariably bag the contracts for construction of water works, sewage treatment plants (STPs), etc. from municipalities. Even though municipalities are free to give construction contracts to any organization including private firms, they usually prefer the parastatals, because of the latter's proximity to the respective state government. To overcome this problem, and at the same time use the experience of the parastatals, states need to de-integrate their respective parastatals into four or five companies and reduce their stake to minority. Competition among these companies can lead to cost savings for the municipalities.

Reorient HUDCO: There is little evidence that the loans from government-owned HUDCO for the urban water and sanitation projects have lent greater sustainability to those projects; yet, they have been growing rapidly. Government guarantees to HUDCO loans and the reported rescheduling of loans in the event of default appear to be creating a moral hazard problem. So, HUDCO needs to be reoriented to ensure that greater pressure is brought to bear on the borrowing entities to focus on viability issues.

Conclusion

It has been recognized for quite some time that the water sector is plagued by inefficient water allocation, wasteful use, expensive supply-driven solutions, and poor maintenance. Even so, new investments are being made—albeit lower than required—without sufficient attempts to remove these weaknesses. As a result, huge assets created with massive investment are getting eroded and are not contributing enough to the achievement of the country's development goals, including millennium development goals and the Tenth Plan goals.

The current financing approach, which is characterized by numerous schemes by the central and state governments, 'projects' by the donor agencies and government-guaranteed loans by financial institutions, has not helped in focusing on outcomes and has led to enormous waste of resources. Scaling up has been attempted in recent years, but without addressing the weaknesses stated above and have therefore been largely unsuccessful. To accelerate progress towards achieving the development goals, the focus has to shift to outcomes and viability from inputs and spending per se. In this context, experience shows that SWAp can provide a viable alternative with all development partners pooling their resources to finance, monitor, and review a government-led programme, where objectives and priorities are clearly laid down. From the World Bank's point of view also, SWAp would be an effective framework, as the focus of Bank attention moves away from traditional, enclave projects towards sector wide outcomes, where the Bank can complement what can be done by other public and private actors. The lessons learned from the successes and mistakes of the past scaling-up attempts would be useful in the design of SWAp.

SWAps can be introduced in the short run; but their sustainability would depend on the extent to which the necessary pre-conditions are established. While some of the policy, regulatory, and institutional changes can be made relatively quickly, others can take time. The choice of instruments and financing approaches in the short and medium term needs to take these constraints into account. The World Bank could help by introducing financing approaches used

[33] Currently, 8 m.ha. are under participatory management (that is, WUAs) out of 58 m.ha. irrigated areas (Source: Planning Commission).

successfully elsewhere and by using some non-traditional instruments such as adaptable programme loans, learning and innovation loan, etc.

Taking a cue from the power sector, it would perhaps be more productive for the World Bank to focus its attention on a few states with a clear commitment to improve their sector performance rather than spread resources over a large number of states as it is currently doing. Even for the few selected states, the Bank's disbursements would be very small in comparison to the states' investments needs. The limited Bank resources must therefore be applied selectively in areas where they are most effective in terms of scaling up. These could include projects that pilot new approaches (such as water market) or financing that supports expansion of proven government programmes on a sector-wide basis (such as Swajaldhara).

The role of the Bank is larger than that of a provider of financing. It is a storehouse of knowledge about issues, approaches and interventions, and their impact on sector performance, around the world. This knowledge can be leveraged to engage state governments in policy dialogues as well as to build capacity in the public agencies active in the water infrastructure sector. Adapting successful cases to the Indian situation would, however, require more than just knowledge transfer: a better understanding of the Indian realities including institutional rigidities and political compulsions.

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13

Economic Reforms Through Principled Pragmatism

V.S. VYAS

There is a growing consensus among policy-makers in this country on key issues related to water. This is reflected in several public pronouncements as much as in numerous official documents. It is widely understood that water is a finite resource; usable water can be augmented only to a limited extent. Conjunctive use of surface water and groundwater needs to be recognized in all projects of water resource development and management. There are competing demands on water, therefore, an integrated and holistic view of water is well appreciated, as also the need for involvement of the users in conservation and management of water. It is recognized that while in situ conservation and management of water is important, conveyance of water over distances is inevitable. With finite water availability, need for economizing water use and avoiding wastage is universally advocated. It is understood that pricing of water to reflect the cost of storage and conveyance is important for financial sustainability of various schemes and projects, especially when water is used as an 'economic good', for example, in irrigation. At the same time, it is widely recognized that the state has to ensure potable supply of water for drinking purposes to all citizens.[1]

