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Economic Impact of Interlinking of Rivers Programme

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Foreword

The ultimate irrigation potential of the country has been assessed at 140 million hectares – 76 million hectares from surface water and 64 million hectares from ground water. Till the end of 1999-00, 94.73 million hectare of irrigation potential is created but utilisation rate has been 89.41 per cent. This can have a significant bearing on both agricultural productivity and overall foodgrain production. However, with declining public investment in agriculture in the recent past, there has hardly been any new initiative to increase the irrigated area. On the contrary left to the vagaries of monsoon while some areas have witnessed flood, the others have witnessed drought. Although India ranks at second place in terms of production of wheat and rice, its rank in terms of productivity it much lower. Substantial gains in production of foodgrain could be achieved by increasing productivity. Irrigation is crucial input for increasing productivity and benefits of modern agricultural technology (certified and quality seeds, fertiliser etc.) could be reaped if it is supplemented by availability of water in terms of quantity and time.

The interlinking of rivers programme (ILR) programme is aimed at linking different surplus rivers of country with the deficient rivers so that the excess water from surplus region could be diverted to deficient region. This would help in increasing irrigation intensity in the country, increasing water availability for drinking and industrial purposes, mitigating effect of drought and floods to a certain extent. Once the dams and reservoirs are constructed and water is stored, hydro electricity could be generated at these sites. Availability of water is one of the constraints for hydro electricity generation during summers, ample storage at dams/reservoirs could increase efficiency of hydro electric power plants. However, some of these impacts are quantifiable and some are difficult to quantify.

Basic purpose of the present study is to assess the macro impact of the ILR programme on Indian economy. In this study macro impacts are analysed both at short- as well as long-term. Short-term impact is analysed with the help of a social accounting matrix for the year 1999-00 at 2000-01 prices. Short-term impact helps us in evaluating the impact of the ILR programme on different sectors of the economy. However, most of the impacts of the ILR programme would be felt with a lag and social accounting matrix (SAM) based analysis is not a dynamic analysis, long-term impacts of the ILR programme can not be evaluated with the help of a SAM. Long-term impact of the ILR programme is evaluated with the help of a macro econometric model. Impact of increased irrigation intensity and hydro electric power generation is considered while evaluating the impacts. Economic impact of certain benefits such as mitigation of drought and floods to a certain extent, increased revenue/income from fishing, picnic site and amusement park are not taken into consideration. The study also deals with the issues related to cost recovery and institutional aspects related to the ILR programme.

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List of Abbreviations

ACP	Average Cost Principle
AIBP	Accelerated Irrigation Benefit Programme
AIEC	Average Incremental Economic Cost
AIFC	Average Incremental Financial Cost
BC	Benefit Cost
BCM	Billion Cubic Meter
BNP	Bhakhra Nangal Project
CCA	Culturable Command Area
CE	Compensation to Employees
CO_2	Carbon Dioxide
CPI	Consumer Price Index
CPIAL	Consumer Price Index (Agricultural Labourers)
CPIIW	Consumer Price Index (Industrial Workers)
CSO	Central Statistical Organisation
CWC	Central Water Commission
DPR	Detailed Project Report
DVC	Damodar Valley Corporation
FGT	Foster, Greer and Thorbecke
GDP	Gross Domestic Product
GDPMP	Gross Domestic Product at Market Prices
GQ	Golden Quadrilateral
GVA	Gross Value Added
Hac	Hectare
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome
IBWC	International Boundary and Water Commission
ID	Irrigated Dry
IGCP	Indira Gandhi Canal Project
IGNP	Indira Gandhi Nahar Project
ILR	Interlinking of Rivers
IMR	Infant Morality Rate
I-O	Input-Output
IRR	Internal Rate of Return

ISWD	Inter-State Water Disputes
JTF	Jogigopa-Tista-Farakka
LIBOR	London Inter Bank Offer Rate
MAF	Million Acre Feet
MCP	Marginal Cost Principle
Mcum	Million Cubic Metres
MI	Mixed Income
MIMAP	Micro Impact of Macro Adjustment Policies
MMR	Maternal Mortality Rate
MoU	Memorandum of Understanding
MSTG	Manas-Sankosh-Tista-Ganga
MW	Mega Watt
NABARD	National Bank for Agricultural and Rural Development
NAS	National Accounts Statistics
NBP	Net Benefit Principle
NCAER	National Council of Applied Economic Research
NCIWRDP	National Commission for Integrated Water Resources Development
NCRWC	National Commission for the Review of the Working of the Constitution
NGO	Non Government Organisation
NSSO	National Sample Survey Organisation
NVA	Net Value Added
NWDA	National Water Development Agency
NWDC	National Water Development Council
NWP	National Water Policy
O&M	Operation & Maintenance
OS	Operating Surplus
PIM	Participatory Irrigation Management
RBO	River Basin Organisations
RMC	Regional Monitoring Committees
ROR	Rate of Return
ROW	Rest of the World
RR	Recovery Ratio
SAARC	South Asian Association for Regional Cooperation
SAM	Social Accounting Matrix

SWPO	State Water Planning Organisation
SWRB	State Water Resources Board
Th. cu. m	Thousand Cubic Metre
TFILR	Task Force on Interlinking of Rivers
TVA	Tennessee Valley Authority
UNICEF	United Nations Children's Education Fund
USAID	US Agency for International Development
WHO	World Health Organisation
WPI	Wholesale Price Index
WUAs	Water User Associations

Executive Summary

The development process initiated in India after independence has changed the production structure of the economy. Although the share of agriculture in the total gross domestic product (GDP) has declined, it still remains the economy's major growth driver. Apart from providing gainful employment and income, agriculture generates demand for non-agricultural goods and services. A slowdown in the growth of agriculture, thus, precipitates a drop in demand for industrial goods and services. Irrigation is one of the crucial inputs for achieving sustained agricultural growth and reducing inequality and poverty. After independence, significant progress has been made in the provision of irrigation facilities. The new agriculture technology is more water-intensive and in the absence of adequate and timely irrigation there will be no great productivity gains.

With increase in population, the per capita water availability declined from 5.20 Th.cu.m per annum in 1950 to 1.80 Th.cu.m per annum in 2000 and is expected to slip further to 1.34 Th.cu.m per annum in 2025. A fall in the level of water availability is a cause of concern and calls for immediate measures to tackle the problem. With an increase in population, the requirement for food is also growing. Faster growth in agriculture production cannot be achieved without increasing irrigation intensity. Till the end of 1999-2000, 94.73 million hectares of irrigation potential had been created but utilisation rate was 89.41 per cent.

To tackle the water crisis threatening the future, steps have to be taken to store the surplus water that flows during the monsoon season as well as adopt all measures for conservation and efficient use of water. One of the answers to the water problem is to conserve the excess monsoon flows and, wherever feasible, use this water in areas, which have inadequate rainfall or are drought-prone. Construction of storage dams in India is indispensable for conservation of excess monsoon flows to meet the growing demand for water. Till date, a total of about 174 BCM of built-up storage had been created. However, total built-up storage created in India is not big in comparison to the built-up storage capacities created in other parts of the World. Kariba dam in Zimbabwe and Aswan dam in Egypt has a storage capacity of 180.6 BCM and 168.9 BCM of water respectively.

The interlinking of rivers (ILR) programme is a major endeavour to create additional storage facilities and transfer water from water-surplus regions to more drought-prone areas through inter-basin transfers. Surplus water transfer is hypothesised both at intra- and inter-basin levels. It is expected to provide additional irrigation in about 30 million hectares and net power generation capacity of about 20,000 to 25,000 MW. Long-distance, inter-basin transfer of water is not a new concept and has been in practice in India for quite some time. Globally, there are a number of examples of inter-basin transfers: the US transfers 45 BCM this way and has plans to add 376 BCM; China has a scheme under implementation, which will transfer about 48 BCM.

The ministry of water resources formulated a National Perspective Plan for water resources development by transferring water from water-surplus basins to water-deficit basins/regions in 1980. NWDA after carrying out detailed studies identified 30 links for preparation of feasibility reports. These links can be divided into two components—the Himalayan (14 links) and the Peninsular (16). These links are aimed at mitigating the effects of floods and droughts, and as well as augmenting income in rural areas in general, and in agriculture in particular. The ILR programme is focused on reducing irrigation uncertainties and mitigating the adverse impact of floods and droughts. Once these canals are built, they will also be used as waterways for navigation, reducing stress on road/rail transport. The successful implementation of the programme is, therefore, of utmost importance for the development of the country and it is necessary that a supportive climate for the programme be created.

The ILR programme could tackle droughts and floods to some extent. According to an estimate by WHO, economic losses due to floods and droughts during 1990-2001 in India stood at $4,604 million. The ILR programme will also help increase access to safe drinking water; at present 92 per cent of the urban and 86 per cent of the rural population have access to safe water supply. According to an estimate of UNICEF, 19 per cent of children under five years of age suffered from diarrhoea in 1999.

India is aiming at attaining the status of a developed country by the early/middle of this century. Sustainability of strong growth as observed in fiscal 2003-04 is a pre-requisite to this. The Millennium Development Goals and Tenth Plan targets strive towards promoting gender equality and empowering women. Better irrigation facilities, catering to both agriculture and domestic purposes, along with clean, good quality water would aid the achievement of other goals as well such as reducing child mortality, morbidity, improving maternal health, and combating diseases.

Scope of this study is limited only to evaluating the economic impact of the ILR programme. The study is impact assessment study not a cost benefit analysis. The study does not deal with environment aspects associated with the ILR programme also. Environment aspects are being looked into in a separate study commissioned by the task force.

An integrated approach becomes necessary when dealing with resources such as water, which transcend state boundaries and form lifelines for entire communities. River deltas and drainage areas suffer from disequilibrium in water supplies that may necessitate the transfer of water from surplus to deficit areas. Power installations and tapping of hydroelectric potential could be jointly developed along with programmes in tributary watersheds to prevent soil erosion. Local supply and distribution networks restrict themselves to exploiting single segments of a basin's total water potential. The experience of Tennessee Valley Authority (TVA), Indira Gandhi Canal Project (IGCP), Colorado River Canal System and Three Gorges Dam are some projects in India and World who confirms this.

Irrigation is a crucial input for agriculture growth. The Bhakra dam enabled Punjab and Haryana to register faster growth and reduce poverty substantially. Irrigation intensity increased substantially in these two states through the dam-canal network and groundwater pumping. The additional irrigated area has been of the order of 6.8 million hectares over 35 years. The production of rice and wheat in the Bhakra command area during 1996-97 was 8 times of production in 1960-61.

Link canals have both short and long-term impact on the economy. The short-term impact of the link canal is in the form of increased employment opportunities and the growth of the services sector. Sectors supplying crucial inputs to the construction sector, such as cement and iron and steel, also grow. In the medium to long term, the major impact of link canals is through increased and assured irrigation. Although the major and direct gainers of the ILR programme will be agriculture and agriculture-dependent households, the entire economy will benefit because of increased agriculture production.

The full impact of the ILR programme on economy will be realised only when construction is completed, reservoirs filled and the water reaches the ultimate users for irrigation, drinking water, industrial purposes and hydropower generation. Until construction is complete, the impact of the ILR programme will be through government investment.

The growth of other sectors will depend on the strength of the backward linkages and forward linkages of the construction sector with the rest of the economy. As the output of sectors supplying inputs to the construction sector increases, it will increase the demand for goods and services in the economy.

The cost of the overall ILR programme has been estimated by the task force/NWDA as Rs 5,60,000 crore at 2002-03 prices. This estimate suffers from two infirmities. First, the cost of 30 links has been taken, whereas there are only 29 links. Jogigopa–Tista–Farakka (JTF) is an alternative link to Manas–Sankosh–Tista–Ganga (MSTG) and only one of these two links will be constructed. Second, the fixed escalation rate of 10 per cent per annum is on the high side. In order to arrive at a better estimate, the fixed escalation rate of 10 per cent per annum was replaced by a more meaningful escalation factor — the government investment deflator for construction to arrive the cost estimate at 2003-04 prices. The cost will undergo changes once the detailed project reports (DPR) of the individual links are prepared. Two alternatives of cost estimates taking into account alternative links (MSTG or JTF) are prepared.

The new aggregated cost of entire programme with MSTG link is estimated as Rs 4,44,331.20 crore at 2003-04 prices. The new aggregated cost is Rs 1,15,668.20 crore or 20.7 per cent lower than the earlier aggregate cost estimate of Rs 5,60,000 crore at 2002-03 prices. The new aggregated cost of entire programme with JTF link is estimated as Rs 4,34,657.13 crore at 2003-04 prices. The new aggregated cost is Rs 1,25,342.87 crore or 22.4 per cent lower than the earlier aggregate cost estimate of Rs 5,60,000 crore at 2002-03 prices.

The Supreme Court has suggested for expeditious completion of project and suggested year 2016 for completion of project. Resolving inter-state political issues and agreement between states and neighbouring countries will take more time. In light of these facts, 10 years time period for programme of this magnitude is too short. However, in our analysis we had limited to 10 years time horizon. The investment plan was worked out after detailed discussions with the officials of the task force on the assumption that the preparation of the DPRs and other formalities would take two years and the actual construction of links would take place from 2006-07.

Apart from increased irrigation, link canals have the potential to generate hydro-electricity, which during summer is low. Once the canals and reservoirs are in place and enough water is stored in reservoirs, it can be used to generate hydro electricity. The ILR programme with the MSTG link is envisaged to generate 28,994.5 MW of power and require 4,193 MW of power for the project, resulting in net power generation of 24,801.5 MW. The JTF link is envisaged to generate 24,822.5 MW of power and require 5252 MW of power for the project resulting in net power generation of 19,570.5 MW.

In short-run, the direct impact of increased investment in the construction sector by Rs 10,000 crore would result in increased value-added of the construction sector by 3.80 per cent. However, due to its forward and backward linkages, the value added of cement would increase by 2.46 per cent, structural clay products by 2.37 per cent and basic metal and metal products by 0.65 per cent. The increased income in the economy would demand more goods and services and thus all sectors of economy would experience growth in their value-added. It is estimated that the incremental value-added generated in the economy would be Rs 17,424 crore (0.91 per cent) by Rs 10,000 crore of additional investment in construction. Direct employment in the construction sector would grow by 22.74 per cent. Sectors such as coal tar products, cement and electricity, gas and water supply would experience higher growth of employment than the construction sector. Total employment in economy would increase nearly by 4 per cent.

It is estimated that the government would earn around Rs 1,157 crore in the form of an operating surplus from the public sector and taxes out of the increased value added of Rs 17,424 crore. Household income would increase by Rs 16,267 crore. All household categories would augment their income. Aggregate private income would grow by 0.76 per cent. Urban regular workers would experience the highest increases followed by casual labourers. Similarly, urban self-employed are also expected to experience an increase in their incomes. Households in rural areas too would experience a rise in their incomes. The highest increase would be for rural other labourers.

The investment and benefit rollout plans are used to generate two different scenarios for the ILR programme. The costs of both the alternatives are nearly the same and the benefits in terms of the increased irrigated area are also similar. Increased irrigation by the ILR programme could result in an increase in the average growth of the real GDP from agriculture by 1.65 percentage points over the baseline scenario with the MSTG link (1.64 percentage points higher growth with the JTF link). The real GDP from the electricity, gas and water supply is expected to grow by an additional 0.18 percentage points over the baseline scenario with the MSTG link (0.15 percentage points higher growth with the JTF link). The average additional growth of the construction sector is estimated to be 1.03 percentage points with the MSTG link and 1.02 percentage points with the JTF link. The impact of this growth on overall growth would be an average additional growth of 0.37 percentage points over the baseline scenario. Food grain production is expected to grow by an additional 2-percentage point over the baseline scenario. The gains in overall GDP growth accrue on annual basis. Over a 13 year period, the gains amount to more than 5 per cent of GDP on a cumulative basis. Foodgrain production is expected to be 305.66 million tonnes in the baseline scenario (without ILR programme). However, due to additional 2-percentage point growth in foodgrain production, it is expected to touch 393.88 million tonnes mark with MSTG link and 393.70 million tonnes mark with JTF link. All prices are expected to fall, the average decline in price ranging from 0.2 percentage points to 0.4 percentage points as compared to the baseline scenario. However, the ILR programme could lead to the average fiscal deficit of the central government increasing by 0.42 percentage points of GDPMP.

The rural household per capita income is expected to increase by 7.49 per cent with the MSTG link and by 7.47 per cent with the JTF link as compared to the baseline growth scenario. Per capita household income of agricultural dependent households in rural area is expected to go up by 13.0 to 13.2 per cent in both the scenarios. For non-agriculture dependent households in rural areas, per capita household income is expected to go up by 4.8 per cent to 5.1 per cent as compared to the baseline scenario. Among urban areas too, agriculture dependent households are expected to benefit more as compared to non-agriculture dependent households, their per capita household income is expected to go up by 9.8 per cent as compared to the baseline scenario. For Non-agriculture dependent households in urban areas, per capita household income is expected to go up by around 4.5 per cent as compared to the baseline scenario.

The expected higher growth of household per capita income in rural areas compared to urban areas would reduce rural poverty at faster pace compared to urban areas. Households in urban areas and non-agriculture dependent households would benefit mainly because of decline in the price level, which would increase their purchasing power and real incomes even if their income level does not go up substantially. The incidence of rural poverty is expected to be lower by around 0.9 percentage points and urban poverty is expected to be lower by 0.4 percentage point compared to baseline scenario. Reduced poverty in rural areas would also reduce migration of the rural poor to urban areas and thus reduce the growth of urban slums and improve the environment in the urban areas. The reduction in poverty is on a sustained basis. The substantial increase in foodgrain production imply that the poverty alleviation programs of the government would be strengthened as well.

The ILR programme although an ambitious programme certainly requires attention of policy makers. Experience of Pakistan in the area of interlinking of river could be an inspiration for India. Pakistan, built a network of river links as a part of Indus treaty works, which functions as replacement links to irrigate those areas, which after partition got deprived of irrigation when three eastern rivers of Indus system were allocated to India. Pakistan built ten links, six barrages and two dams during the post-treaty period of 1960-1970. If Pakistan can manage to complete the interlinking of its river in 10 years, it should not be difficult for India to complete the task of interlinking of rivers.