The consensus on such key issues is not reflected in ground realities. Each major water user and/or water provider zealously guards its 'territory'. Groundwater is indiscriminately 'mined' and increasingly large areas are coming under dark zone. Efforts to conserve water through rainwater harvesting and recharging of wells have not gone beyond symbolic gestures. Conveyance of water from surplus to deficit regions even within the state is not an easy task. Interstate transfer of water is becoming an increasingly difficult proposition. All major decisions are taken by state bureaucracies. Only large-scale experiment in the involvement of the people in water management has been the watershed management programme, which at best can be considered a mixed success.

[1] Many of these aspects of development and management of water resources are reflected in various official documents. See, for example, Mid Term Appraisal of Ninth Five-Year Plan, Government of India, Planning Commission, New Delhi, 2000, p. 75–6. International consensus on many of these issues is reflected in so-called 'Dublin Principles.' For details, see, Water Resources Sector Strategy, World Bank (2004, p. 28).

Vast sums of public money are invested for developing surface water resources, but the use efficiency is very low. There is no evidence of appreciable savings in the use of water in agriculture or for domestic purposes. Water released for irrigation or industrial purposes by public authorities does not reflect cost of conveyance and distribution, leave aside its scarcity value. There is reluctance to pay even for highly subsidized water by the users. Large subsidies to water users coexist with, in fact, lead to paucity of resources for O&M. Water markets, wherever they exist, have proved to be a mixed blessing. Generally, their existence coincides with over-exploitation of groundwater resources. Public regulations on allocation and use of water are honoured more in breach than in compliance.

It will be useful to underline the main characteristics of the Indian polity and the way they impinge on water-related issues. Ours is a federal, multiparty, democratic state. Although the sphere of activities of the centre and the states—and now even of the institutions below state level activities is defined in the Constitution —there is no agreed interpretation on different rights and obligations. For example, water development and management is a state subject, however, there is an 'entry' (entry 56) which gives power to the centre to regulate interstate management of water resources. Each constituent unit wants to zealously guard what it considers as its legitimate riparian rights. Issues become more contentious if there are different ruling coalitions in the centre and the states, although the existence of the same ruling party at both levels is no guarantee to an agreed division of rights and responsibilities. Existence of de jure right of the state on water and de facto manifestation at the ground level, where it coincides with land rights breeds inequities and conflicts. Another major factor influencing the course of development in the water sector is the active and decisive role of state bureaucracies. Over the years it has led to a 'dependency' syndrome and weakening of initiative of the civil society. Market, the third major institution, plays, by and large, a secondary role in the management of natural resources even in the developed economies. In developing countries like ours, characterized by multiparty competitive electoral politics its role is further weakened.

At the same time, there are some positive features of the social and political structures of the country which could help in attaining integrated and sustainable use of natural resources, including water resources. Reverence to water as a life-sustaining element and tradition of respect for water sources is a part of our culture. Other features of socio-economic milieu which should help in evolving sane policies in the water sector would include, a functioning democracy which makes the decision-makers accountable for their deeds, an alert and effective press, a class of intelligentsia and civil society leaders who act as influential opinion builders, an active and impartial judiciary, a system of decentralised governance guaranteed by the Constitution, an increasingly conducive environment for economic reforms and a variety of successful experiments in different parts of the country in conserving and managing water resources by the stakeholders.

It is this milieu of favourable and not-so-favourable features of society, economy, and polity in which the professed principles of development and conservation of water resources have to be translated into implementable strategies. Lack of appreciation of these features by the national and international agencies have created the gap between the pronounced objectives and practices at the ground level. In any case, given India's social and political systems steps to reach the objectives enshrined in the principles would have to be cautious and gradual. While the goals of ensuring efficient, equitable, and sustainable development and management of water resources should always be kept in the forefront, strategies and programmes have to be guided by pragmatic considerations.

Holistic Approach to Development and Management

A major source of inefficiency and unsustainability in the development and management of water is a partial, if not parochial, view of water resources by authorities controlling water as much as by the users. A consequence of such parochial view is that each segment insists on according high priority to its need and ignoring the claims of other parties. Thus, the largest water-related department in the state governments—the irrigation department—would pay scant attention to the drinking water requirement. Within the irrigation department the section dealing with surface water resources has little communication with those dealing with the groundwater resources. Separate departments deal with the supply of water and its proper use at the field level, that is, Irrigation Department in one case and Command Area Development Authority in other case.[2] Interdependence of diverse sources and multiple uses is generally forgotten in the present arrangements. Institutional integration of various departments at policy level is necessary for avoiding conflict between various uses, for example, irrigation and drinking water, as well as between different user groups, for example, urban and rural, and ensuring an integrated planning of surface and groundwater resources.

Till recently, water management was identified with irrigation management, although with increase in population and diversification of economic activities and greater concern for maintaining ecological balance, non-irrigation use of water is becoming progressively more important. Within the irrigation department irrigation engineers dominated in controlling and supervising water resources. Even now the role of other disciplines in water management is not fully appreciated. Yet in developing water conserving crops or practices agricultural scientists can make major contributions. Similarly, mechanical and electrical engineers can play important role in suggesting devices for regulating water supply and in lifting water in efficient, dependable, ways. Economic and social sciences have obvious roles in allocation and optimum utilization of water, and in mobilizing communities for collective action. In several other areas different sciences and technologies have important part to play. With multiple uses and finite supplies, the need for a multidisciplinary approach is quite evident.

For ensuring a holistic and integrated approach the beginning has to be made by collecting basin-wise information on water availability, together with approximate idea on the water requirements for irrigation, drinking, and other purposes. Absence of scientific information on the status of water resources at the ground level results in widespread misunderstanding on the availability of and constraints in use of water in different areas and among different users. The lack of relevant information exacerbates problems, particularly in the case of groundwater extraction. To start with, such perspectives on water supply and demand have to be formulated at the basin level. However, relevant information needs to be collated, and a comprehensive strategy of water development and management formulated, by an apex organization at the state level.

The first step in this direction will be the creation of a Water Resources Development Authority in the state government charged with the duty of planning, auditing, and budgeting of water resources of the state as a whole, keeping in view demand for water for diverse uses and supply from various sources. The mandate of such an agency should be to look into sectoral reforms rather than concentrate on project implementation. The agency should be headed by a senior administrator, then alone it will be able to obtain necessary information from relevant sources and impart weight to its suggestions. This apex organization will have to be a mutidisciplinary unit, with expertise in technical as well as social sciences. Establishment of such an agency at apex level will not entail any major reform in the civil service structure.[3] As the funding agencies are also insisting on establishing such an apex

[2] A telling example of such partial view is a blanket ban on digging of wells in canal command area, though the latter may help in recharging groundwater and ameliorating the threat of waterlogging. Such examples are many.

[3] Rajasthan has made a beginning by bringing all water-related departments of the state government under a Principal Secretary Water Resources.

organization, there are good chances of its coming into existence, at least in a few states. Simultaneously, technically competent organizations have to be formed at the basin level to do the needed groundwork.

Prioritizing and Sequencing of Projects

The absence of an integrated approach leads to several distortions in the development and management of water resources. By common consent drinking water is given the highest priority. In most of the basins, requirements for drinking water will not be more than 10 to 12 per cent of available supplies. Yet because of the partial view, this requirement is ignored while preparing irrigation projects. As a result, drinking water scarcity is witnessed more or less ubiquitously, especially in the urban areas. There is a need to earmark sufficient water for this purpose in any scheme of water development. If that is not done, it is not because of lack of popular support for the allocation for drinking water, but due to a partial approach to water resource development.

Even for irrigation development, over-reliance on cost–benefit analysis has often resulted in biased development of water resources, with well-endowed regions getting more than their fair share compared to the less endowed regions. This has resulted in widening of regional inequalities and leading, in several cases, to demand for separate states.[4] Economic as well as political compulsions suggest that focus should shift to more fragile regions in order to sustain their agricultural economy. This is especially true for drought-prone regions. Even with extensive—rather than intensive—irrigation social returns on investment in development of water resources in the water-scarce regions are likely to be higher than in the water-surplus regions.