It is difficult to quantify economic impacts of benefits such as the mitigation of drought and floods, the increased income because of fishing and amusement parks at the dams and reservoir sites and so on. After the construction of Bhakra dam, Govind Sagar become a source of livelihood for oustee agriculturist of the area. Large number of local children, women and adults are catching fish in Govind Sagar. The fishing generates an income of Rs 5,000 per month for the locals and main profit goes to fishing federation of Himachal Pradesh.

Irrigation sector in India suffers from the problem of low cost recovery. Recovery of working expenses through gross receipts of irrigation and multipurpose river valley projects declined from 93 per cent in 1976-77 to 34 per cent in 1986-87. If interest on capital outlays is included in working expenses, the recovery through gross receipts declines even further (Table 4.1). Recovery declined from 36.4 per cent in 1976-77 to 8.1 per cent in 1991-92. It increased to 13.2 per cent in 1993-94 before slipping to 6.3 per cent in 1998-99. Recovery of working expenses through gross receipts remains poor and has fallen. Only in the states of Bihar, Gujarat, Haryana, Kerala, and Orissa has there been an improvement. Andhra Pradesh had the poorest performance in cost recovery in 1998-99, followed by West Bengal and Maharashtra.

During the pre independence period, irrigation works in India were treated as commercial enterprises with water charges on the basis of rate of return (ROR) prevailing in the London money market. These water charges used to cover all cost and a return to capital. The ROR used to be reviewed from time to time. Twice in the past (1854 and 1917), the volumetric measure of charging was tried but discontinued after it met with limited success. The charges for water were levied on the basis of the irrigated area, with differential area-based rates by crops and season to take in to account variation in water demand.

After independence, irrigation was viewed as infrastructure for agricultural development rather than a commercial enterprise. The ROR was subsequently reduced and was later replaced by the benefit-cost (BC) ratio for sanctioning of projects rather than financial criteria. A BC ratio of 1.5 was suggested as prudent precaution against likely increases in the cost of projects. The Second Irrigation Commission, 1972, further recommended that a lower BC ratio of 1 might be acceptable more on social grounds in drought-prone areas. In 1983, the Nitin Desai Committee forwarded the idea of the internal rate of return (IRR), suggesting that projects should normally earn a minimum IRR of 9 per cent. However, for drought-prone and hilly areas and in areas with only 75 per cent of dependable flows in the basin, a lower IRR of 7 per cent was recommended.

Successive Finance Commissions also stressed on recovery of certain percentage of capital investment apart from working (O&M) expenses. The Eleventh Finance Commission has recognized that this would have to be done in a gradual manner. Receipts should cover not only maintenance expenditure but also leave some surplus as return on capital invested. The Tenth Five Year Plan emphasises that the pricing structure of water needs to reflect the scarcity value of water, with revenues earned by state governments covering at least the O&M costs. A revision of water rates is necessary in the interest of efficiency. However, it should go hand in hand with improvement in quality of service.

The group of officers formed by the Planning Commission recommended that the irrigation water rate should cover full annual O&M cost in phases in the next five years. As users have little financial responsibility for current irrigation practices, their involvement through water user associations will improve both the quality and cost of water supply. By entrusting responsibility with these associations for funding and execution of maintenance repair below the outlet level, cost recovery would be improved. Experience of Andhra Pradesh is interesting, where large-scale institutional reforms involving creation of WUAs is occurring. The World Bank, NABARD, and the Accelerated Irrigation Benefit Programme (AIBP) are funding this programme.

The National Commission for Integrated Water Resources Development in its report emphasised that the value of the product must also be included when evolving rate structures for crops and water usage. The tariff should include O&M and part of capital cost along with the value of the product, which, the report says, should be 1 per cent of the gross value of the produce per hectare in respect of cereal crops with a higher percentage for cash crops. Overall, the National Commission recommends the rationalisation of basic principles of fixing water tariffs in states, encouragement of user group formation and a move towards volumetric pricing, adherence to equity considerations to protect small and marginal farmers, and higher user charges for industry. It recommends the formation of a water pricing authority in each state by statute, on the lines of energy pricing authorities. These would be independent authorities whose recommendations would be binding.

The issues of water pricing and cost recovery is complex and politically sensitive. Many parties come to power by offering freebies—often in the form of free water and electricity to farmers—to vote banks. This puts a lot of pressure on the already-fragile fiscal condition of the state and central governments. The quality of irrigation services is deteriorating and one of the major factors for this is the low gross receipt from irrigation system due to lower water rates. However, increasing water rates is not the solution to the problem, the quality of these services also has to be improved. A two-tier rate structure as proposed by the Committee on Pricing of Irrigation Water should come in force. The roadmap suggested by the committee can tackle the problems faced by the irrigation system in India.

Water falls in the state list (entry 17) as well as in the union list (entry 56). Though being able to exercise legislative intervention, the role of the state remains largely in tact due to non-interference of the Union. Water also finds a place in 'economic and social planning' in the concurrent list (entry 20) and is, hence, subject to the provision of central clearance for inclusion in the national Plan. States are responsible for the development and apportionment of their water resources. Water transfers between basins are also subject to state requirements.

There needs to be a reorientation of the current thinking in the ministry structure to reorient itself to the needs of river basin and participatory management. Present political compulsions where multi-party democracy exists underline the need for co-operative solutions. The Indian context will require a homegrown institutional structure. However learning from failures of river boards in the past and from their successes, one can strive to develop a homegrown institutional structure that would incorporate important elements such as WUAs, *panchayat*s and state irrigation boards.

Only with a framework that has a well-built in grievance redressal system, can faith be incorporated into the organizational structure. It is important to ensure that the common interests of all parties are met and proper representation—both Centre and state, is given in the institutional setup. Looking at inter-state water disputes and time taken to resolve these issues, the study recommend that there should be a national commission for basin management. This commission should give broad policy outlines, monitor river basins and their administration. Different river basin organisations should come under this national commission. There should be a regional monitoring committee to monitor different river basins in different regions. State hydropower department, water department should be under river basin organisations. Water user associations should be formed at micro level. These water user associations should have responsibility distribution of water and collection of water user charges.

Chapter 1

Introduction

The development process initiated in India after independence has changed the production structure of the economy. Although the share of agriculture in the total gross domestic product (GDP) declined to less than 20 per cent in 2006-07 from 57.4 per cent in 1950-51, it still remains the economy's major growth driver. Nearly 64 per cent of the population in rural areas and 4 per cent in urban areas depend on agriculture as their principal source of income. Nearly 55 per cent of the household income in the rural areas and nearly 2 per cent in urban areas originates from the agricultural sector. Apart from providing gainful employment and income, agriculture generates demand for non-agricultural goods and services. A slowdown in the growth of agriculture, thus, precipitates a drop in demand for industrial goods and services.

Irrigation is one of the crucial inputs for achieving sustained agricultural growth and reducing inequality and poverty. After independence, significant progress has been made in the provision of irrigation facilities. Although we have one of the largest irrigated areas in the world, the irrigation intensity is still low. The irrigated area under foodgrain as a percentage of gross cropped area increased to 43 per cent in 2002-03 from 18 per cent in 1950-51. Similarly, fertiliser consumption and distribution of certified/quality seeds have also increased. The new agriculture technology is more water-intensive and in the absence of adequate and timely irrigation there will be no great productivity gains. However, Indian agriculture is still dependent on the monsoon. The drought situation in 2002 and its impact on agricultural production in general and growth in particular are a result of this dependence. Therefore, to attain sustainable growth from agriculture, the irrigation intensity has to improve.

India is well-endowed with land and water resources. However, our large water resources are exhausting rapidly. Most of the water, which we receive either from perennial rivers, such as the *Ganga*, the *Yamuna*, and the *Brahamputra,* or from rainfall in the June-September period drains into the seas. India has made sufficient progress in storing this precious water by constructing reservoirs and dams. With the rapidly-growing population and increased urbanisation and industrialisation, the shortage of water has now begun to be felt all across the country and is, in some cases, rather critical.

The Indian population, which was 361 million in 1951, increased to 1.03 billion in 2001, and is expected to be 1.27 billion by 2016 (*Census of India*). With an increase in population, the per capita water availability declined from 5.20 Th.cu.m per annum in 1950 to 1.80 Th.cu.m per annum in 2000 and is expected to slip further to 1.34 Th.cu.m per annum in 2025. As per international standards, the per capita water availability of less than 1 Th.cu.m per annum is the yardstick of water scarcity. A fall in the level of water availability is a cause of concern and calls for immediate measures to tackle the problem. A report of the NCIWRDP estimated India's water requirement in the 973–1180 BCM range by 2050, when the population is expected to stabilise around 1.5 billion.

At present, annual foodgrain production in India hovers around 200 million tonnes. With an increase in population, the requirement for food is also growing. Faster growth in agriculture production cannot be achieved without increasing irrigation intensity. The optimal irrigation potential of the country has been assessed at 140 million hectares—76 million hectares from surface water and 64 million hectares from ground water. Till the end of 1999-2000, 94.73 million hectares of irrigation potential had been created but utilisation rate was 89.41 per cent.

To tackle the water crisis threatening the future, steps have to be taken to store the surplus water that flows during the monsoon season as well as adopt all measures for conservation and efficient use of water. The average annual surface water flow available to the country is estimated at 1,869 billion cubic metre (BCM). However, because of topographical, hydrological, and other constraints, only about 690 BCM of the available surface water can be utilised. Along with the additional annual replenishment of ground water of 432 BCM, the utilisable water resource in the country stands at 1,122 BCM. The average annual rainfall in India amounts to an annual precipitation of 4,000 BCM. Of this, the average annual flow in the river system of India has been estimated at 1,953 BCM. However, more than 80 per cent of the annual runoff in rivers occurs during the monsoon months of June-September. Due to this runoff, most of the water not only flows unutilised to the sea, but also causes immense flood losses. Clearly one of the answers to the water problem is to conserve the excess monsoon flows and, wherever feasible, use this water in areas, which have inadequate rainfall or are drought-prone.

Construction of storage dams in India is indispensable for conservation of excess monsoon flows to meet the growing demand for water. Minor storage, watershed development through check dams, and use of ground water are supplementary to major storage, but not alternatives. Since the possible storage sites are limited and spatial and temporal variation considerable, the country needs to develop all possible storage systems—big as well as small, surface, or ground. Till date, a total of about 174 BCM of built-up storage had been created. Another 76 BCM of storage capacity will be available from the projects under construction. Another 3 BCM capacity of small tanks will increase total capacity available to 253 BCM. There are another 132 BCM of identified capacity and this along with other capacities would need to be taken up quickly.

The interlinking of rivers (ILR) programme is a major endeavour to create additional storage facilities and transfer water from water-surplus regions to more drought-prone areas through inter-basin transfers. Surplus water transfer is hypothesised both at intra- and inter-basin levels. It is expected to provide additional irrigation in about 35 million hectares and power generation capacity of 30,000 MW. Long-distance, inter-basin transfer of water is not a new concept and has been in practice in India for quite some time. The Periyar Project, the Parambikulam Aliyar Project, the Kurnool-Cudappah canal, and the Telegu Ganga projects in south India; and the Beas-Sutlej link and the Rajasthan canal in the north are good examples. Globally, there are a number of examples of inter-basin transfers: the US transfers 45 BCM this way and has plans to add 376 BCM; China has a scheme under implementation, which will transfer about 48 BCM.

The concept of inter-basin transfer on a large scale has been under consideration for some time. The idea was mooted in as early as 1926 by Sir C.P. Ramaswamy Aiyar and then by K.L. Rao and Capt. Dastur in 1970 and 1980, respectively. The idea was transformed to have a national water grid, transferring surplus waters from the *Ganga* and the *Brahmaputra* to water-deficient regions in central and southern India. The ministry of water resources formulated a National Perspective Plan for water resources development by transferring water from water-surplus basins to water-deficit basins/regions. Subsequently, the National Water Development Agency was set up in 1982 as a society to carry out surveys and investigations, and to prepare feasibility reports for the links under the National Perspective Plan. NWDA after carrying out detailed studies identified 30 links for preparation of feasibility reports (Figure 1.1). These links can be divided into two components—the Himalayan (14 links) and the Peninsular (16). These links are aimed at mitigating the effects of floods and droughts, and as well as augmenting income in rural areas in general, and in agriculture in particular. The ILR programme is focused on reducing irrigation uncertainties and mitigating the adverse impact of floods and droughts. Every year, during the south-west monsoon season, while, on the one hand, certain parts of Assam, Bihar, and Orissa get affected by floods, some parts of southern India face acute water shortage on the other. Apart from agriculture, households face drinking water shortage and the use of unclean water causes various water-borne diseases. Industry and power generation also suffer due to interruption in water supply. During summer, some of the hydroelectric power plants operate below their usual capacity due to shortage of water. Perennial flow of water stored in reservoirs through the ILR programme will reduce many such uncertainties. Once these canals are built, they will also be used as waterways for navigation, reducing stress on road/rail transport. These waterways can supply raw material to industries in areas that do not have road/rail links. More important, an additional mode of transport will be available at much less cost, as compared to building a road/rail network. The successful implementation of the programme is, therefore, of utmost importance for the development of the country and it is necessary that a supportive climate for the programme be created.

Link canals will have both short- and long-term impact on the economy. The short-term impact will be in the form of increased employment opportunities and growth of the services sector in the area. Besides, sectors supplying crucial inputs to the construction sector such as cement and iron and steel will also grow. In the medium to long term, the major impact will be through increased/assured irrigation, which will lead to increased agricultural production. Thus, the agricultural sector will stand to benefit most.

The proposed ILR programme requires huge investment. However, this investment will take place over a period of 10 to 15 years, depending on the length of each canal. Smaller canals will take less time for construction, and the ultimate result in the form of increased/assured irrigation will be realised sooner than in the case of larger canals. It will put extra pressure on the already fragile position of public finances of the country especially on deficit and debt position. As mentioned earlier, in the short run (during the construction phase of canals), major gains to the economy will be in the form of employment generation, somewhat similar to the employment generation in the Golden Quadrilateral (GQ) project. However, with increased construction activities, sectors such as steel and cement will also grow, as the demand for these crucial inputs for construction activities will increase. Growth of other sectors will depend upon the strength of backward (sectors supplying inputs to construction sector) and forward (sectors which are using output of construction sector as input) linkages of construction sector with rest of the economy. As the output of certain sectors will increase, this will increase the demand for goods and services in the economy. In the medium to long term, once the construction of these canals is complete, the gain to the economy will be in the form of increased/assured irrigation, which will have direct impact on agricultural production and the growth of the economy.

Moreover, other gains to the economy will be in the form of tackling of droughts and floods to some extent. According to an estimate by WHO[1], economic losses due to

[1] http://www.who.int/water_sanitation_health/Globassessment/GlasspdfTOC.htm

floods and droughts during 1990-2001 in India stood at $4,604 million. The ILR programme will also help increase access to safe drinking water; at present 92 per cent of the urban and 86 per cent of the rural population have access to safe water supply. According to an estimate of UNICEF[2], 19 per cent of children under five years of age suffered from diarrhoea in 1999.

India is aiming at attaining the status of a developed country by the early/middle of this century. Sustainability of strong growth as observed in fiscal 2005-06 and 2006-07 is a pre-requisite to this. Although the share of agriculture in the total GDP has been decreasing in past five decades, the sector remains one of the major growth drivers of the economy. Apart from targeting the status of a developed country, emphasis should also be given to attain millennium development goals. These are:

1. Eradication of extreme poverty and hunger
2. Achievement of universal primary education
3. Promotion of gender equality and woman empowerment
4. Reduction of child mortality
5. Improvement of maternal health
6. Combat of HIV/AIDS, malaria, and other diseases
7. Environment sustainability
8. Building of a global partnership for development

The Tenth Five-Year Plan, formulated by the Planning Commission, had set the following monitorable targets for the Plan period and beyond:

1. Reduction of poverty ratio by 5 percentage points by 2007 and 15 percentage points by 2010
2. Provision of gainful and high-quality employment at least to the labour force over the Plan period
3. All children in school by 2003, all children to complete 5 years of schooling by 2007
4. Reduction in gender gaps in literacy and wage rates by at least 50 per cent by 2007
5. Reduction in the decadal rate of population growth between 2001 and 2011 to 16.2 per cent
6. Increase in literacy rate to 75 per cent within the Plan period
7. Reduction of infant mortality rate (IMR) to 45 per 1000 live births by 2007 and to 28 by 2012

[2] http://www.childinfo.org/index2.htm

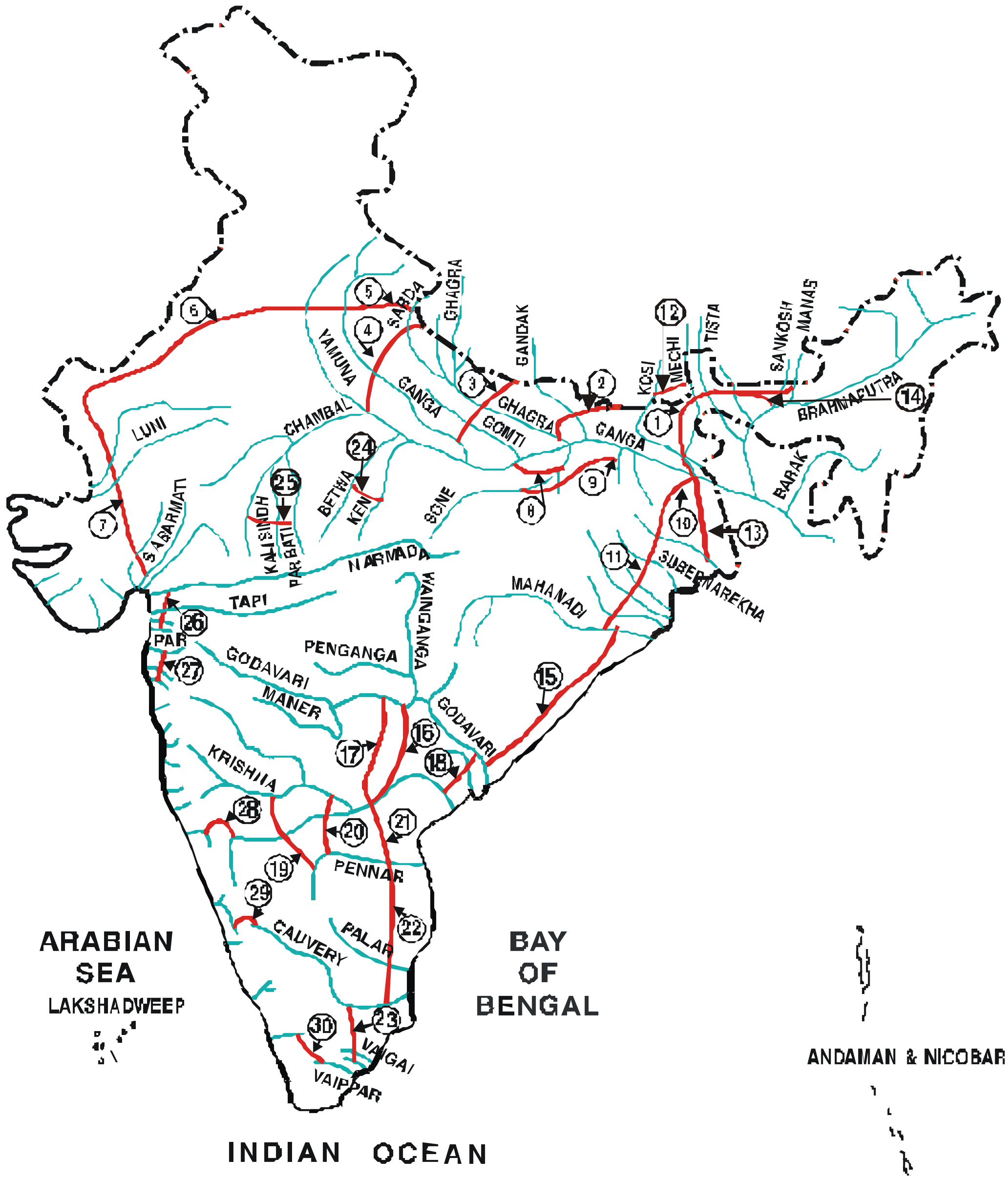
8. Reduction of maternal mortality rate (MMR) to 2 per cent per 1000 live births by 2007 and to 1 by 2012
9. Increase in forest and tree cover to 25 per cent by 2007 and 33 per cent by 2012
10. All villages to have sustained access to potable drinking water within the Plan period
11. Cleaning of all major polluted rivers by 2007 and other notified stretches by 2012

The Millennium Development Goals strive towards promoting gender equality and empowering women. Better irrigation facilities, catering to both agriculture and domestic purposes, along with clean, good quality water would aid the achievement of other goals as well such as reducing child mortality, morbidity, improving maternal health, and combating diseases.