An important lesson learnt from past experience is that huge amount of resources are used continuously to start new projects, which linger for years without giving commensurate benefits from investment. Apart from the economic loss to the state, delay in completion of projects means that constituencies in favour of reforms do not emerge, which early completion of project resulting in the flow of benefits to some sections of population could ensure. The Indian experience in this regard is particularly glaring. We have projects which have straddled over several Five-Year Plan periods![5] The National Commission for Integrated Water Resources Development (GOI 1999) had drawn a list of unfinished projects, which ought to be completed on priority basis. Similar recommendations are made in several official documents, but with very little improvement in the situation. Justification of a plethora of unfinished projects has to be found in competitive politics. Politicians desire to please as many groups as possible with the promise of development projects in their constituencies.

The other reason, which is equally widespread for delay in availing the benefits of the projects, is due to faulty, rather uncoordinated planning. Examples of reservoirs being complete without the construction of distributaries, or distributaries completed without completing water channels are all too familiar.[6] The Accelerated Irrigation Benefit Programme launched to complete the unfinished projects is a step in right direction. Not only large projects have long and delayed gestation period, numerous small projects also suffer from the same fate. Currently, various schemes of the government especially schemes under Rural Infrastructure Development Fund

[4] The current agitation for a separate Telangana state has at the root the issue of unequal development of water resources in Andhra Pradesh.

[5] Example, Indira Gandhi Nahar Priyojana (IGNP), earlier known as Rajasthan Canal Project, which started in 1955 and is still continuing.

[6] Type of distortions caused by such uncoordinated planning is illustrated in the case of IGNP. National Commission reported, 'as water began to rise in the reservoir, and canal system to take it to the tail end is not ready, head reach farmers have plenty of water available and tend to plant water intensive crops. This establishes a pattern of water use that cannot be easily changed at a later stage', p. 19. Recent agitation of the head reach farmers in IGNP vindicated their apprehension.

(RIDF) promise to tackle this malady. Introduction of the command area development authorities, along with the construction of the project is also a step in the right direction. It is important that equal attention is given to improving physical structures and control mechanisms on these projects. Ensuring early benefits from a project is important for building a constituency for reforms in this sector. The strategy of 'picking low hanging fruits first' has much to be commended for!

PARTICIPATION OF STAKEHOLDERS

In managing the country's vast surface water resources, the bureaucracy has acquired a commanding position. Even for the management of groundwater resources they have important, though indirect, role. The result has been the development of a 'dependency syndrome' among the water users, leaving the major responsibility for the development and management of water resources to the state. It is often argued that reasons for ills of the irrigation management is the alienation of farmers from the process of planning and distribution of water resources. This is in sharp contrast to the earlier traditions in this country when community had the major responsibility of creating and maintaining water resources. Bureaucracy as a system has certain inherent limitations. The bureaucratic system as it exists in our country is identified with short-term considerations, lack of accountability, and neglect of local involvement. These are formidable hurdles. Participation by the farmers on the other hand has led to improvement in water use efficiency. The experience of other countries (Philippines, Japan, for example) also supports the view (Sengupta 1991, Mitra 1992).

If the community has to play an important role certain preconditions have to be met. Experience of various projects where community participation has been successful have suggested some common features. These include:

- the program should generate a sense of ownership;
- it should allow freedom to innovate;
- there should be provision for expeditious resolution of conflicts;
- efforts to mobilize community should precede the launch of the programme; and
- eventually the collaborative arrangements should be institutionalized.[7]

Recent experiences with WUAs is relevant in this context. In a state like Andhra Pradesh where they were introduced with full state backing, their strengths and weaknesses are quite manifest. In-depth studies have shown that they have made positive impact on providing irrigation to the tail enders; in increasing area under irrigation; and in increasing revenue. Their impact is not significant on other counts, such as improvements in repairs and maintenance, or in the collection of irrigation charges. They have not been able to take integrated view of ground and surface water resources. Nor could they remain immune from political factionalism (Raju 2001, Reddy et al. 2004). All things considered, they do provide an institutional base for affecting participatory management of irrigation resources, and need further strengthening. A three-tier structure with WUA federated in a distributional committee at the distributory level and the latter federating at the project level in a project committee may impart needed organizational strength. WUA is becoming an accepted institution in a growing number of states. It is possible to strengthen them in the light of experience gained, that is, by broadening their authority to encompass minor irrigation as well as groundwater within the scope of their activities, and providing them financial and technical resources, rather than continuing with parallel institutions.[8]

[7] Construction and management of tanks and water bodies in arid parts of Rajasthan for drinking water supplies by local communities, and their subsequent decay with state intervention illustrate these lessons. See, *Jal Aur Samaj* (Joshi 2005). Similar experience is narrated with reference to Maharashtra's pani panchayats (see Deshpande and Reddy 1990).

[8] Even in Andhra Pradesh, command area development authorities continue, though their functions clearly overlap with WUAs.

Another important development which has a significant bearing on people's participation is the constitutional recognition to panchayati raj institutions (PRI). By involving these representative bodies in water budgeting and auditing the institutionalization of peoples' participation is not only possible, it is relatively easy. To start with, the lowest level of PRI institutions, that is, gram panchayats, should be involved in preparing inventory of water needs and availability in each village, particularly for the drinking water. This information should be used for introducing 'bottom-up' planning of water resources, with dovetailing requirements and availability at the basin level, and should be collated at the apex level, that is, at the level of the proposed water resources development agency. Similarly, maintenance and repair of the minor projects could be entrusted to the gram panchayats. Where direct involvement of the people's representatives is not possible, say, in large projects, their voice could be heard at the level of a properly constituted and empowered project committee. Such institutional changes, which would facilitate participation of stakeholders, are possible within the given political structure.

Rights and Obligations of Stakeholders

There is ambiguity in the rights and obligations of water providers and water users at all levels. For example, 'entry 56' of the Constitution gives power to the centre to intervene in interstate water disputes. However, this provision is rarely evoked and the interstate disputes go for adjudication to various tribunals and boards, with no satisfactory solution (Iyer 2003). Partly, this is due to the fact that the circumstances and modalities for the centre's intervention are not elaborated. But the main reason for the lingering of disputes is that the states interpret riparian rights in their own favour. The present pattern of sharing of water between upstream and downstream states takes the normal stream flows in a normal rainfall year as the basis for distribution. As a result upstream states insist on pre-empting their share of water irrespective of fact whether the rainfall in the catchments areas is normal or scarce, and the downstream states have to be satisfied with their share from the residual supplies.

At the states' level, water-policy documents do emphasize the role of local communities in the development and management of water resources. However, none of the states have clearly devolved rights, or spelled the obligations, of the local communities at the water basin or PRI level. Intentions to devolve the rights are not supported by the institutions to exercise these rights. Inventorying the needs and availability of water at the panchayat level and collating these at the basin level, and again at the apex level, as suggested above will impart strength to the local level institutions. While sorting out these rights may take some time, a beginning can be made by defining rights and obligations of the individual users.

It is easier to define property rights in surface water resources, as these are by and large publicly owned. Usufruct rights are accorded to the individual users. Here too, because of the lack of accountability every action of the bureaucracy is defended in the name of 'public interest'. Institutional mechanism to ensure justifiable reason for the state action has to be devised to correct the lacunae. Similarly, there is no clarity in riparian rights between head reach and tail reach canal commands. Often, by the time water reaches tail-end farmers, they tend to face severe shortages, especially in the scarcity years as there is no clear and agreed distribution mechanism.

Major difficulties are faced in defining clear and enforceable proprietary rights in relation to groundwater resources, which are mainly owned by private individuals.[9] The problem is compounded, as it is difficult to monitor the stock and flow of groundwater in an aquifer. Current practice is to treat water rights as adjunct to land rights, which in large parts of the country approximate to proprietorship rights. This has lead to indiscriminate 'mining' of water by individual

[9] At the national level 95 per cent of groundwater structures are privately owned.

well owners irrespective of adverse consequences for other well owners drawing water from same aquifer. Under this arrangement the landless households do not have any claim on water resources. At the same time collective ownership, wherever tried on a large scale (for example, the eastern Uttar Pradesh tubewell project), could not be sustained for a long period.

In principle, water in a basin needs to be considered as a common pool resource.[10] Usufruct rights in terms of permissible drawls for specified irrigated area and for drinking water requirements of the household can be laid down. To ensure compliance to the arrangements for the drawls of water, best solution will be metering of water. However, this is very difficult. Due to large number of scattered wells, with different size of holdings and different capacity of water lifting motors, the regulation of the number of hours of power can easily be implemented. It may be more practical to put regulation through specification of the horsepower of the water lifting devices on tube wells. Clearly, to make it work the energy policy of the states has to be in tune with the water policy.