The ILR programme would substantially improve the life of women in rural areas. At present, women have to spend the major portion of their time in collection of drinking water. Gender interests and needs have to be translated into water terms and creative, workable solutions, and alternatives need to be understood and adopted by irrigation planners and managers.

Traditional objectives of irrigation (viz. increasing agricultural productivity) need to be viewed also in the context of end-users of water from irrigation and the needs of agriculturist vis-à-vis those of women (who may or may not be agriculturists) need to be taken into account. Women, due to their dual roles as household managers (which also includes their role as primary care givers) and as agriculturists (in animal husbandry—livestock, maintenance of farms) have additional responsibilities and their requirements from irrigation waters are broader. Furthermore, women may be engaged in activities such as crafts and wage labour. Though recognised that water for domestic purposes needs to be taken into account, irrigation systems are rarely structured or planned to continuously improve access for domestic purposes. Irrigation canals and control structures can have a positive impact on family life, as time saved in collecting water may be used in other work or social duties. Non-inclusion or poor representation of women in water-user associations (WUAs) is another issue. The inclusion of women's perspectives, their ideas, opinions, needs and interests will thus require an active and conscious effort. Women get training in health and hygiene and are asked to preserve hygienic conditions at water points, which involves no payment. Focusing on domestic roles of women solely also detracts away from the joint responsibility that men and women together have towards their family, their health, and related water and sanitation issues. Furthermore, training in 'technical' skills should not exclude women. Sometimes potential side effect of an irrigation initiative may benefit women unintentionally. The growth of weeds as a result of irrigation had the side effect of increased fodder enabling women to increase milk and ghee production. Women's priority concern was largely for water for domestic use—encompassing functions such as drinking, cooking, bathing, washing clothes, and water for animals to drink and wash. The design and project implementation should therefore begin only after consultation with women and other stakeholders. This would also foster greater community participation and enable the success of participatory approaches such as WUAs.

Figure 1.1: Proposed Inter Basin Water Transfer Links



Himalayan Component

1. Brahmaputra – Ganga (MSTG)
2. Kosi-Ghagra
3. Gandak-Ganga
4. Ghagra-Yamuna
5. Sarda-Yamuna
6. Yamuna-Rajasthan
7. Rajasthan-Sabarmati
8. Chunar-Sone Barrage
9. Sone Dam-Southern Tributaries of Ganga
10. Ganga-Damodar-Subernarekha
11. Subernarekha-Mahanadi
12. Kosi-Mechi
13. Farakka-Sunderbans
14. Brahmaputra(ALT)-Ganga (JTF)

Peninsular Component

16. Mahanadi (Mani Bhadra)-Godavari(Dowlaiswram)
17. Godavari (Inchampalli Low Dam)-Krishna (Nagarjunasagar Tail Pond)
18. Godavari (Inchampalli) –Krishna (Nagarjunasagar)
19. Godavari (Polavaram) – Krishna (Vijayawada)
20. Krishna (Almatti)-Pennar
21. Krishna(Srisailam)-Pennar
22. Krishna (Nagarjunasagar)- Pennar (Somasila)
23. Pennar(Somasila)-Cauvery (Grand Anicut)
24. Cauvery (Kattalai)-Vaigaigundar
25. Ken-Betwa
26. Parbati-Kalisindh-Chambal
27. Par-Tapi-Narmada
28. Damanganga-Pinjal
29. Bedti-Varda

Source: National Water Development Agency

Chapter 2

Benefits of River Valley Projects

Introduction

An integrated approach becomes necessary when dealing with resources such as water, which transcend state boundaries and form lifelines for entire communities. River deltas and drainage areas suffer from disequilibrium in water supplies that may necessitate the transfer of water from surplus to deficit areas, capture of flood waters, provision of minimum channel depths for waterway transport and well-developed irrigation channels to re-energise and create more agricultural land and opportunities.

Power installations and tapping of hydroelectric potential could be jointly developed along with programmes in tributary watersheds to prevent soil erosion. Local supply and distribution networks restrict themselves to exploiting single segments of a basin's total water potential. Large-scale economies are suggested by integration into a single system (Krutilla and Eckstein 1958). The experience of some river projects around the world seeks to confirm this.

Tennessee Valley Authority (TVA)

The Tennessee Valley in the United States is drained by the Tennessee River and its tributaries spanning an area of 41,000 square miles and seven states. At the onset of the policy planning for the River in the post-Depression phase in the 1930s, the River Valley was in poor condition. Depletion and erosion of soil due to concentrated farming[3]; falling crop yields and farm incomes; extensive deforestation, particularly of timber, necessitated policy intervention. Also, navigation along the river was difficult, with the shallow upper course of the river, steep mountain ridges, sharp rapids, whirlpools in the middle course and erratic water volume patterns preventing easy movement of traffic; only the lower course was easily navigable.

In 1933, the TVA was set up to administer natural resources in the river drainage basin. Its three broad basic powers included controlling floods, improving navigation, and producing electrical power as far as was consistent and economically viable. Provision of electric power to rural areas was deemed imperative[4]. The Act that set up the authority also stressed the importance of providing for reforestation and proper

[3] "Even by Depression standards, the Tennessee Valley was in sad shape in 1933. Much of the land had been farmed too hard and for too long, eroding and depleting the soil. Crop yields had fallen along with farm incomes. The best timber had been cut."
Source: http://www.state.tn.us/sos/bluebook/online/section4/tva.pdf

[4] In the 1930s, though nearly 90 per cent of urban areas had electricity, only 10 per cent of rural dwellers did. Private utility companies argued that it was too expensive to provide the infrastructure (electric lines) to connect rural farms.

use of marginal lands along with the agricultural and industrial development of the Valley (see box 2.1 for TVA profile).

The TVA power system today oversees the largest public power system in the US. It consists of 3 nuclear-generating plants, 11 coal-fired plants, 29 hydroelectric dams, 5 combustion-turbine plants, and 27,000 km of transmission lines. The primary aim of the dams was—and remains—the prevention and reduction of destructive floods with power generation having emerged a key function. At present, TVA power plants provide 31,517 MW of dependable generating capacity[5] (Table 2.1).

Table 2.1: Electricity Network of TVA

	1960s	2002	
Power generated	12,000 MW	Hydro plants	10.2 million MW-hours
		Nuclear plants	45 million MW-hours
		Combustion turbines	1.19 million MW-hours
Consumers	**1/3rds –** industries **2/3rds –** 155 locally-owned municipal and cooperative distribution systems	8.3 million consumers; 158 local municipal, and cooperative power distributors	

Source: 1960s - *Encyclopaedia Britannica* (1970)
2002 - http://www.state.tn.us/sos/bluebook/online/section4/tva.pdf

Benefits have been felt in other spheres as well. The TVA has carried out programmes focusing on the control and proper use of water resources and the conservation and preservation of land resources. The work has been done with the cooperation of federal and state agencies, and the agricultural extension services of land grant colleges and universities[6].

As the Tennessee Valley region is primarily agricultural, efforts have been made to promote and facilitate the requirements of the farming community. Various government agencies such as the US Department of Agriculture, Civilian Service Corporations, and local organisations of farmers are carrying out programmes for rehabilitation of land. The TVA simultaneously developed fertilisers, taught farmers how to improve crop yields, helped replant forests, control fires, and improve the habitat for wildlife and fish. This enabled farmers to develop techniques for encouraging sustained agriculture. Electricity generation created more productive farms and better livelihood, drawing additional industries to the region[7].

In economic and community development programmes, TVA provides technical assistance in areas, including industrial development, regional waste management, and tourism promotion working with local communities and groups to develop maximum

5 http://www.state.tn.us/sos/bluebook/online/section4/tva.pdf
6 http://newdeal.feri.org/guides/tnguide/ch09.htm
7 http://www.state.tn.us/sos/bluebook/online/section4/tva.pdf

use of available area resources. In coordination with regional learning centres, businesses, and industries, the authority has identified skills needed in the high-technology job market and has also set up training centres to cater to these future demands[8].

Box 2.1 TVA Profile

- Fifth-largest river system in the US
- 650 miles (1,050 km) of navigable river
- 11,000 (17,600 km) of public shorelines
- 480,000 acres (190,000 hectares) of recreation lakes
- 25 flood control dams
- US$829 million capital invested in the valley
- US$23 million of economic development loan commitment to valley businesses
- US$951 million spent with valley businesses for goods and services in 1999
- Largest wholesale producer of electricity in the US
- More than 6 million customers served
- Fuel sources: fossil, nuclear, hydro, and combustion turbine
- Total assets: US$33 billion
- Total debt: US$26 billion

Source: *TVA Annual Report*, 1999 cited in USAID (2002)

Two attributes separate the TVA's approach to development of the river basin and administration of its resources, making it unique. First, the application of the concept of 'multiple use' throughout the watershed, which made it possible to develop the river system for multiple purposes. This has enabled policy-makers and target populations exploit the full potential of the waters. Secondly, its administration and organisational setup, which made possible a network of agreements and contracts across state governments that has led to the emergence of cooperative administration.

Various river basins around the world, such as the Cauca in Colombia and the Damodar valley development project in India, emulated facets of the TVA's development.

Indira Gandhi Canal Project (IGCP)

Rajasthan, the largest state in India, has a geographical area of 342 lakh hectares of which 150 lakh hectares is under cultivation. More than 80 per cent of the cultivated land does not receive any kind of irrigation, giving rise to rainfall-dependent agriculture. The climatic conditions and sandy terrain prevented any kind of employment save a nomadic existence. The objective of the Indira Gandhi Nahar Pariyojana was to convert 1.54 million hectares of arid and semi-arid desert land into cultivate command area utilising about 9.5 m. cu. mts. of water per year from the *Ravi* and *Beas* rivers (NCAER 1993).

The construction on the project began in 1958 just below the confluence of the *Beas* and *Sutlej* Rivers of the Indus River system. In 1961, the first waters were released from the canal. Today, it is one of the largest canal systems in the world.

Implementation was divided into two stages with the second stage commencing in the Fourth Five-Year Plan and the first stage itself being split. The organisational

[8] http://www.usembassy.de/usa/etexts/gov/govmanual/tva.pdf

structure focused on three aspects—the Indira Gandhi Canal Project Board, the Colonisation Organisation, and the Command Area Development Authority. The main aims were to build infrastructure, canals, bridges, regulators; and undertake water control, afforestation, construction of roads, provision of drinking water, facilities for setting up industries and firms; planning of land utilisation, crop planning and agricultural demonstration farms, cooperative societies, and banks. The Colonisation Organisation is responsible for habitation and housing along with fixing of land tenures.

Its sole function remains the provision of adequate irrigation facilities. The Indira Gandhi canal flows through inhospitable and sparsely populated terrain with the entire command area falling in three districts of the Great Indian Desert. Its objectives consisted of extending irrigation facilities to dry and arid regions and increasing land under cultivation, supplying drinking water to people and cattle, developing rural water infrastructure, and preventing migration from rural areas along with creating employment for the unemployed and underemployed.

Table 2.2: Salient Features of the IGNP

Particulars	Unit	Stage I	Stage II	Total
Culturable command area at full development				
i) Under flow irrigation	Lakh ha	4.79	8.67	13.46
ii) Under lift irrigation	Lakh ha	0.46	3.12	3.58
Total	Lakh ha	5.25	11.79	17.06
Irrigation potential at full development (likely after 2007)				
i) Flow areas	Lakh ha	5.27	6.94	12.21
ii) Lift areas	Lakh ha	0.51	2.50	3.01
Total	Lakh ha	5.78	9.44	15.22
Requirement of water				
i) For irrigation	MAF	3.37	3.35	6.72
ii) For drinking and industrial use	MAF	0.22	0.65	0.87
Total	MAF	3.59	4.00	7.59

Source: Hooja (2003)

Koshteh (1995), in a study encompassing 1974-75 to 1989-90 found that the major source of irrigation water for farming remained underground and surface water, but irrigated farming through canals was rising in Rajasthan. Specifically, the Indira Gandhi Canal Project was observed to be the main source of irrigation for irrigated farming in the Indira Gandhi Canal Stage I Command Area (Table 2.2). Prior to its construction in the Thar Desert, there had been no source of irrigation water in the dry area of western Rajasthan. Comparison of non-irrigated and irrigated tracts shows considerable degrees of differences. Changes in the land use pattern of the latter with an inverse relation between irrigated water availability and percentage of cultivable waste land, current fallow land and old fallow land to total geographical area of IGCP

Stage I irrigated area are seen. Irrigation capacity created and utilised increased as a result (Tables 2.3 and 2.4).

Table 2.3: Irrigation Potential Created and Utilised in Stage I (lakh hectare)

Year	Stage I Phase I up to km 74 (A)				Stage I Phase II km 74-km 189 (B)				Stage I as a whole Total (A+B)			
	1	2	3	4	1	2	3	4	1	2	3	4
1976-77	3.36	0.31	0.34	2.74	0.86	0.04	0.05	0.05	4.22	0.35	0.39	2.79
1986-87	4.06	2.81	3.09	4.63	1.63	0.89	0.98	0.61	5.69	3.70	4.07	5.24
1996-97	4.07	2.90	3.19	5.41	1.77	1.60	1.79	1.42	5.84	4.50	4.95	6.82

1: Area opened up through canal irrigation
2: Area covered by lined water course
3: Irrigation potential created
4: Utilised
Source: Hooja (2003)

Table 2.4: Irrigation Potential Created and Utilised in Stage II

Year	1	2	3	4
1981-82	0.28	0	0	0
1986-87	0.76	0	0	0.05
1996-97	4.39	3.41	2.73	1.59

1: Area opened up through canal irrigation
2: Area covered by lined water course
3: Irrigation potential created
4: Utilised
Source: Hooja (2003)

Furthermore, a positive relationship between irrigation water availability and area under major *kharif* (cotton, guar, and groundnut) and *rabi* (wheat, gram, and mustard) crops as well as their proportion to total irrigated area had gone up considerably. A positive relationship was also seen between the productivity of almost all major crops and irrigation water availability.

Rajasthan's Indira Gandhi Nahar Pariyojana benefits largely consist of a successful irrigation programme where areas falling under canal irrigation have become prosperous. A shift from subsistence crops to commercial crops has also been seen bringing prosperity and alternative employment opportunities to a region. Yields obtained from *kharif* and *rabi* crops have increased substantially (Table 2.5).

Koshteh (1995) documented the success of Stage I of the canal project, highlighting its contributions in terms of higher employment, migration figures, and demand for services. Irrigated areas also saw lower participation of workers in primary sector activities as compared to secondary and tertiary, indicating rural economic development and diversification of employment opportunities along with increasing efficiency of production. He terms the progress made as "Greening the Desert", highlighting the advances made in agricultural development and settlement.

In a book with the same title, Hooja (2003) brings up the major impacts of the IGCP that were estimated in 1993-94 by the Canal Board of the IGCP. About 637,000 hectares area of land is irrigated bringing land hitherto unproductive into the fold of agriculture. About Rs 650 crore worth of agricultural produce is being grown annually. Good quality drinking water has become available to more than 1.8 million people living in 6 towns/cities and 1,624 villages. Improvement in the household income and expenditure structure has taken place, with employment to more than 400,000 people being provided. In a study conducted by NCAER (1993), it was found that average income per family was found to be Rs 17,000 per year in Stage I, Phase II and Rs 13,000 per year in Stage II in the sample studied. This is astounding for an area predominantly consisting of desert which hitherto had few economic activities, let alone agriculture.

Table 2.5: Crop Yields (quintals per hectare)

Year	Kharif crops				Rabi crops			
	Cotton	Paddy	Groundnut	Arhar	Guwar	Wheat	Gram	Mustard
Stage I								
1974-75	8.91	27.50	N.A.	N.A.	N.A.	12.71	7.36	6.22
1975-76	8.91	27.50	N.A.	N.A.	N.A.	14.32	9.27	3.71
1976-77	8.90	29.87	N.A.	N.A.	N.A.	15.96	9.72	6.81
1977-78	9.91	28.68	N.A.	N.A.	N.A.	16.56	10.38	6.86
1978-79	11.34	33.52	N.A.	N.A.	N.A.	18.40	10.60	8.10
1979-80	11.50	29.91	17.72	12.12	N.A.	18.25	8.48	6.77
1980-81	10.41	20.12	16.00	10.00	N.A.	18.25	8.20	6.20
1981-82	10.15	33.44	14.65	8.38	9.57	19.50	7.00	8.50
1982-83	11.30	37.63	15.10	N.A.	9.57	23.80	6.55	9.71
1983-84	8.14	42.80	18.10	N.A.	9.01	18.77	6.50	10.50
1984-85	13.38	40.35	18.14	N.A.	8.31	13.32	6.15	10.45
1985-86	11.38	35.00	13.61	9.53	9.53	20.00	8.00	12.00
1986-87	12.74	N.A.	15.93	N.A.	7.46	20.39	5.64	8.35
1987-88	5.45	N.A.	7.72	N.A.	4.98	12.29	3.62	6.42
1988-89	11.17	47.07	14.20	N.A.	8.73	30.33	7.75	12.34
1989-90	18.20	50.25	15.39	N.A.	8.10	23.59	8.67	9.92
1990-91	16.72	56.00	14.21	N.A.	9.21	27.72	5.53	10.84
1991-92	16.47	45.00	11.36	N.A.	7.66	30.00	5.80	7.49
1992-93	15.60	N.A.	12.04	N.A.	8.53	27.31	6.13	8.74
1993-94	14.21	N.A.	13.66	N.A.	6.57	30.95	5.37	9.84
1994-95	10.17	N.A.	15.31	N.A.	7.52	33.26	10.92	11.23
1995-96	13.40	N.A.	15.07	N.A.	6.86	31.25	8.81	12.21
1996-97	12.81	N.A.	16.04	N.A.	7.01	31.48	8.09	13.47
Stage II								
1993-94	N.A.	N.A.	N.A.	N.A.	N.A.	12.33	5.64	9.26
1994-95	N.A.	N.A.	15.74	N.A.	2.72	13.50	10.95	6.64
1995-96	8.83	N.A.	15.70	N.A.	4.32	17.13	10.81	8.82
1996-97	9.78	N.A.	17.01	N.A.	4.00	19.16	10.00	10.24

Source: Hooja (2003)

The Colorado River Canal System

The Colorado River Canal System is seen by many as the lifeline to southwest US. Cutting through 1,450 miles of mountains and deserts, the *Colorado* river supplies water to over 25 million people and helps irrigate 3.5 million acres of farmland. More water is exported from the Colorado River's 250,000 square-mile basin than from any other river basin in the world. The river's waters are diverted to supply numerous regions, including the Salt Lake Valley in Utah; the Rio Grande Basin in New Mexico, Cheyenne, and Wyoming; the southern coastal plain and irrigation districts in California; and over the Continental Divide to the city of Denver[9].

Much of the southwest is located in an arid region and the threat of impending drought poses a hazard to economies and livelihoods. In addition, the limiting factor for development of land in western US was seen to be the dearth of availability of water. Damming the *Colorado*, which drains snowmelt and rain from the western side of the Rocky Mountains, was seen as a solution. In 1922, the Colorado River Compact outlined a plan to build a series of dams along the *Colorado* that would control floods and ensure a steady water supply for southwestern states[10]. Furthermore, wet winters lead to flood discharges of more than 200,000 sec ft, wreaking havoc. For example, the silt brought down annually to Yuma produces dangerous meandering in the leveed sections of the delta causing the river to seek new outlets, necessitating intervention.

For the purposes of controlling floods and regulating the flow of the lower *Colorado* river, interception of silt, provision for storage and delivery of water for irrigation purposes, and generation of power, a series of large dams was commissioned. The first was along the lower *Colorado* river with the construction of the Hoover Dam in 1931. The dams were intended to provide drought protection to cities and farms via their massive storage reservoirs and safety from floods that followed in wet winters. Lake Mead, created by the captured waters from the Hoover Dam has become a tourist attraction as well.

Shortly after the completion of Hoover Dam, planning and construction began on other dams. From Havasu Lake, the reservoir impounded by another dam built, water is transported some 250 miles across California to supply a portion of the water needs of Los Angeles and most of the water supply to San Diego.

In a typical year, reclamation projects in the Lower Colorado Region supply irrigation water to more than 2.7 million acres of land in the US and Mexico, and supply more

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[9] http://www.water-ed.org/coloradoriver.asp

[10] http://earthsci.terc.edu/content/investigations/esu401/esu401page01.cfm?chapter_no=investigation

than 18 million people with municipal or industrial water. In 2000, Arizona used 2.6 million acre-feet of *Colorado* river water; California used 5.3 maf; Nevada used 332,000 acre-feet; and 1.7 million acre-feet was delivered to Mexico. Regional dams and reservoirs also help protect water users against drought. Since the completion of Hoover Dam in 1935, there has never been a water shortage on the lower *Colorado* river[11].

Among other benefits, hydroelectric power plants in the River Project generate nearly 6 billion-kilowatt hours of electricity in an average year. To conserve the environment, four national wildlife refuges and one national wildlife area have been developed on the lower *Colorado* river. These provide a habitat for fish and waterfowl as well as provide recreational opportunities. In 2000, reclamation dams prevented an estimated $1.4 million in potential flood damages throughout the southwest US.

Three Gorges Dam

Currently being built on the third largest river in the world, the *Yangtze*—in the most populous country in the world, China—the Three Gorges Dam is going to be the biggest dam in the world on its completion. The *Yangtze*, the site of devastating floods causing loss of lives and damage to property, is unpredictable. In an effort to control its movement, and meet the growing demand for electricity and power due to China's economic growth, the project is being carried out. The project was initiated in 1994 and will be completed in 2009. Reports emerging from China for the rationale for the project emphasise many aspects.

The principal reasoning behind the project is generation of power. It is estimated that China's power output must rise by 8 per cent annually to keep pace with the 6 per cent annual increase in gross national product. China depends largely on coal for its heating and electricity needs. Growing coal consumption poses a huge threat to the environment as coal burning emits several harmful gases, including carbon dioxide (CO_2). The dam has to reduce emissions of sulphur dioxide and carbon dioxide, and generate electricity equal to nearly 40 million tonnes of coal[12].

The dam will also relieve the danger of flooding. The Chang Jing River Valley has been chronically threatened by flooding. For example, in 1954, a flood killed 30,000 people and left one million homeless. The huge flood storage capacity will lessen the frequency of major floods. The risk that the dam will increase flooding is remote according to government sources.

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[11] http://www.usbr.gov/lc/region/g1000/benefit.htm

[12] http://www.american.edu/ted/threedam.htm

In addition, navigation capacities on the river from Yichang to Chongging will be improved and, therefore, fleets can make direct trips. Shipping will become faster, cheaper and safer as the rapid waters are brought under control.

Chapter 3

Economic Impact of Interlinking of Rivers

Introduction

Agriculture, despite experiencing a slowdown in growth and a decline in its share in GDP, is still one of the major growth drivers of the Indian economy. Its importance can be gauged from the fact that in the 54 years since 1950, the Indian economy grew by more than 7 per cent in 12 years. Of these, in 9 years, it was agriculture that was mainly responsible (Table 3.1). But it is also true that most of these years follow a drought year.

Table 3.1: Sectoral Growth Rate for Selected Year (%)

Years	Agriculture	Industry	Services	Total
1958-59	9.8	6.6	4.1	7.6
1960-61	6.6	10.7	5.7	7.1
1964-65	9.1	6.8	5.8	7.6
1967-68	14.4	2.7	3.6	8.1
1975-76	12.4	6.2	6.6	9.0
1980-81	12.2	4.2	4.0	7.2
1983-84	9.6	8.1	5.5	7.7
1988-89	15.5	9.2	7.3	10.5
1994-95	5.0	10.2	7.1	7.3
1995-96	-0.9	11.6	10.5	7.3
1996-67	9.6	7.1	7.2	7.8
2003-04	10.00	7.38	8.51	8.54
2004-05	-0.04	9.75	9.55	7.52
2005-06 (Quick Estimates)	6.02	9.58	9.83	8.99

Source: Using data from CSO

Even more importantly until 2003-04, it was only in four years that the economy grew at more than 8 per cent. Each of these years coincides with very high growth of the agriculture sector. In contrast, industry and services have, at best, pulled up GDP growth to 7.3 per cent when there was no significant contribution from agriculture.

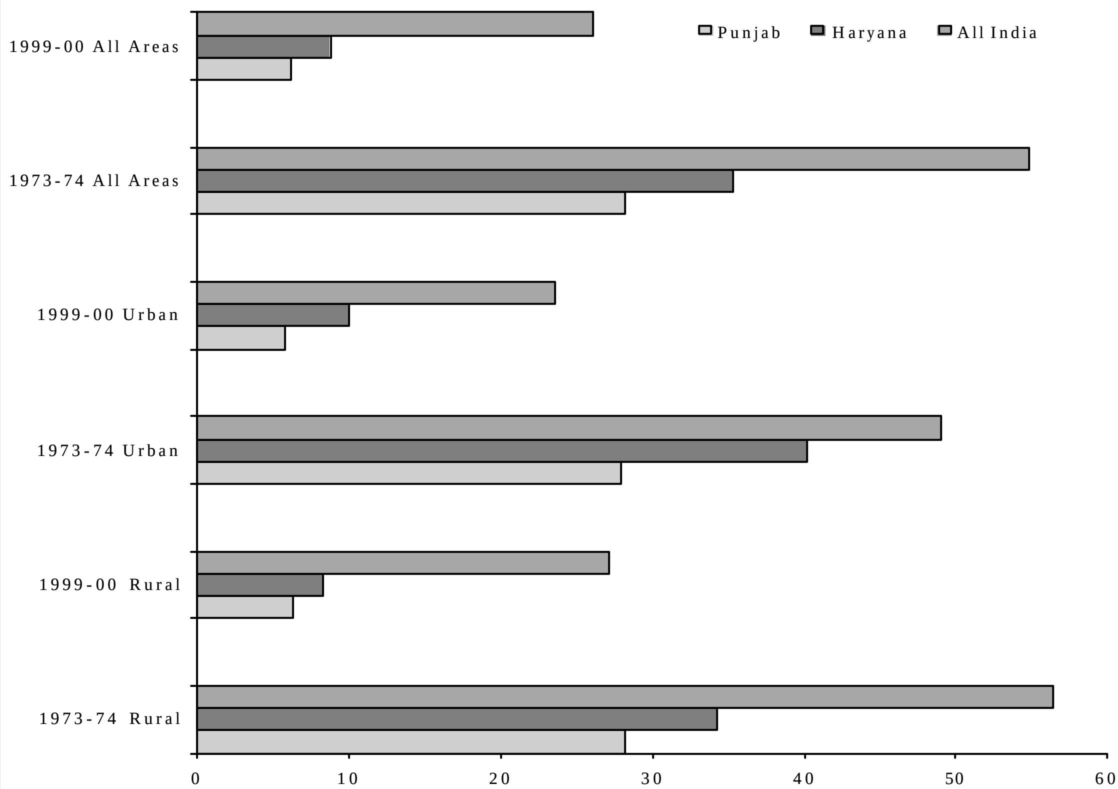
Irrigation is a crucial input for agriculture growth. For example, the Bhakra dam enabled Punjab and Haryana to register faster growth as compared to rest of the country. After Bhakra dam, irrigation intensity increased substantially in Punjab and Haryana through the dam-canal network and groundwater pumping. The additional irrigated area has been of the order of 6.8 million hectares over 35 years. Increased irrigation intensity led to increased usage of HYV seeds, at present more than 90 per cent of the area under wheat and 80 per cent under paddy cultivation uses HYV seeds. The region uses one of the most advanced agriculture technologies in India. Gross cropped area between 1996-97 and 1960-61 in Bhakra dam project area increased by 53 per cent. Gross irrigated area during the same period increased by 194 per cent and the production of rice and wheat in the Bhakra command area during 1996-97 was 8 times of production in 1960-61. In the year 2001-02 Punjab with 5.05 per cent share in the country's area under foodgrain contributed 11.74 per cent to the nation's foodgrain production, at the same time Haryana with 3.49 per cent share in the country's area under foodgrain contributed 6.27 per cent to the nation's foodgrain production. Foodgrain productivity in the states of Punjab and Haryana is 2.32 and 1.80 times of the national average. Haryana and Punjab are also instrumental in India achieving food security and helped in reducing volatility in the foodgrain prices. These two states contribute largely to the central pool procurement of rice and wheat. In the year 2002-03, Punjab contributed 50.29 per cent of rice and 51.84 per cent of wheat to the overall procurement. Contribution of Haryana during the same period has been 8.35 per cent and 30.95 per cent for rice and wheat respectively. Thus, Punjab and Haryana put together contributed nearly 72 per cent of the total rice and wheat procurement in the year 2002-03. Impact of higher growth led by agricultural sector is also reflected on declining incidence of poverty and improvement in the living standards in these two states. Incidence of rural poverty in Punjab and Haryana in 1999-00 declined to 22.5 per cent and 24.2 per cent respectively compared to the incidence of rural poverty in 1973-74. In contrast incidence of rural poverty at all India level in 1999-00 declined to 48.0 per cent of the incidence of rural poverty in 1973-74 (Table 3.2 and Figure 3.1).

Table 3.2: Poverty Ratios in Punjab, Haryana and All India (%)

States	Rural		Urban		All Areas	
	1973-74	1999-00	1973-74	1999-00	1973-74	1999-00
Punjab	28.21	6.35	27.96	5.75	28.15	6.16
Haryana	34.23	8.27	40.18	10.00	35.36	8.74
All India	56.44	27.09	49.01	23.62	54.88	26.10

Source: Planning Commission

Figure 3.1: Placewise Incidence of Poverty (per cent)



One of the most reliable structural methods to control floods is to store the excess water in dams. Although Bhakra and Pong were not planned as flood control reservoirs, they were expected to provide a cushion. Even so, the two dams helped in moderating floods by absorbing peak flood inflows (Table 3.3). Bhakra has solved the problem of recurring floods in the Sutlej, where a large part of the wide riverbed below the Bhakra dam is now utilised for intensive agriculture.

Link canals have both short and long-term impact on the economy. The short-term impact of the link canal is in the form of increased employment opportunities and the growth of the services sector. Sectors supplying crucial inputs to the construction sector, such as cement and iron and steel, also grow. In the medium to long term, the major impact of link canals is through increased and assured irrigation. Although the major and direct gainers of the interlinking of rivers (ILR) programme will be agriculture and agriculture- dependent households, the entire economy will benefit because of increased agriculture production.

The ILR programme involves huge construction activity, comparable in scale to the Golden Quadrilateral (GQ) project. The construction activities in the ILR would include construction of dams, reservoirs and canals. The construction time of these activities will depend on the number of dams/reservoirs, length of canals and the topography of the area. The impact of the ILR programme on agriculture will be realised only when construction is completed, reservoirs filled and the water reaches the ultimate users for irrigation, drinking, industrial purposes and hydropower generation. Until construction is complete, the impact of the ILR programme will be through government investment. This will have an impact on the industries supplying inputs for construction. There will also be an increase in employment and thus on demand for goods and services.

Table 3.3: Impact on Moderation of Floods

Year	Bhakra Dam		Beas Dam	
	Peak Flood Inflow (Cumecs)	Maximum Release (Cumecs)	Peak Flood Inflow (Cumecs)	Maximum Release (Cumecs)
1978	10719	3887	-	-
1988	9004	4209	10692	7972
1992	6625	1542	6587	2741
1994	6364	1695	8931	1406
1995	8977	1658	9623	5633
1998	5244	1330	4270	-

The growth of the other sectors will depend on the strength of the backward linkages (sectors supplying inputs to construction sector) and forward linkages (sectors which are using output of construction sector as input) of the construction sector with the rest of the economy. As the output of certain sector increases, it will increase the demand for goods and services in the economy. In the medium- to long-term, once the construction of these canals is over, the gain to the economy will be in the form of increased and assured irrigation, which will have direct impact on agricultural production and the growth. As is evident from Table 3.4a and 3.4b, the productivity of crops under irrigation is much higher.

Table 3.4a: Irrigated and Unirrigated Yield of Rice in Selected States

(Kg per Hectare)

State/ Season	Irrigated Yield				Unirrigated Yield			
	1994-95	1995-96	1996-97	1997-98	1994-95	1995-96	1996-97	1997-98
Andhra Pradesh (Kharif)	2522	2438	2491	2227	1420	1505	1402	909
Assam (Autumn)	1705	1434	NA	2008	1051	1012	NA	1172
Bihar (Autumn)	1227	1426	NA	1569	864	996	NA	1068
Gujarat	1889	2036	NA	NA	1139	792	NA	NA
Himachal Pradesh	1667	1524	2195	1770	1489	1411	1472	1413
Karnataka (Kharif)	2904	2947	NA	NA	1833	1678	NA	NA
Madhya Pradesh	1636	1724	1790	NA	1164	973	975	NA
Orissa (Autumn)	1421	1519	1719	2224	1108	1087	819	1580
Orissa (Winter)	1754	1683	2174	2627	1493	1412	1206	2019
Punjab (Autumn)	3419	3147	NA	3414	1295	1467	1854	NA
Rajasthan (Kharif)	1700	1612	1813	1431	794	496	851	977
Tamil Nadu (S/T/P)	3264	2505	2596	NA	NA	NA	NA	NA
Uttar Pradesh (Winter)	2056	2053	NA	NA	1556	NA	NA	NA
West Bengal (Aus)	2267	2319	NA	NA	1601	1622	NA	NA
West Bengal (Winter)	2200	2325	NA	NA	1730	1872	NA	NA

NA: Not Available

Source: Area and Production of Principal Crops in India, Ministry of Agriculture

Table 3.4b: Irrigated and Unirrigated Yield of Wheat in Selected States

(Kg per Hectare)

State	Irrigated Yield				Unirrigated Yield			
	1994-95	1995-96	1996-97	1997-98	1994-95	1995-96	1996-97	1997-98
Bihar	2150	2051	NA	1997	1567	1482	NA	1621
Gujarat	3104	2502	NA	NA	531	434	NA	NA
Haryana	3668	3664	3884	3580	2186	2017	2371	2967
Himachal Pradesh	NA	2393	2219	2022	1741	1650	1792	1846
Karnataka	1403	1222	NA	NA	433	435	NA	NA
Madhya Pradesh	2262	2092	2271	NA	965	959	939	NA
Maharashtra	1696	1480	NA	1048	717	633	NA	409
Orissa	3121	1207	1311	1028	NA	NA	915	366
Punjab	4143	3936	NA	NA	2427	2084	NA	NA
Rajasthan	2446	2528	2771	2574	1072	1769	2043	1208
Uttar Pradesh	2592	NA	NA	NA	1483	NA	NA	NA
West Bengal	2199	2250	NA	NA	1551	1263	NA	NA

NA: Not Available

Source: Area and Production of Principal Crops in India, Ministry of Agriculture

To finance the ILR programme, the government will have to either withdraw funds from other programmes or borrow more. This has implications for the fiscal situation via interest payments on these borrowings.