Most of the successful schemes of equitable sharing of water have started with the concept of water resource as a common pool resource and household's entitlement for water for irrigation and drinking purposes on some equitable principles.[11] These requirements have to be stipulated in the water policy of the states. There are several examples in our country and in other countries which suggest that the cooperative management of water resources provides suitable environment for equitable distribution and judicious use of water (Singh and Ballabh 1996). Conditions which will facilitate such cooperative arrangements are:

- organization of the owners of overlying land in some formal association;
- association to evolve its own strategy for judicious use of water; and
- association to have reliable technical information on the groundwater.

Going beyond the definition of rights, difficulties arise in spelling out the obligations of water users, especially in view of depleting groundwater resources. It may be necessary to put a moratorium on digging the wells not only in the 'dark zones', but even in other areas as well where paucity of groundwater is imminent. It is necessary to stipulate an obligation of recharging wells on the well owners. Salutary impact of water harvesting and groundwater recharge are well documented in the studies of water-scarce regions (Shah 2002). For larger holdings it could be in terms of putting a water reservoir on the holdings. Smaller farmers may be asked to give their contribution in the form of labour on community projects for recharging wells.[12]

Conflict Resolution

Water is a scarce resource with multiple uses. With increase in population and changes in lifestyles, the gap between demand and supply is getting aggravated, leading to disputes among various users. The conflicts surface among groundwater users in the same water basin. In case of surface water users, conflicts arise between downstream and upstream farmers drawing water from same stream or canal. Bulk supply of water from rural areas to urban areas is always fraught with conflict. There are only a few interstate rivers where the concerned states are happy with the ongoing arrangements. Problems in relation to rivers crossing international boundaries are more intractable. On paper we do have dispute redressal mechanisms extant or proposed at various levels. For interstate disputes, for example, the Sarkaria Commission has suggested an elaborate set of principles. A Central Groundwater Authority has come into existence to suggest, among other things, best practices for groundwater use. States

[10] Common pool resource is defined as 'a resource that is used in common by an identified group of owners of overlying land.' (Singh 1994).

[11] For example, Ralegaon Siddhi or Pani Panchayat (Deshpande and Reddy 1990).

[12] Restrictive regulations such as prohibition on digging wells in command area of canals may be withdrawn.

have their own machinery to settle disputes among the water users. However, neither the intensity nor the frequency of water-related disputes have abated. Such conflicts have lead to inefficient and inequitable use of water.

It will be infinitely better to avoid conflict situations rather than seek mechanisms for conflict resolution. The preconditions for minimizing conflicts at the local level, which we have emphasized earlier, are: clear definition of property rights, dependable estimates of the water availability over time and over space, and basin-level planning of water resources. If the property or the usufruct rights are clearly defined they can be used as an explicit provision in formal or informal contracts among different water users and among water users and water providers. Ambiguity in proprietary rights is at the root of several disputes.

The second precondition for more harmonious relations among different stakeholders is the adequate knowledge about the availability of water. Since not only does the rainfall fluctuate from year to year, the conditions of permeations and hence of recharge also differ in different soil and climatic conditions, which makes periodic assessment of water resources necessary. In the absence of reliable information on the availability of water the upstream farmers may create bunds, check dams or reservoirs in good faith to impound water, in the rainy season depriving tail-end people of adequate supply of water. The basin-level planning can accommodate and adjust demands from various sources. Such arrangements can succeed if clearly defined rules on water conservation and use are formed with common consent. In successful projects of this nature there are well-defined rules for distribution of water, for fixing the priorities, maximum acreage of irrigation per worker, agreed cropping pattern, etc. There are also rules to take care of contingencies, such as water shortage or power shortage. Formal or informal institutions are in place to ensure that the rules are adhered to.[13]

For avoiding, or at least minimizing, conflict in larger projects, say the bulk transfer of water from rural areas to urban areas, it is important to identify the 'losers' and 'gainers' in an unambiguous way, and have a transparent mechanism to compensate the losers. Enough experience has been gained in compensating and rehabilitating displaced persons uprooted due to large projects. Same principles can be applied in compensating farmers who are deprived of water resources to quench the thirst of the city dwellers. One of the precautions suggested by the National Commission to avoid conflicts in distribution of water is to plan water use judiciously by taking into account the availability of water in a basin. For example, in a basin with possible surplus, optimum utilization may be aimed at. For deficit regions cropping pattern with lower irrigation intensity may be planned.[14]