Cost of Interlinking of Rivers Programme

The National Water Development Agency (NWDA) has estimated the cost of each link separately through its pre-feasibility and feasibility studies. These estimates were made at different points in time. Thus, the cost estimate of Godavari (Inchampalli) -

Krishna (Nagargunasagar) was prepared in 1987-88 and Damanganga-Pinjal in 2000-01 at the respective year's prices.

In order to arrive at the cost estimate for a single reference year, the prices of all base year cost estimates were updated at 2002-03 prices by NWDA. However, it was done assuming 10 per cent growth per annum in cost from base year.

The cost of the overall ILR programme has thus been estimated as Rs 5,60,000 crore at 2002-03 prices. This estimate suffers from two infirmities.

First, the cost of 30 links has been taken, whereas there are only 29 links. Jogigopa–Tista–Farakka (JTF) is an alternative link to Manas–Sankosh–Tista–Ganga (MSTG) and only one of these two links will be constructed.

Second, the fixed escalation rate of 10 per cent per annum is on the high side. In order to arrive at a better estimate detailed discussions with the officials of the task force showed that:

- The fixed escalation rate of 10 per cent per annum should be replaced by a more meaningful escalation factor. It was decided that the government investment deflator for construction should be used to arrive the cost estimate at 2003-04 prices. This cost will undergo changes once the detailed project reports (DPR) of the individual links are prepared.
- There will be two alternatives of cost estimates taking into account alternative links (MSTG or JTF).

The National Accounts Statistics (NAS) provide estimates of government investment in the construction sector at current and 1993-94 prices. The government investment deflator has been estimated from this data and used for arriving at a probable cost of the ILR programme. Link-wise estimates by both methodologies are provided in Table 3.5.

The new cost estimates at 2003-04 prices are Rs 1,15,669 crore less than earlier estimates if the MSTG link is constructed and Rs 1,25,343 crore less than the earlier estimate if the JTF link is constructed.

Another important fact is that these costs are prices a year later i.e. 2003-04 as opposed to 2002-03 prices earlier.

The two factors for lower cost estimates are, first, only one link cost is considered compared to the earlier estimates where both links cost was included, and, second, the escalation is on the basis of the government investment deflator.

Table 3.5 reveals that by using the appropriate price index for price escalation results in a cost reduction of the peninsular component of the ILR programme by Rs 16,498 crore at 2003-04 prices. However, the cost of the Himalayan component goes up by Rs 6,298 crore if the MSTG link is built but goes down by Rs 3,376 crore if the JTF link is built.

If one looks at earlier cost estimates, the provision of Rs 65,000 crore for linking Himalayan and the peninsular components and the contingency charge for the Himalayan components of Rs 40,000 crore are provided for in costs estimates. These two provisions of Rs 1,05,000 crore have been built into the individual link costs on the following assumptions:

- The Rs 65,000 crore provision of linking the Himalayan and peninsular links is added on to the cost of the Subernarekha–Mahanadi link.
- The Rs 40,000 crore contingency charges for the Himalayan components are distributed pro rata among the individual links on the basis of their cost.

The new cost estimates of all peninsular links are less than the earlier estimates, whereas the cost estimates of the three Himalayan links are higher than the earlier costs. The major cost differential is in the Subernarekha–Mahanadi link where the cost of linking the Himalayan and the peninsular links is added.

Table 3.5: Cost Estimate of ILR Programme (Rs Crore)

Sl. No.	Link	Cost of Link at 2002-03 Prices as estimated by Task Force	Cost of Link at 2003-04 Prices, New Estimate
A.	**Peninsular Links**		
1	Mahanadi-Godavari	16348.97	14192.97
2	Par-Tapi-Narmada	8180.73	7077.57
3	Parbati-Kalisindh-Chambal	4526.74	3689.82
4	Ken-Betwa	4263.04	3726.54
5	Damanganga-Pinjal	1143.45	1110.92
6	Godavari (Polavaram)-Krishna (Vijyawada)	10419.09	9107.84
7	Godavari (Inchampalli)-Krishna (Nagargunasagar)	27653.38	23431.19
8	Godavari (Inchampalli Low Dam)-Krishna (Nagargunasagar)	11506.78	10058.65
9	Krishna (Nagarjunasagar)-Pennar (Somasila)	9254.58	8297.91
10	Krishna (Srisailam)-Pennar	118.59	106.33
11	Krishna (Almatti)-Pennar	8984.70	7442.52
12	Pennar (Somasila)-Palar-Cauvery (Grand Anicut)	7082.42	6191.09
13	Cauvery (Kattalai)-Vaigai-Gundar	5181.05	4529.02
14	Pamba-Achankovil-Vaippar	3626.05	3003.66
15	Bedti-Varada	622.50	515.65
16	Netravati-Hemavati	394.25	326.58
	Total Cost of Peninsular Link	**119306.32**	**102808.26**
B.	**Himalayan Links**		
1	Manas-Sankosh-Tista-Ganga	57764.68	56520.17
2	Jogighopa-Tista-Farakka	45442.69	46846.10
3	Ganga - Damodar - Subernarekha	20189.84	19849.71

Sl. No.	Link	Cost of Link at 2002-03 Prices as estimated by Task Force	Cost of Link at 2003-04 Prices, New Estimate
4	Subernarekha - Mahanadi	10223.10	70403.07
5	Kosi - Mechi	16417.99	16328.32
6	Kosi-Ghagara	17629.62	16964.19
7	Chunar - Sone Barrage	4807.46	4726.47
8	Sone Dam - Southern Tributaries of Ganga	7757.97	7627.26
9	Farakka – Sunderbans	625.39	644.70
10	Sarda – Yamuna	23395.79	22656.09
11	Yamuna – Rajasthan	11435.52	11073.98
12	Rajasthan – Sabarmati	11608.32	11241.29
13	Ghagra – Yamuna	79745.62	76465.57
14	Gandak – Ganga	28181.18	27022.12
	Total Cost of Himalayan Link	**335225.17**	**-**
	Total Cost of Himalayan Link with MSTG Link	**-**	**341522.94**
	Total Cost of Himalayan Link with JTF Link	**-**	**331848.87**

Source: Basic Data from Task Force on Interlinking of Rivers and National Accounts Statistics

Taking into account the provisions of Rs 1,05,000 crore provided in the earlier cost estimates, the new cost estimate of Himalayan component if the MSTG link is built is Rs 98,702 crore less than the earlier estimate. It is lower by Rs 1,08,376 crore if the JTF link is built.

The new aggregated cost of entire programme with MSTG link is estimated as Rs 4,44,331.20 crore at 2003-04 prices. The new aggregated cost is Rs 1,15,668.20 crore or 20.7 per cent lower than the earlier aggregate cost estimate of Rs 5,60,000 crore at 2002-03 prices. The new aggregated cost of entire programme with JTF link is estimated as Rs 4,34,657.13 crore at 2003-04 prices. The new aggregated cost is Rs 1,25,342.87 crore or 22.4 per cent lower than the earlier aggregate cost estimate of Rs 5,60,000 crore at 2002-03 prices.

Investment Rollout Plan

The Supreme Court has suggested for expeditious completion of project and suggested year 2016 for completion of project. Resolving inter-state political issues and agreement between states and neighbouring countries will take more time. In light of these facts, 10 years time period for programme of this magnitude is too short, most probably the programme would take nearly 35 to 40 years, however, with use of modern construction and remote sensing technologies the programme at best could be completed in 25 years. However, in our analysis we had limited to 10 years time horizon. The investment plan was worked out after detailed discussions with the officials of the task force on the assumption that the preparation of the DPRs and other formalities would take two years and the actual construction of links would take place from 2006-07.

The time for construction of these links would vary according to the length of these canals, the number of reservoirs and dams to be constructed and the topography of the region. Smaller links such as Damanganga–Pinjal, Cauvery (Kattalai)–Vaigai–Gundar, Parbati–Kalisindh–Chambal and Netravati–Hemavatii could take as little as 3 years to complete, whereas bigger links such as the MSTG could take 8 years.

Two sets of the investment rollout plan are provided in Table 3.6 (Figure 3.2). At the start of the programme, investment would be small but would increase gradually, peaking in the 2011-12. It will then start falling. However, in comparison with the present capital expenditure by the central government (Rs 92,336 crore for 2004-05 (BE)), investment rollout from year 2008-09 to 2014-05 will have considerable strain on central government finances. After the passage of fiscal responsibility and budget management rules (FRBMR), 2004[13] government is committed to reduce fiscal deficit by 0.3 percentage point of GDP every year and bring it down to 3 per cent of GDP at the fiscal year 2007-08. The FRBMR also put a restriction on government borrowings, it says that the central government shall not assume additional liabilities (including external debt at current exchange rate) in excess of 9 per cent of GDP for the financial year 2004-05. In each subsequent financial year, the limit of 9 per cent of GDP shall be progressively reduced by at least one percentage point of GDP. The Gazette notification of FRBMR is on the basis of fiscal responsibility and budget management act (FRBMA), passed out by the parliament and every government irrespective of the party/alliance has to adhere to it.

The investment plan will help in clearing doubts in the mind of people and opponents of the ILR programme that investment is not going to take place in a single or couple of years but over at least 10 years. Since the impact analysis assumes that the ILR programme is entirely financed by central government a longer roll out plan would also help in reducing the impact on public finances.

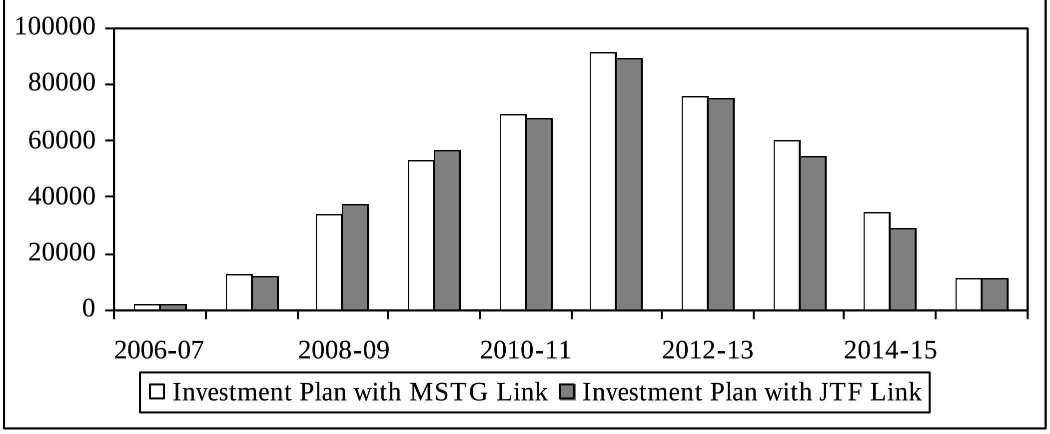
[13] The Gazette of India, Extraordinary, July 2, 2004.

Table 3.6: Investment Rollout Plan of ILR Programme (Rs Crore at 2003-04 Prices)

Year	Investment Plan with MSTG Link	Investment Plan with JTF Link
2006-07	2191.03	2191.03
2007-08	12899.43	11932.02
2008-09	34014.86	37732.06
2009-10	52929.97	56647.17
2010-11	69683.53	67748.71
2011-12	91109.17	89174.35
2012-13	75598.00	74630.59
2013-14	59888.46	54236.44
2014-15	34970.28	29318.26
2015-16	11046.49	11046.49
Total	444331.20	434657.13

Source: Computed

Figure 3.2: Investment Rollout Plan (Rs Crore at 2003-04 Prices)



Benefits

The quantifiable benefits of the ILR programme are in the form of increased irrigation, increased drinking and industrial water supply, and electricity generation. Table 3.7 describes the benefits from individual links.

Both India and Nepal are expected to benefit. Irrigation benefits in India are 15.7 million hectare and in Nepal 0.725 million hectare. Domestic and industrial water supply will account for nearly 12 thousand Mcum, which is equivalent to nearly 1.6 million hectares of irrigated area. The integration of the Himalayan and the peninsular components will generate 3 million hectares of irrigated area. Ground water recharge by these link canals would provide another 10 million hectares of irrigated area. Hence the ILR programme has potential of increasing irrigated area by

30 million hectare. The envisaged additional area to be irrigated by the ILR is nearly 40 per cent of the current irrigated area (75.5 million hectares in 1998-99).

Link canals have the potential to generate hydro-electricity, which during summer is low. Once the canals and reservoirs are in place and enough water is stored in reservoirs, it can be used to generate hydro electricity. The ILR programme with the MSTG link is envisaged to generate 28,994.5 MW of power and require 4,193 MW of power for the project, resulting in net power generation of 24,801.5 MW. The JTF link is envisaged to generate 24,822.5 MW of power and require 5252 MW of power for the project resulting in net power generation of 19,570.5 MW[14].

[14] It has been pointed out by CEA on the earlier version of this report that the additional power generation in the case of Mahanadi-Godavari link would be only 70 MW as against 966 MW given in Table 3.7. Similarly the additional power would be only 27 MW in the case of Godavari (Ichampalli)-Krishna (Nagarajun Sagar) as against 975 MW in Table 3.7. Together the change is a reduction in additional power generation by 7-8 per cent and would not affect the main conclusions of the analysis. However, we must note that the estimates are based on a range of assumptions and have been based on consultations with the officials.

Table 3.7: Linkwise Benefits

Sl. No.	Link	Annual Irrigation (Lakh Hac.)	Power Generation (MW)	Power Requirement (MW)	Domestic and Industrial Water Supply (Mcum)
A.	**Peninsular Links**				
1	Mahanadi-Godavari	4.54	966.0	0	0
2	Par-Tapi-Narmada	1.63	32.5	0	0
3	Parbati-Kalisindh-Chambal	2.18	0.0	0	13.2
4	Ken-Betwa	4.97	72.0	0	12
5	Damanganga-Pinjal	0.00	0.0	0	909
6	Godavari (Polavaram)-Krishna (Vijywada)	5.82	0.0	0	0
7	Godavari (Inchampalli)-Krishna (Nagargunasagar)	3.19	975.0	1705	0
8	Godavari (Inchampalli Low Dam)-Krishna (Nagargunasagar)	6.50	0.0	177	0
9	Krishna (Nagarjunasagar)-Pennar (Somasila)	5.81	120.0	0	0
10	Krishna (Srisailam)-Pennar	0.00	17.0	0	0
11	Krishna (Almatti)-Pennar	2.35	0.0	0	0
12	Pennar (Somasila)-Palar-Cauvery (Grand Anicut)	4.91	0.0	0	1155
13	Cauvery (Kattalai)-Vaigai-Gundar	3.53	0.0	0	109
14	Pamba-Achankovil-Vaippar	0.91	508.0	0	0
15	Bedti-Varada	0.60	4.0	61	0
16	Netravati-Hemavati	0.34	0.0	6	0
	Total Benefits from Peninsular Link	**47.28**	**2694.5**	**1949**	**2198.2**
B.	**Himalayan Links**				
1	Manas-Sankosh-Tista-Ganga	6.54	5287.0	0	0
2	Jogighopa-Tista-Farakka	5.94	1115.0	1059	216
3	Ganga - Damodar – Subernarekha	8.47	0.0	1278	484
4	Subernarekha – Mahanadi	0.545	9.0	715	0
5	Kosi – Mechi	4.74	3180	0	24
6	Kosi-Ghagara	10.58	0.0	0	48
7	Chunar - Sone Barrage	0.67	0.0	251	0
8	Sone Dam - Southern Tributaries of Ganga	3.07	95.0	0	360
9	Farakka – Sunderbans	1.50	0.0	0	184
10	Sarda – Yamuna	3.75	3600.0	0	6250
11	Yamuna – Rajasthan	2.877	0.0	0	57
12	Rajasthan – Sabarmati	7.39	0.0	0	282
13	Ghagra - Yamuna	26.65	10884.0	0	1382
14	Gandak - Ganga	40.40	3245.0	0	700
Total Benefits from Himalayan Links with the MSTG Link		**117.182**	**26300.0**	**2244**	**9771.0**
Total Benefits from Himalayan Links with the JTF Link		**116.582**	**22128.0**	**3303**	**9987.0**
Total Benefits with the MSTG Link		**164.462**	**28994.5**	**4193**	**11969.2**
Total Benefits with the JTF Link		**163.862**	**24822.5**	**5252**	**12185.2**
Benefits in Nepal		**7.250**	**0.00**	**0.00**	**0.00**
Benefit in India with the MSTG Link		**157.212**	**28994.5**	**4193**	**11969.2**
Benefit in India with the JTF Link		**156.612**	**24822.5**	**5252**	**12185.2**

Source: Task Force on Interlinking of Rivers Programme

Benefit Rollout Plan

The benefit rollout would follow a pattern similar to the investment plan but with a lag. The cumulative benefit rollout plan is provided in Table 3.8 (Figure 3.3 and 3.4).