The precaution suggested above, that is, clarity in property rights, dependable information on the availability of water, and basin-level planning of water use, may minimize the areas of conflict, but there would always be circumstances where conflict of interest cannot be avoided and the need for conflict resolution becomes obvious. For example, there are always chances of conflict between line departments and user groups or conflict among the user groups. Experience in our country and elsewhere suggests some lessons on conflict avoidance or conflict resolution. In the first place, reforms have to take place at the level of irrigation authority as well as at the level of water users. The process may start at the bureaucratic level in the case of the canal irrigation system. In the case of groundwater the reform may start at the farmer level, as more resistance is likely to come from those who are likely to lose their monopoly power.

It will be helpful if such resolution takes place at or near the source of conflict, with provisions

[13] See Community Managed Water Resources Development Project in Dag Block of Jhalawar District, Rajasthan, by Nirlesh Kothari, Institute of Rural Management, Anand (IRMA), April 2004.

[14] See National Commission on Integrated Water Resource Development.

for adjudication at appropriate levels. With the advent of the panchayati raj the first stage for resolving disputes could be the nyaya panchayats at the *taluq* or the panchayat samiti level. Higher tiers may be approached only as courts for appeal. Another institutional arrangement on which gradually consensus is evolving is that organization responsible for dispute settlement ought to be separate from government and function autonomously. Constitution of a water regulatory authority on the lines of power regulatory authorities, which along with determining tariff can also adjudicate in allocation-related disputes between competing claimants, could be considered. Already a beginning has been made in Maharashtra to constitute a regulatory authority to determine tariff on irrigation water.

Cost Recovery and Privatization

A common observation on India's irrigation system is the low level of maintenance and neglect of timely repairs. The reasons advanced for this malady is the low cost recovery, which leaves very little resources with the concerned authority to ensure proper upkeep[15]. There is, of course, difficulty in determining the nature of the cost, that is, whether one should take average cost or the marginal cost of the service provider. Also, what should constitute the elements of costs to be recovered is also not universally agreed. The amount of capital cost and the variable cost to be recovered differs in various discussions on this subject. It is clear, however, that the beneficiaries are paying an inadequate amount whatever may be the concept and components of cost.

It is important in this context to distinguish between pricing of drinking water and pricing of water used for commercial purposes, say irrigation. When it comes to drinking water, it should be considered a 'natural' good. Minimum supply of drinking water should be ensured to every citizen as a matter of right. Even in such instances recovery of financial cost from the sections who have wherewithal to pay, are justified. There are examples of users paying willingly and regularly the charges if the supply is assured and timely.[16] For truly indigent sections the state should subsidize a public authority responsible for supplying drinking water to such sections of the population.

There could be one or several among the following reasons to explain tardy cost recovery characterizing most of the programmes and schemes:

- political compulsion of the multiparty system;
- laxity in cost collection;
- inequity in the charges levied; and
- dissatisfaction with the services provided.

There is an element of truth in all these explanations. In the environment of competitive electoral politics, it is understandable that in order to get votes the contending parties may 'lure' the beneficiaries by offering free or low price water and related services. Once they come to power and face the paucity of resources they realize their mistake. Laxity in the collection of dues, inadequate though they are, could be due to paucity of collection staff or a faulty system of dues collection. Considering the precarious financial position of the state governments, this is not an unlikely situation. Volumetric assessment of water consumption has all but broken down even for drinking water use in urban areas, and is a rarity in the rural areas. Changes are fixed keeping neither the number of watering nor the availability of water in mind. Therefore, there is all the motivation on the part of the users to avoid paying the charges. The most important reason cited in this context is unsatisfactory and unreliable services, both in terms of timing and quantum, which provide justification for not paying the dues.

All these causes for low as well as non-payment

[15] In Rajasthan, water charges account for 8 per cent of O&M costs.