Table 3.8: Benefit Rollout Plan

Year	Irrigation Benefit (Lakh Hectare)		Net Power Generation (MW)	
	With MSTG Link	With JTF Link	With MSTG Link	With JTF Link
2006-07	0.00	0.00	0.00	0.00
2007-08	0.00	0.00	0.00	0.00
2008-09	7.31	7.31	0.00	0.00
2009-10	24.06	24.06	72.00	72.00
2010-11	36.54	36.54	72.00	72.00
2011-12	48.52	53.11	41.50	41.50
2012-13	81.66	90.85	1,943.50	1,999.50
2013-14	169.84	174.20	1,593.50	1,649.50
2014-15	266.76	266.30	20,849.50	15,618.50
2015-16	299.70	299.24	24,801.50	19,570.50

Source: Computed

Figure 3.3: Irrigation Benefit Rollout Plan (Lakh Hectare)

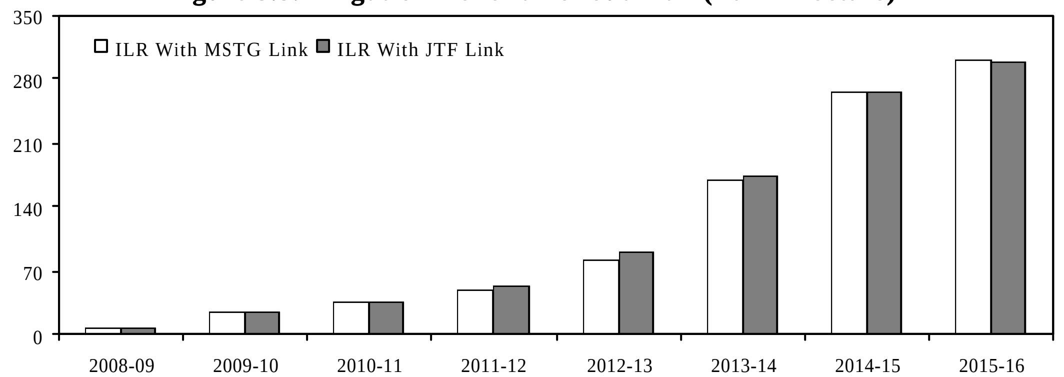
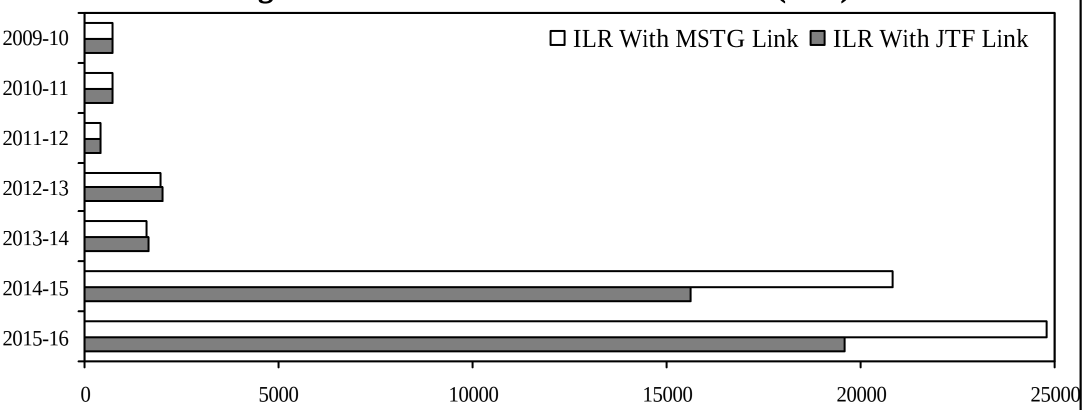


Figure 3.4 Net Power Benefit Rollout Plan (MW)



The cost and irrigation benefit potentials of the two alternatives are nearly the same. But due to the topography of the JTF link, the net power benefit is lower compared to the MSTG link. Irrigation benefits would start flowing earlier. Other benefits, which are difficult to quantify, are in the form of prevention of floods and droughts. The dams and reservoirs could be a source of revenue from fishing.

Short-term Impact of ILR Programme

The short-term impacts of the programme are analysed using a Social Accounting Matrix (SAM) based model. SAM is a simple and efficient framework to organise data in a consistent way. It is a particular representation of the macro and meso economic accounts of a socio-economic system. It captures the transactions and transfers between all economic agents in the system. It provides a classification and organisational scheme for the data useful to analysts and policymakers alike. The main features of a SAM are:

- The accounts are represented as a square matrix, where the incomings and outgoings for each account are shown as a corresponding row and column of the matrix;
- It is comprehensive and portrays all the economic activities of the system;
- It is flexible both in the degree of disaggregation and in the emphasis placed on different parts of the economic system.

A standard social accounting matrix lists payments (expenditures) in columns and the receipts in rows. These row and columns represent the different production activities, economic agents, institutions, and policy instruments of an economy at a chosen level of disaggregation.

In other words, SAM is a national tableau that shows how commodities and services are produced and disbursed and how the agents in the economy generate income and expend it in a particular year. One can consider entries in the rows as ‘deliveries’ of income flow to different recipients, and the entries in the columns as income ‘claims’.

The receipts of production accounts are from intermediate demand and final demand consisting of expenditures of households and government, investment and net exports (exports minus imports). The cost of production includes input costs, gross value added and net indirect taxes.

The underlying principle of double-entry accounting requires that row totals equal column totals for each account in the SAM. In practice, a SAM is the natural extension of the Input-Output (I-O) accounting system devised by Leontief more than 50 years ago. The extension of I-O table to a social accounting matrix framework is performed by partitioning the accounts into endogenous and exogenous accounts and assuming that the column coefficients of all the exogenous accounts are constant. Endogenous accounts are those for which changes in the level of expenditure directly follow any change in income, while exogenous accounts are those for which we assume that the expenditures are set independently of income. Schematic structure of SAM is presented in Figure 3.5.

Figure 3.5: Schematic structure of SAM

Receipt	Expenditure						
	Production Account	**Factors of Production**	**Households**	**Indirect Taxes**	**Government Account**	**Capital Account**	**Rest of the World**
Production Account (18 Production Sectors)	Input Output Table **A11**		Private Consumption **A13**		Government Consumption **A15**	Investment **A16**	Exports **A17**
Factors of Production	Value Added **A21**						Net Factor Income **A27**
Households (9 Categories)		Value Added Income **A32**			Government Transfers, Interest on Debt **A35**		Net Current Transfers **A37**
Indirect Taxes	Indirect Taxes on Purchases **A41**		Consumption Taxes **A43**		Indirect Taxes on Purchases **A45**	Indirect Taxes on Purchases **A46**	
Government		Income from Entrepreneurship **A52**	Income Tax and Corporate Tax **A53**	Total Indirect Tax **A54**			
Capital Account			Household Savings **A63**		Government Savings **A65**		Foreign Savings **A67**
Rest of the World	Imports **A71**				Government Transfers to ROW **A75**		

Construction of SAM for 2000-01

Sectorisation of a SAM depends on the kind of issues that it seeks to address. In the present exercise, the emphasis is on evaluating the short-run impact of the ILR programmes especially on employment and income distribution. The forward and backward linkages of the identified sectors with the rest of the economy govern the sectorisation.

In the present study, an 18-sector SAM has been constructed for 2000-01 at 2000-01 prices. Any sector supplying more than 5 per cent of its output to construction sector or purchasing more than 5 per cent of its input from the construction sector has been selected. The rest of the sectors are clubbed according to their homogeneity and data availability.

The 115 sectors of 1993-94 input-output table provided by the CSO was first aggregated into 18 sectors and then updated to the 2000-01 value. The coefficients were updated using relative price information to arrive at the 2000-01 value.

The following method has been used to update the coefficients.

$a_{ij} = P_iX_{ij} / P_jX_j$

Where X_{ij} is the intermediate flow,

X_j is the output of j^{th} sector, and,

P_i, P_j are sectoral prices.

In the base year all the prices are unity and P_i, P_j cancel out.

For 2000-01, if sectoral prices change in different proportions these will not cancel out. So even if the input-output coefficient remains the same, the current price estimates of the aij's have to be computed considering different sectoral rates of inflation.

The generalised expression for this updating of coefficients can be written as follows:

A' = PAP, where A' is updated matrix and P is a diagonal matrix if 'rate of sectoral price change'.

Data Source

The data on the value of output and gross value added for each of these 18 sectors is taken from NAS, 2002[15]. For some of the sectors, these are directly available in NAS, but for the rest certain assumptions are made.

For agriculture and mining, the value of output is taken directly from NAS. For the mining sector value-added is also available. But the disaggregation of value-added is not available for the agricultural sectors. Value-added output ratios as observed in the input-output table for 1993-94 is applied on respective values of output to get the gross value added. Gross value added of the manufacturing sector is given at aggregate level in NAS. At the two-digit level, unadjusted value added is given for registered and unregistered manufacturing sectors.

On combining the registered and unregistered value-added and adjusting them so that the sum equals value-added at the aggregate level, we get value-added for each manufacturing sector. The value of output for these sectors is available for the registered part only. The value of output of the unregistered sector is estimated by using the value-added output ratio of registered manufacturing. For the remaining

[15] Central statistical organisation (2002), National Accounts Statistics, 2002, Government of India

sectors, value-added is available in NAS and the value of output is computed using their value added output ratio in the 1993-94 input-output table.

Information from employment-unemployment survey conducted in the 55th round by NSSO is used for industry-wise employment. Data on households' groupwise consumption pattern is taken from the 55th round of NSSO consumption expenditure survey. Adopting norms of income distribution as observed in the MIMAP study, private income distribution across households is done.[16]

Distribution of Gross Value Added

Value added is distributed as government income (operating surplus - OS) and private income. Government income is taken directly from NAS for the following sectors:

1. Allied agriculture
2. Mining
3. Construction
4. Transport
5. Trade
6. Other services

For the rest of the sectors, the operating surplus is distributed among the sub-sectors by applying the structure of value-added on the operating surplus. Private income is estimated as the difference between the value added and government income. Private income is further divided into labour/wage income and capital/non-wage income.

In this study, labour and capital are the two factors of production used in production process. Wage income is also available in NAS for some sectors. The distribution of wage income in different sub-sectors is done adopting the same methodology as in the distribution of the operating surplus. Capital income is estimated as the difference between private income and wage income for all the sectors. Wage income and capital income form the factor income is then distributed among different households.

We have following 9 types of households, 5 in rural areas and 4 in urban areas:

1. Self Employed in non-agriculture - Rural
2. Agricultural Labour - Rural
3. Other labour - Rural
4. Self Employed in agriculture - Rural
5. Others - Rural
6. Self Employed - Urban

[16] Pradhan, Basanta K. and P.K. Roy (2003), "The Well Being of Indian Households, MIMAP-India Survey Report", Tata McGraw Hill and NCAER, New Delhi.

7. Regular - Urban
8. Casual Labour - Urban
9. Others – Urban

SAM Multiplier and Analysis of Results

To study the impact of increased construction activity on the rest of the economy, we have used the SAM multiplier analysis, which quantifies the magnitude of inter-industry linkages and consumption induced effects in addition to purely direct impacts. Multipliers are summary measures that reflect the total effects of a policy change in relation to its direct effects. A multiplier of 1.5 shows that for every rupee of value- added generated directly by the project, another 0.5 rupees would be generated in the form of indirect effects.

Value Added, Income Distribution and Employment Multipliers

Giving an exogenous shock to the system generates SAM multipliers. Table 3.9 depicts the sectoral value-added multipliers by 18 production sectors. The second column provides the value-added multiplier by each sector.

For example, a multiplier of 2.2377 for the food grain sector implies that if the demand for food grains increases by one unit, the value-added of this sector would increase by 2.2377 units. The food grain sector has the highest value-added multiplier and generates the maximum additional income among the 18 sectors if the demand from each sector increases by one unit.

Mining and quarrying sector has lowest value of value-added multiplier and thus generates the lowest additional income corresponding to a unit increase in output.

The source of demand of goods and services of a particular sector could be from government, the capital account and the rest of the world. But in the specification of the SAM multiplier, the source of the increase in demand does not make any difference. A one unit increase (decrease) in demand from different sources will have the same impact on the multiplier.

The construction sector has a value-added multiplier of 1.6267 and has the seventh rank among 18 sectors.

The increased value-added generated by an increase in demand of a sector would be distributed between government and households (private income). Government income would increase through an increase in the operating surplus of public sector enterprises and the increased direct and indirect taxes on consumption of goods and services.

Private income would be distributed across different households on the basis of their share in the supply of capital and labour in the production process. Labour and capital income multipliers of each sector are provided in third and fourth columns of Table 3.9.

Labour income multipliers are higher than capital income multipliers for labour intensive production sectors such as food grains, non-food grains & other crops, mining and quarrying, construction, electricity, gas and water supply and other services.

Table 3.9: Value Added Multipliers

Sectors	Value Added Multiplier	Labour Income Multiplier	Capital Income Multiplier
Foodgrain	2.2377	1.5267	0.7111
Non-foodgrain & other crops	2.2173	1.5633	0.6541
Allied agriculture	2.1544	0.7733	1.3811
Mining and quarrying	0.2889	0.1809	0.1080
Wood and wood products	1.8875	0.7690	1.1185
Coal Tar products	0.7717	0.3721	0.3996
Paints, Varnishes and lacquers	1.5196	0.6876	0.8320
Structural clay products	1.3025	0.5885	0.7140
Cement	1.2344	0.5694	0.6649
Basic metal industries and metal products	1.1018	0.5069	0.5949
Electrical wires & cables	0.8457	0.3833	0.4624
Other Manufacturing	1.3931	0.6676	0.7255
Construction	1.6267	0.9059	0.7208
Electricity, Gas and Water Supply	0.9537	0.5176	0.4361
Transport	1.5253	0.7551	0.7702
Trade	2.0008	0.7773	1.2236
Banking	1.5043	0.7427	0.7616
Other Services	1.8278	0.9791	0.8486

If the demand for these sectors increases, a larger share of the additional value-added generated in these sectors would accrue to the labour-supplying households as compared to owners of capital. The construction sector ranks fourth in the labour income multiplier amongst the 18 sectors after foodgrain, non-foodgrain and other crops and other services. It ranks ninth for capital income multiplier among the 18 sectors.

The increased labour and capital income are then distributed across nine different categories of households on the basis of the share of factor ownerships. Table 3.10 and 3.11 provide income multipliers for different household categories in rural and urban areas.

Employment multipliers are generated using SAM and labour-output ratios for different sectors. An employment multiplier is defined as the impact of the change in final demand on the changes in employment.

The direct employment effect of unit increase in final demand in sector is obtained from i^{th} sector's employment to the output ratio. Employment multipliers are subject to a larger margin of error as the relationship between output and employment is less rigid in practice than assumed in the input-output model.

Table 3.10: Income Multipliers for Rural Areas

Sectors	RHH 1	RHH 2	RHH 3	RHH 4	RHH 5
Foodgrain	0.1702	0.2607	0.3165	0.4948	0.0270
Non-foodgrain & other crops	0.1642	0.2666	0.3217	0.4764	0.0260
Allied agriculture	0.2252	0.1371	0.1925	0.6682	0.0360
Mining and quarrying	0.0234	0.0310	0.0382	0.0683	0.0037
Wood and wood products	0.1893	0.1351	0.1834	0.5602	0.0302
Coal Tar products	0.0723	0.0647	0.0843	0.2131	0.0115
Paints, Varnishes and lacquers	0.1463	0.1200	0.1587	0.4321	0.0233
Structural clay products	0.1255	0.1027	0.1359	0.3706	0.0200
Cement	0.1179	0.0992	0.1306	0.3480	0.0188
Basic metal industries and metal products	0.1054	0.0883	0.1164	0.3110	0.0168
Electrical wires & cables	0.0814	0.0669	0.0884	0.2403	0.0130
Other Manufacturing	0.1309	0.1161	0.1515	0.3859	0.0209
Construction	0.1417	0.1562	0.1972	0.4158	0.0225
Electricity, Gas and Water Supply	0.0843	0.0894	0.1134	0.2475	0.0134
Transport	0.1412	0.1310	0.1697	0.4159	0.0225
Trade	0.2040	0.1370	0.1883	0.6043	0.0326
Banking	0.1394	0.1289	0.1671	0.4107	0.0222
Other Services	0.1626	0.1692	0.2154	0.4779	0.0259

RHH 1: Self Employed in Non-agriculture, Rural
RHH 2: Agricultural Labourers, Rural
RHH 3: Other Labourers, Rural
RHH 4: Self Employed in Agriculture, Rural
RHH 5: Others, Rural

The economic rationale underlying the multiplier is that the change (increase/decrease) in a sector's output produced by a change in its final demand unleashes forces which affect the output of all those industrial sectors that supply/buy input to/from this sector directly or indirectly. The inter-industry flows of the input-output transactions table make possible the tracing and evaluation of this chain reaction. Table 3.12 provides the employment multiplier of 18 sectors.

A value of 378 for the construction sector means that employment of about 378 man-years would be generated as a result of increase in demand by Rs 1 crore for this sector's output.

The foodgrain sector has the highest employment multiplier. If the output of food grains increases by Rs 1 crore, its employment increases by 1936 man-years.

Table 3.11: Income Multipliers for Urban Area

Sectors	UHH 1	UHH 2	UHH 3	UHH 4
Foodgrain	0.2541	0.5900	0.0719	0.0525
Non-foodgrain & other crops	0.2436	0.5973	0.0718	0.0497
Allied agriculture	0.3577	0.3932	0.0624	0.0821
Mining and quarrying	0.0354	0.0721	0.0091	0.0075
Wood and wood products	0.2986	0.3674	0.0555	0.0678
Coal Tar products	0.1127	0.1647	0.0233	0.0251
Paints, Varnishes and lacquers	0.2292	0.3130	0.0454	0.0515
Structural clay products	0.1966	0.2681	0.0389	0.0442
Cement	0.1845	0.2570	0.0370	0.0413
Basic metal industries and metal products	0.1649	0.2290	0.0330	0.0369
Electrical wires & cables	0.1275	0.1744	0.0253	0.0286
Other Manufacturing	0.2041	0.2963	0.0420	0.0455
Construction	0.2178	0.3777	0.0503	0.0474
Electricity, Gas and Water Supply	0.1299	0.2180	0.0293	0.0284
Transport	0.2196	0.3305	0.0462	0.0487
Trade	0.3226	0.3800	0.0585	0.0736
Banking	0.2169	0.3254	0.0455	0.0481
Other Services	0.2511	0.4147	0.0561	0.0550

UHH 1: Self-Employed, Urban
UHH 2: Regular Workers, Urban
UHH 3: Casual Labourers, Urban
UHH 4: Others, Urban

Table 3.12: Employment Multipliers

Sector	Employment Multiplier	Rank
Foodgrain	1936	(1)
Non-foodgrain & other crops	504	(4)
Allied agriculture	512	(3)
Mining and quarrying	61	(18)
Wood and wood products	639	(2)
Coal Tar products	172	(17)
Paints, Varnishes and lacquers	329	(10)
Structural clay products	398	(7)
Cement	267	(13)
Basic metal industries and metal products	238	(14)
Electrical wires & cables	189	(16)
Other Manufacturing	325	(11)
Construction	378	(8)
Electricity, Gas and Water Supply	212	(15)
Transport	344	(9)
Trade	444	(5)
Banking	272	(12)
Other Services	398	(6)

Impact of Increased Demand of Construction

As mentioned, the initial phase of the ILR programme would involve huge construction activity and demand for construction would increase. In order to find its impact on the economy and at the household level, different SAM multipliers are calculated.