[16] This is illustrated by the Integrated Water Supply and Sanitation Programme in Churu districts of Rajasthan, popularly known as *Apani Yojana*. Also see Reddy (1999).

of costs need to be addressed simultaneously. As regards the promises of the political party on this and on several other water-related issues there is a need for evolving a consensus. Establishment of an independent water regulatory authority will also be very helpful in this context. Several innovative ways could be found to meet the shortage of irrigation staff. Giving responsibility to WUAs is one alternative suggested in this context. (However, it should be noted that WUAs may not be very keen to 'tax' themselves.) Rationalization of irrigation dues between crops and between regions has a full justification. It may lead to better compliance. And reluctance to pay the dues is justified if services are tardy. In fact, any attempt to recover cost should ensure tangible benefits along with cost recovery. Without addressing the issues of efficiency and accountability of service providers, idea of cost recovery will not float.

Many a time the question of privatization is raised in this context. Large supply of water—and nearly the total supply of groundwater—is privately owned. However, private investment in large—or even medium-scale—surface water projects has not evoked much response. Keeping in view the large investment, long gestation period, and low returns, it is understandable. Besides, there are unresolved public policy issues in environment and social spheres which impinge on the large-scale private investment in the development of water resources. There are, however, opportunities for water markets in the distribution of water supplies. Examples of well owners who sell water to needy clients are fairly common. Water markets do exist not only to supply irrigation water but also drinking water. There is justification for private markets, particularly in irrigation, as it is a commercial, profit oriented, activity. Water could be considered an 'economic good' in that context. However, water markets are not simple to establish nor a panacea for all water-related problems. There are preconditions for their successful functioning which are akin to conditions for success of all contractual transactions.

Many states are toying with the idea of public–private partnership in irrigation. The idea is to sell water from public projects in bulk to the private parties who, in turn, can 'retail' it to the actual users. Such arrangements have worked successfully with communitarian and cooperative institutions. They could also work in the context of public–private collaboration, but should be preceded by a transparent and comprehensive strategy for the development and management of water resource.[17]

Water Literacy and Awareness Generation

Success of reforms in the water sector hinges on public perception. The perceptions range from water being considered as a gift of nature and hence a free good to the perception of water as private property such as land and other productive assets. There is a need to inculcate a more balanced view, that is, an awareness that water is a scarce resource with multiple uses and multiple claimants and is inequitably distributed over time and space, and that the users have only usufruct rights. There is also a tendency to view water-related problems in a short-term perspective. Changing such perspectives is a precondition for instituting any reform in the water sector. These perspectives can be corrected by opinion leaders in different walks of life whose help should be sought while introducing reforms.

There is one more task where public awareness is needed. So far most of the reforms were directed to correct the supply side inequities. Even when demand was to be influenced the main reliance was on price mechanism. Undoubtedly price affects the consumption in a measurable way, but its influence will not be very significant if share of expenditure on water is relatively small in

[17] 'While private investment and management are playing, and must play a growing role, this must take place within a publicly established long term development and legal and regulatory framework, and without crowding out community-managed infrastructure and beneficiary participation in design and management of water systems.' (World Bank 2004, p. 12).

consumer's budget. In such situations education and persuasion by the opinion leaders who have some credibility is likely to be more effective. It should be recognized that there is a diverse set of opinion leaders, ranging from religious leaders to journalists to academics, with varying influence and effectiveness. Cooperation of leaders from different walks of life has to be mobilized to achieve the objectives.

There is a need for 'water education' at all levels. A concerted effort to educate students in their youth—in schools and colleges—will have lasting effect in terms of appreciation of the water situation. The population in general should be sensitized to the critical nature of the water situation. There is enough scope for the state, market, and civil society institutions to contribute to the goals enunciated in the Dublin Principles. This would be possible by creating awareness about the benefits from reforms, and the price that is being extracted from present systems and arrangements, together with progressively enlarging the constituency of those who will benefit from the reforms.

Interpreting Principled Pragmatism

Principled pragmatism in the Indian context should be interpreted more broadly than progressive approximation to some allocative principles of neo-classical economics. It would have to be aimed at a viable mix of equity and efficiency. Given the nature of the Indian polity, the large proportion of the poor population, the alert media, and the influential civil society, institutions will always keep issues of equity at the centre stage. At the same time, limited availability of water coupled with wide fluctuations and a growing demand from diverse set of users could be used to focus attention on the efficient and economic use of water. However, it is possible to progress towards these goals in gradual yet concrete measures. To achieve this it is important to build a consensus in favour of reforms, demonstrate that progressively larger sections are benefiting from the reforms, and strategies adopted are in consonance with the social values and political institutions of the country.

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