Here we try to quantify impact of increased investment in the construction sector by assuming that the final demand of the construction sector increases by Rs 10,000 crore through higher investments in the construction sector. Increased construction activity will require higher inputs from sectors such as steel, cement etc. These sectors in turn would demand higher inputs from other sectors and this would have a triggering/multiplier effect on the economy. The output of different sectors would change depending upon the strength of the sector's forward and backward linkages. As output grows, value-added will also grow. To produce a higher output, labour demand would also grow and thus employment in the economy would also grow. The impact of a Rs 10,000 crore increase in investment in construction sector on sectoral value added and employment is presented in Table 3.13.

Table 3.13: Growth of Value Added and Employment Corresponding to Rs 10000 Crore Increase in Investment in Construction (%)

Sectors	Growth of Value Added	Growth in Employment
Foodgrain	0.88	1.25
Non-foodgrain & other crops	0.69	3.90
Allied agriculture	0.71	3.06
Mining and quarrying	0.95	6.50
Wood and wood products	1.89	4.82
Coal Tar products	1.61	37.15
Paints, Varnishes and lacquers	1.26	20.81
Structural clay products	2.37	6.51
Cement	2.46	31.73
Basic metal industries and metal products	0.65	17.45
Electrical wires & cables	0.72	11.08
Other Manufacturing	0.49	6.84
Construction	3.80	22.74
Electricity, Gas and Water Supply	1.06	25.09
Transport	0.85	6.51
Trade	0.81	3.72
Banking	0.78	14.38
Other Services	0.62	3.80
Total	0.91	3.99

The direct impact of increased investment in the construction sector by Rs 10,000 crore would result in increased value-added of the construction sector by 3.80 per cent. However, due to its forward and backward linkages, the value added of cement would increase by 2.46 per cent, structural clay products by 2.37 per cent and basic metal and metal products by 0.65 per cent.

The increased income in the economy would demand more goods and services and thus all sectors of economy would experience growth in their value-added. It is estimated that the incremental value-added generated in the economy would be Rs 17,424 crore (0.91 per cent) by Rs 10,000 crore of additional investment in construction. Direct employment in the construction sector would grow by 22.74 per cent. Sectors such as coal tar products, cement and electricity, gas and water supply would experience higher growth of employment than the construction sector. Total employment in economy would increase nearly by 4 per cent.

A part of the incremental value-added generated in the economy would go to the government and a larger share of it would be distributed among the households on the basis of income distribution multipliers. It is estimated that the government would earn around Rs 1,157 crore in form of an operating surplus from the public sector and taxes out of the increased value added of Rs 17,424 crore. Household income would increase by Rs 16,267 crore. Increased private income would be distributed across different categories of households on the basis of their contribution of labour and capital to the production activities.

Table 3.14: Growth of Household Income Corresponding to Rs 10000 Crore Increase in Investment in Construction (%)

Household Categories	Percentage Change in Income
Rural - Self Employed in Non-Agriculture	0.73
Rural - Agricultural Labourers	0.84
Rural - Other Labourers	0.87
Rural - Self Employed in Agriculture	0.71
Rural – Others	0.57
Urban - Self Employed	0.69
Urban – Regular	0.87
Urban - Casual Labourers	0.80
Urban – Others	0.58
Total Household Income	0.76

All household categories would augment their income. Aggregate private income would grow by 0.76 per cent (Table 3.14). Urban regular workers would experience the highest increases followed by casual labourers. This is due to direct and indirect impact of increased construction activities, which would increase demand for other goods and services required for construction. Similarly, urban self-employed are also expected to experience an increase in their incomes. Households in rural areas too would experience a rise in their incomes. The highest increase would be for rural other labourers. Rural other-labour households will be the labour-supplying households and they will experience a larger gain in their household incomes.

Agricultural labourers are generally under employed and they too have an opportunity to engage themselves in production activities during the lean season. The impact on the income of other rural household categories would be through the increased demand for goods and services required by the construction sector. SAM is a general equilibrium analysis, however, it has a strong assumption that there is no capacity constraints which means that there is excess capacity.

Long-term Impact of the ILR Programme

The long-term impact of the ILR Programme would be in the form of increased irrigation, hydro electric power generation, mitigation of drought and floods to a certain extent, reservoirs and dams could be an income source from fishing and amusement parks.

However, the economic impacts of benefits other than increased irrigation and hydro electricity generation are difficult to quantify. So the long-term impact of link canals are analysed by taking into account increased irrigation and hydro electricity generation only. The cost and benefit rollout plans discussed earlier are used in evaluating long-term impact of link canals.

The long-term impact of link canals is evaluated with the help of a macro econometric model. The economy is divided in the following six production sectors:

- Agriculture and allied activities,
- Mining and quarrying, and manufacturing,
- Construction,
- Electricity, gas and water supply,
- Transport, storage and communication, and
- Services

Production functions for different sectors are estimated separately. The agriculture sector is further sub-divided into four different crops, viz. rice, wheat, other crops (coarse cereals and pulses) and non-foodgrain. The acreage and productivity of these four crops has been estimated separately. The acreage under a crop responds to the irrigated area under a crop, profitability of a crop vis-à-vis competing crops and rainfall. The productivity of a crop depends on rainfall, irrigation intensity and the input-output price ratio.

The model has following eight different blocks:

- Agriculture production block,
- Non-agriculture production block,
- National income block,
- Fiscal block,
- Monetary block,
- Price block,

- Private investment and expenditure block, and
- Trade block

These eight blocks interact within themselves as well as between themselves so that the impact on any policy change is felt on the entire economy.

For example, in the initial period of the ILR programme the major economic activity will be in the construction sector (non-agriculture production block) as a result of which GDP from the construction sector would increase. This will have a direct impact on national income and the fiscal blocks. Increased GDP from the construction sector will have positive impact on demand for goods and services and the entire economy will get an upward push because of this increased investment. However, increased public investment in the construction sector could increase the fiscal deficit of the central government and this will have a negative impact on growth.

The model is estimated using the data set for 1970-71 to 2000-01 for most variables. However for some of the variables such as the real and nominal effective exchange rate of the rupee data is not available for 1970-71 to 1974-75. So estimation is done using data for 1975-76 to 2000-01. The estimated equations are tested for sign and significance levels. Tracking of the economy for 1975-76 to 2000-01 was done before making use of the model for further analysis.

Baseline Growth Scenario

The estimated model is used to forecast the growth trajectory for 2004-05 to 2018-19. The key assumptions are:

- Rainfall is assumed to be normal (average of 50 years rainfall, 1901 to 1950) for 205-06 to 2018-19 period.
- Procurement price of rice and wheat is assumed to grow by 5 per cent per annum.
- Bank Rate is assumed to decline by 0.2 percentage point every year.
- Central government capital expenditure is assumed to grow at 15 per cent per annum.
- Depreciation of capital stock is taken as average depreciation rate of last five years.
- Direct tax rate of central government is assume to increase by 0.05 per cent per annum.
- Employment in the central government is assumed to decline by 0.002 lakh per annum and by 0.01 lakh in central and state government.
- Sectoral government investment would grow by average growth of last five years.

- Government revenue expenditure excluding wage bill, interest payment, subsidies would grow by 14.31 per cent per annum.
- Indirect tax rate would decline by 0.1 per cent per annum.
- The nominal effective exchange rate of rupee would appreciate by 1.15 per cent in 2004-05 and would depreciate by 2 per cent per annum thereafter.
- Estimates of population projected by registrar general and census commissioner are used.
- Recoveries of loans is assumed to be Rs 16,403 crore per annum.
- World income is assumed to grow at 4 per cent per annum.
- Central and total subsidies are assumed to grow at 8 per cent per annum.
- Energy prices are assumed to grow by 6.18 per cent per annum.
- Agricultural input prices are assumed to grow at 8.33 per cent per annum.
- London inter bank offer rate (LIBOR) is assumed to declined by 5 per cent of previous years value every year.
- Net invisible receipts are expected to grow at 28 per cent per annum.

The growth scenario and forecast in the baseline scenario for 2004-05 to 2018-19 is presented in Table 3.15.

Table 3.15: Growth of Macro Variables during 2004-05 to 2018-19 and 2006-07 and 2018-19 in Baseline Scenario (%)

Variables	Average 2004-05 to 2018-19	Average 2006-07 to 2018-19
Real GDP from Agriculture	2.26	2.27
Real GDP from Mining and Manufacturing	9.07	9.35
Real GDP from Electricity, Gas and Water Supply	8.86	9.09
Real GDP from Construction	8.46	8.64
Real GDP from Transport, Storage and Communication	10.69	11.04
Real GDP from Services	12.02	12.52
Real GDP at Factor Cost	9.71	10.13
Fiscal Deficit of Central Government *	3.68	3.53
WPI of Foodgrains	4.83	4.94
WPI of Non-foodgrains	5.13	5.08
WPI of Agricultural Commodities	5.06	5.05
WPI Manufactured Products	3.90	3.86
WPI all Commodities	4.68	4.67
CPI (Agricultural Labourers)	4.20	4.17
CPI (Industrial Workers)	5.12	5.10
Production of Foodgrains	2.47	2.46
Production of Non-foodgrains	2.04	1.98
Exports (Rupee term)	12.75	12.72
Imports (Rupee term)	19.72	20.34

* Percentage of GDPMP at current prices

The second column of Table 3.15 represents the average growth during the entire forecasting period of 2004-05 to 2018-19. As discussed in the investment rollout plan, the construction of these canals, dams/reservoirs could at best start from 2006-07[17]. In order to have a comparison of the growth trajectory of the key macro variables before and after the ILR programme, the third column represents the average growth during 2006-07 to 2018-19. It is expected that the economy would register an average growth of 9.71 per cent per annum during 2004-05 to 2018-19. Services, infrastructure (electricity, gas and water supply, transport, storage and communication) and manufacturing would be the major growth drivers. Average growth of GDP from agriculture is expected to decline to 2.26 per cent. This is consistent with the pattern of declining growth of agricultural GDP, average growth of agricultural GDP declined from 4.4 per cent in the eighties to 3.0 per cent in the nineties. The average fiscal deficit of the central government is expected to be around 3.68 per cent of GDPMP. The average growth of whole sale prices is expected to be 4.68 per cent, portraying a picture of high growth and low inflation regime. Foodgrain production is expected to grow on average by 2.47 per cent per annum and non-foodgrain by 2.04 per cent. Both exports and imports are expected to grow. But higher growth could result in higher average import growth, 7 per cent higher than the average export growth.

Baseline Income Distribution and Poverty Profile

This section focuses on the likely income distribution and poverty profile of the country in 2018-19 on the basis on baseline growth scenario presented in earlier section. The income distribution and poverty profile presented here is different from the usual income distribution by deciles or percentiles of population and is presented by household occupation category.

A household generates income by offering its labour and capital (including land) in the factor markets. The return to its labour and capital vary across sectors. Hence the first task in estimating income distribution is to distribute value-added generated in the economy by factors of production (labour and capital) in each production sector. The NAS provide data on value-added by production sectors. However, the distribution of sectoral gross value added (GVA) in the wage and non-wage income is not directly available.

[17] The commencement year for the ILR project was chosen in consultation with the officials of the TFILR. The project has not commenced in 2006-07 and may not have made significant progress in 2007-08 either. However, the model results provide a comparison of the economic scenario with and without the project over a period of time. While any significant structural changes in policies and the economy would lead to changes in the results, a mere change in the starting year would not have significant implications. It would not be possible to re-estimate all the parameters because of changes in the starting year of the project, on ex-ante basis and may also not be required as indicated earlier, unless we are envisaging any structural changes in the economy.

GVA can be divided into two parts, namely, net value added (NVA) and depreciation. Sectoral distribution of NVA is available in the form of compensation to employees (CE) and operating surplus/mixed income (OS/MI) for both the organised as well as the unorganised sectors of the economy. The CE takes into account wages paid to the hired workers and does not include the imputed value of family labour used in self-employment. The OS includes rent, profit and interest etc for organised sector, which is entirely non-wage income.

However, in the unorganised sector, OS and family labour income in self-employment put together is called MI. In order to have non-wage income from the unorganised sector, the imputed value of family labour involved in the unorganised sectors has to be deducted from MI. Depreciation is assumed to be a non-wage income. The CE of organised and unorganised sector put together, along with the family labour component of the unorganised sector, gives wage income.

The sum of OS of the organised sector, which is the difference between MI and imputed value of family labour in the unorganised sector and depreciation of both organised and unorganised sectors, gives non-wage income. In this study we have used the methodology as described in Pradhan, Sahoo and Saluja (1999)[18] to distribute GVA into wage and non-wage components.

Distribution of Household Income by Sources of Income

The data on household income by economic activities is very rare in India. The National Sample Survey Organisation through its consumer expenditure surveys compiles information only on consumer expenditure by different economic activities for some years and the latest available data pertains to the year 1993-94. So household income data for 1994-95 generated from Micro Impact of Macro Adjustment Policies in India survey (MIMAP-INDIA survey) conducted by the National Council of Applied Economic Research is used in the study[19].

As mentioned earlier, a household generates income by offering its labour and capital (including land) in the factor markets. Labour and capital are used in different production sectors and the household generates income from different occupational sources. Source from where household generates maximum income is defined as the occupation of the household. All households in rural and urban areas are divided into 12 categories (6 each in rural and in urban areas). These categories are as follows:

- Self employed in agriculture,

[18] Pradhan, B. K., Amarendra Sahoo and M.R. Saluja (1999), "A Social Accounting Matrix for India, 1994-95", *Economic and Political Weekly*, Vol. XXXIV, No. 48, pp. 3378-94, November.
[19] Pradhan, B. K. and P.K. Roy (2003), The Well Being of Indian Households, MIMAP-India Survey Report, NCAER and Tata McGraw Hill, 2003.

- Self employed in non-agriculture,
- Salary earners,
- Agriculture wage earners,
- Non-agriculture wage earners, and
- Others

Income distribution during 1994-95 to 2018-19 is obtained by using forecasted values of GDP, base level sectoral distribution of value added into wage (including imputed value of family labour), non-wage and depreciation and the base level distribution of household income by the source of income. Forecasted GDP is distributed among 12 household categories. Sectoral value added is first divided into three components viz., wage, non-wage and depreciation for all the six sectors. The wage income part of the value-added represents compensation to employees (including family labour), whereas non-wage income and depreciation put together represents the operating surplus and goes to the owners of capital. The wage income of the agriculture sector is distributed across 12 household categories according to their share in total of agriculture wages and family labour employed in self employment in agriculture put together. The non-wage income and the depreciation in the agriculture sector are distributed among household categories according to their share in self-employment in agriculture (capital).

One of the drawbacks of our exercise is that non-agricultural income is distributed across households in totality. From the survey data it is not possible to differentiate the sector of origin of non-agricultural income. As a result, growth rates of the different non-agriculture sectors have the same impact on income distribution, whereas in reality this may not be true.

Wage and non-wage income, along with the depreciation components of all non-agriculture sectors are added together to get the wage and non-wage income from non-agriculture sectors as a whole. The wage income of the non-agriculture sectors is distributed across the household categories according to their share in family labour income from self-employment in non-agriculture, salaries, non-agriculture wages and family labour income from other sources put together.

There is one more limitation of the study, as salary incomes are assumed to be from the non-agriculture sector only. Similarly, non-wage income from the non-agriculture sector is distributed across households according to their share in self-employment in non-agriculture (capital) and other sources (capital) put together.

Impact of Growth & Inequality on Poverty

Suppose θ is a poverty index which is a function of three factors: 1) the poverty line, Z, 2) mean per capita income, μ, and 3) inequality of income. Income inequality is more

$$dq = \frac{\partial q}{\partial m} dm + \sum_{i=1}^{K} \frac{\partial q}{\partial m_i} d m_i \quad --- \quad (I)$$

generally represented by a Lorenz curve. Any shift in the Lorenz curve will change the inequality. Suppose a Lorenz curve is characterised by k parameters m_1, m_2, - - -, m_k, then shifts in the Lorenz curve will occur as a result of changes in any of these parameters. If we assume that the poverty line Z is fixed, then

which decomposes the change in poverty into: 1) the impact of growth when the distribution of income does not change, and 2) the effect of income distribution when the total income of the society remains unchanged. The first component in the right hand side of (I) may be called the 'pure growth effect' and the second component as the 'inequality effect'.

In this study we have used the FGT class of poverty measures, proposed by Foster, Greer and Thorbecke (1984)[20]. The advantage of using the FGT class of poverty measures is that these measures are additively decomposable, i.e., if population is divided into k mutually exclusive population groups, then the poverty measure for the total population can be written as a weighted average of the population group poverty measures with the population share as weight.

Population Group-wise Income Growth and Poverty

As mentioned earlier, the FGT class of poverty measure is used in the study. These are additively decomposable. Let the entire population be divided into m groups. A poverty measure θ is then said to be additively decomposable if

$$q = \sum_{i=1}^{m} f_i q_i \quad --- \quad (II)$$

1

where θ_i is the poverty measure of the i^{th} subgroup and f_i the proportion of the population of the i^{th} subgroup such that $f_1 + f_2 + - - - + f_m = 1$.

When growth takes place, it has an effect on income inequality within various groups. Then proportionate change in poverty in the i^{th} group can be written as:

$$\frac{d q_i}{q_i} = h_{q_i} \frac{d m_i}{m_i} + e_{q_i} \frac{dG_i}{G_i} \quad --- \quad (III)$$

where, G_i is the inequality parameter and $\varepsilon_{\theta i}$ is the elasticity of the inequality parameter w.r.t. the mean income for the i^{th} sub-group. The first term on the right hand side gives the growth effect and the second term gives the inequality effect due to the income

[20] Foster, J. E., J. Greer and E. Thorbecke (1985), "A Class of Decomposable Poverty Measures", *Econometrica*, Vol. 52, May 1984, pp. 761-66.

growth of the population group i on its poverty. The population group wise poverty changes can be aggregated to the total poverty using equation II.

To estimate poverty for the future, one should either use different poverty lines for different years or use a base year poverty line and convert income into base year prices. In this study, we have decided to use the base year (1994-95) poverty line for the period 1994-95 to 2018-19 and the income is converted into the 1994-95 prices using CPIAL and CPIIW as deflators for rural and urban income respectively. It is discussed earlier that the change in poverty can be decomposed into change in growth and change in inequality. However, due to data constraints at the household group level, it is assumed that growth takes place without changing the distribution of income, i.e., the second term on the right hand side of the equation I is zero. Implicitly, at the rural, urban and all India level, partly, the change in distribution is taken into account. That is, the intra-household group inequality is unaffected while the inter-household group inequality keeps changing. This assumption is common in this kind of work. The per capita income by the household category at 1994-95 prices at three points of times is presented in Table 3.16. All households will experience an increase in their per capita income, however, the increase for agriculture dependent households is much lower as compared to non-agriculture dependent households. It is expected that on the average, per capita income for rural areas would grow by 8.44 per cent during the period 2004-05 to 2018-19, and the same for urban areas would grow by 8.21 per cent. In rural areas, agricultural dependent households would experience a growth of around 5.3 per cent as compared to a growth of 10.2 to 10.7 per cent for non-agricultural dependent households. In urban areas, agriculture dependent households would experience a growth in per capita income of the order of 4.5 per cent and non-agriculture dependent households would experience a growth of 8.0 to 8.4 per cent in their per capita income.

Table 3.16: Per Capita Income by Household Category at 1994-95 Prices in Baseline Scenario (Rs)

Household Category	**2004-05**	**2006-07**	**2018-19**
Rural			
Self Employed in Agriculture	11033	11426	22893
Self Employed in Non-agriculture	26185	28222	105558
Salaried Earners	16275	17589	67428
Agriculture Wage Earners	6575	6807	13493
Non-agriculture Wage Earners	8563	9259	35522
Other Households	25454	27296	98731
Rural (Total)	11880	12569	36958
Urban			
Self Employed in Agriculture	13715	14135	25360
Self Employed in Non-agriculture	32288	34092	96312
Salaried Earners	24511	25933	75476
Agriculture Wage Earners	5088	5219	9452
Non-agriculture Wage Earners	9455	10010	28997

Other Households	50245	52913	148424
Agriculturist (Self Employed + Wage Earners)	8477	8711	15702
Urban (Total)	25348	26783	76506

Among urban areas, small proportions of households are dependent on agriculture. While estimating poverty among urban areas, self-employed in agriculture and agricultural wage earners are combined in one category as agriculturist. The household category-wise poverty estimate for the baseline scenario is done using equation I and is presented in Table 3.17. Household category-wise poverty estimates are aggregated to rural and urban areas and then to all India with using equation II. It is expected that the growth profile presented earlier could help in reducing incidence of poverty considerably both in rural as well as urban areas. Higher growth of non-agricultural sector vis-à-vis agricultural sector would lead to a faster decline of poverty in urban areas as compared to rural areas. It is expected that the incidence of poverty in rural areas could decline to 13.57 per cent and in urban areas it could decline to 9.48 per cent. Overall incidence of poverty could decline to 12.15 per cent. However, the incidence of poverty for households belonging to agricultural wage earners in rural areas, agriculturists and non-agricultural wage earners in urban areas is expected to be large as compared to others. These result calls for government attention for specific programmes focused mainly on these vulnerable groups so that these groups could be brought in line with the other occupation groups in the development ladder.

Table 3.17: Household Category-wise Poverty Estimates in Baseline Scenario (%)

Household Category	2004-05	2006-07	2018-19
Rural			
Self Employed in Agriculture	20.38	18.35	6.93
Self Employed in Non-agriculture	9.86	9.59	7.55
Salaried Earners	7.75	7.33	4.61
Agriculture Wage Earners	37.15	36.21	28.61
Non-agriculture Wage Earners	21.93	20.00	9.36
Other Households	9.43	8.65	4.08
Rural (Total)	**22.73**	**21.46**	**13.57**
Urban			
Agriculturist (Self Employed + Wage Earners)	66.76	63.19	33.30
Self Employed in Non-agriculture	26.88	24.44	10.20
Salaried Earners	10.32	9.88	6.71
Non-agriculture Wage Earners	36.99	33.76	14.75
Other Households	12.39	11.25	4.52
Urban (Total)	**19.85**	**18.44**	**9.48**
All India			
All India (Rural + Urban)	**21.86**	**20.53**	**12.15**

Long-term Impact of ILR Programme with MSTG and JTF Link

The investment and benefit rollout plans discussed earlier are used to generate two different scenarios for the ILR programme. The costs of both the alternatives are nearly the same and the benefits in terms of the increased irrigated area are also similar. However, the power benefits corresponding to both scenarios differ substantially due to higher power requirement in the JTF link. The growth scenarios of the ILR programme corresponding to MSTG and JTF links are presented in table 3.18.

Table 3.18: Comparative Growth Scenario (Average Growth during 2006-07 to 2018-19, %)

Variables	Baseline Scenario	ILR Programme with MSTG Link	ILR Programme with JTF Link
Real GDP from Agriculture	2.27	3.92	3.91
Real GDP from Mining and Manufacturing	9.35	9.86	9.86
Real GDP from Electricity, Gas and Water Supply	9.09	9.27	9.24
Real GDP from Construction	8.64	9.67	9.66
Real GDP from Transport, Storage and Communication	11.04	11.19	11.19
Real GDP from Services	12.52	12.69	12.69
Real GDP at Factor Cost	10.13	10.50	10.50
Fiscal Deficit of Central Government *	3.53	3.95	3.95
WPI of Foodgrains	4.94	4.61	4.61
WPI of Non-foodgrains	5.08	4.68	4.67
WPI of Agricultural Commodities	5.05	4.66	4.66
WPI Manufactured Products	3.86	3.66	3.66
WPI all Commodities	4.67	4.47	4.47
CPI (Agricultural Labourers)	4.17	3.89	3.89
CPI (Industrial Workers)	5.10	4.82	4.81
Production of Foodgrains	2.46	4.53	4.52
Production of Non-foodgrains	1.98	4.17	4.17
Exports (Rupee term)	12.72	12.53	12.53
Imports (Rupee term)	20.34	20.70	20.70

* Percentage of GDPMP at current prices

The economic impact under the two scenarios does not vary much. Increased irrigation by the ILR programme could result in an increase in the average growth of the real GDP from agriculture by 1.65 percentage points over the baseline scenario with the MSTG link (1.64 percentage points higher growth with the JTF link). Differential power benefits from the two options result in a differential incremental growth of the electricity, gas and water supply sectors. The real GDP from the electricity, gas and water supply is expected to grow by an additional 0.18 percentage points over the baseline scenario with the MSTG link (0.15 percentage points higher growth with the JTF link). The average additional growth of the construction sector is estimated to be 1.03 percentage points with the MSTG link and 1.02 percentage points with the JTF link. The average additional growth of mining and manufacturing sector is expected to be 0.51 percentage points. The impact of this growth on overall growth would be an average additional growth of 0.37 percentage points over the baseline scenario.

Food grain production is expected to grow by an additional 2-percentage point over the baseline scenario (average growth of 4.5 per cent as against 2.5 per cent in baseline scenario). Foodgrain production is expected to be 305.66 million tonnes in the baseline scenario (without ILR programme). However, due to additional 2-percentage point growth in foodgrain production, foodgrain production is expected to touch 393.88 million tonnes mark with MSTG link and 393.70 million tonnes mark with JTF link (Figure 3.6 and Table 3.19). However, impact of ILR programme on agriculture sector would be felt only from the year 2008-09, when benefit in the form of increased irrigation would start. Average foodgrain production growth in baseline scenario during 2008-09 to 2018-19 is expected to be 2.43 per cent, it is expected to be 4.87 per cent for ILR programme with MSTG link and 4.86 per cent for ILR programme with JTF link. In other words, foodgrain production growth during 2008-09 to 2018-19 with ILR programme is expected to be double than that of baseline scenario.

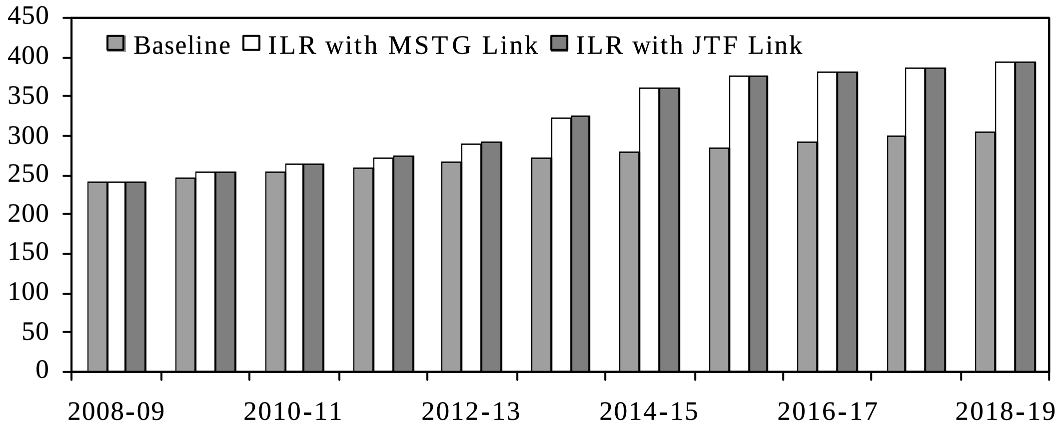
Table 3.19: Foodgrain Production (Million Tonnes)

Year	Baseline	ILR with MSTG Link	ILR with JTF Link
2006-07	228.66	228.66	228.66
2007-08	234.72	234.72	234.72
2008-09	240.90	242.98	242.98
2009-10	247.13	254.00	254.00
2010-11	253.43	263.78	263.78
2011-12	259.77	273.51	274.88
2012-13	266.17	289.81	292.57
2013-14	272.62	323.59	324.80
2014-15	279.12	360.54	360.21
2015-16	285.68	376.21	375.95
2016-17	292.29	381.47	381.25
2017-18	298.95	387.49	387.29
2018-19	305.66	393.88	393.70
Average Growth (2006-07 to 2018-19)	2.46	4.53	4.52
Average Growth (2008-09 to 2018-19)	2.43	4.87	4.86

Source: Computed

All prices are expected to fall, the average decline in price ranging from 0.2 percentage points to 0.4 percentage points as compared to the baseline scenario. The average export growth is expected to decline marginally due to higher domestic demand, however, higher domestic activity could lead to higher import demand.

Figure 3.6: Foodgrain Production (Million Tonnes)



The gains in terms of acceleration in the overall growth of GDP are estimated to be about 0.4 percentage point per year with contributions mainly from agriculture, manufacturing, construction and power sectors. It should be noted that these gains are obtained each year. In other words, the cumulative impact of the proposed ILR project estimated to be more than 5 per cent of GDP over the 13 year period. The gains will clearly continue into the future.

Impact of the ILR Programme on Income Distribution and Poverty

The ILR programme will have a major impact on the rural area in the general and agriculture dependent households in particular. The rural household per capita income is expected to increase by 7.49 per cent with the MSTG link and by 7.47 per cent with the JTF link as compared to the baseline growth scenario (Table 3.20).

Table 3.20: Comparative Household Per Capita Income in 2018-19 at 1994-95 Prices (Rs)

Household Category	Baseline Scenario	ILR programme with MSTG Link	ILR programme with JTF Link
Rural			
Self Employed in Agriculture	22893	25873	25867
Self Employed in Non-agriculture	105558	110710	110694
Salaried Earners	67428	70691	70685
Agriculture Wage Earners	13493	15273	15269
Non-agriculture Wage Earners	35522	37231	37228
Other Households	98731	103777	103759
Total	36958	39726	39719
Urban			
Self Employed in Agriculture	25360	27835	27830
Self Employed in Non-agriculture	96312	100778	100767
Salaried Earners	75476	78905	78901
Agriculture Wage Earners	9452	10376	10375
Non-agriculture Wage Earners	28997	30326	30324
Other Households	148424	155345	155326
Agriculturist (Self Employed + Labour)	15702	17235	17232
Total (Urban)	76506	80050	80043

Per capita household income of agricultural dependent households in rural area is expected to go up by 13.0 to 13.2 per cent in both the scenarios. For Non-agriculture dependent households in rural areas, per capita household income is expected to go up by 4.8 per cent to 5.1 per cent as compared to the baseline scenario. Among urban areas too, agriculture dependent households are expected to benefit more as compared to non-agriculture dependent households, their per capita household income is expected to go up by 9.8 per cent as compared to the baseline scenario. For Non-agriculture dependent households in urban areas, per capita household income is expected to go up by around 4.5 per cent as compared to the baseline scenario.

The higher increase in household per capita income of agriculture-dependent households compared to non-agriculture dependent households would reduce their poverty level faster. The expected higher growth of household per capita income in rural areas compared to urban areas would reduce rural poverty at faster pace compared to urban areas. Households in urban areas and non-agriculture dependent households would benefit mainly because of decline in the price level, which would increase their purchasing power and real incomes even if their income level does not go up substantially. It is expected that the incidence of rural poverty would decline to 12.7 per cent in both the scenarios as compared to base level incidence of poverty of 13.6 per cent (Table 3.21). The incidence of rural poverty is expected to be lower by around 0.9 percentage points and urban poverty is expected to be lower by 0.4 percentage point compared to baseline scenario.

Table 3.21: Comparative Households Category Wise Poverty Estimates (2018-19, %)

Household Category	Baseline Scenario	ILR programme with MSTG Link	ILR programme with JTF Link
Rural			
Self Employed in Agriculture	6.93	5.69	5.69
Self Employed in Non-agriculture	7.55	7.48	7.48
Salaried Earners	4.61	4.53	4.53
Agriculture Wage Earners	28.61	27.29	27.29
Non-agriculture Wage Earners	9.36	9.09	9.09
Other Households	4.08	3.95	3.95
Rural (Total)	**13.57**	**12.69**	**12.70**
Urban			
Agriculturist (Labour + Self Employed)	33.30	29.83	29.84
Self Employed in Non-agriculture	10.20	9.79	9.79
Salaried Earners	6.71	6.60	6.60
Non-agriculture Wage Earners	14.75	14.20	14.20
Other Households	4.52	4.33	4.33
Urban (Total)	**9.48**	**9.10**	**9.10**
All India			
All India (Rural + Urban)	**12.15**	**11.45**	**11.45**

It is expected that the ILR programme has the potential to reduce the incidence of poverty of the self-employed in agriculture and agricultural labourer households by around 1.3 percentage point in 2018-19 as compared to baseline incidence of poverty. In urban areas, the incidence of poverty of agriculturist is expected to decline by 3.5 percentage points as compared to baseline incidence of poverty. The decline in incidence of poverty as compared to baseline incidence of poverty for other category of households would be in the range of 0.1 to 0.6 percentage points.

The poverty reduction impact of the ILR project is significant in specific segments of the society. The project, while creating additional output and employment, leads to decline in poverty. Although the estimated decline in terms of head count ratios may seem to be relatively small, we must note that it is a sustained reduction in poverty as the output gains are of long-term nature. Moreover, the poverty reduction through higher agricultural production can take place only where the links provide additional irrigation and power. However, it is also important to recognise that the impact on annual foodgrain production by about 90 million tonnes by 2018-19 is a significant gain that will help in stronger poverty alleviation measures throughout the country.

A Summing Up

A program as complex as ILR raises many concerns even when its benefits are large. It is necessary to take into account both the benefits and concerns in order to maximise the positive impact of the program. In this section we highlight some of the key concerns and benefits of the program that have been discussed in greater detail earlier.

The direct impact of ILR project has been estimated as (a) increasing the potential to irrigate 30 million hectares, (b) net generation of hydro electricity to the tune of 24,800 MW with MSTG and 19,570 with JTF, and (c) 12000 million cubic meters of drinking water. On the other hand, the investment requirement for carrying out the project (given in Table 3.6) is estimated as Rs. 444331.2 crore (Rs. 434657.13 crore with JTF). This investment will be rolled out over a period of ten years.

The benefits of ILR project indicated above can be converted into monetary terms using the norms used in the preparation of feasibility reports of various constituent link projects. However, these would be only illustrative since the norms would be based on only average conditions. Again for illustrative purposes using the norms from the feasibility report prepared for linking Godavari and Krishna rivers between Inchampalli and Pulichintala we can estimate the benefits.

The Annual irrigation benefits that arise due to ILR are estimated as Rs. 17,482 per hectare of command area. The power generated is valued at Rs. 1.67 per unit as it is the existing average rate in Andhra Pradesh. Similarly, drinking water is Rs. 2,01,78,692 per million cubic meters, at the water tariffs prevailing in Hyderabad City. The following table contains the annual benefits for ILR Project, once completed.

Table 3.22
Estimated Value of Annual Benefits of ILR Project

Benefit	Quantity	Rate	Value of benefit (Rs. crore)
Irrigation	30 million hectares	Rs.17,482 per hectare	52,446
Power	24800 MW	Rs. 1.67 per unit	414
Drinking water	12 billion cubic meters	Rs. 2.02 crore per million cubic meter	24,214
Total			77,075

Note: these benefits are estimated using MSTG link. The calculation using JTF link works out to be Rs. 76,990 crore in 2003 prices.

The above mentioned benefits of irrigation hinge on the availability of suitable seeds and its varietals to different states. As Ramaswami (2002) noted, India has invested considerable resources in public sector agricultural research. Besides this, because of new technologies and stronger intellectual property rights protection, the seed industry has also transformed. The private sector has grown to be a sizeable presence in the case of many crops. National Seeds Policy announced in 2002 envisages generation and diffusion of new yield improving technologies. The import and export of seeds has also been liberalised. These factors have expanded the capacity of the agricultural system to meet the increased demand for quality seeds emerging from increased irrigation potential from the ILR program.

However, it will be necessary to monitor the supply systems and take necessary steps so that there will not be shortages of inputs such as quality seeds so that the potential for agricultural production created by the ILR program is not under-utilised.

Similar to the unobservable benefits of ILR project, there are apprehensions about the sustainability of gains of ILR project. For example, it has been felt that the presence of increased soil degradation, wide spread deficiency of organic carbon, major, secondary and micronutrients, a growth of 4.87 percent may not be possible merely by enhancing the coverage under irrigation. It is true that mono-cropping of rice has caused degradation of the paddy microenvironment and reductions in rice yield growth in many irrigated areas in Asia. Problems include, 1) build up of salinity and water-logging; 2) micro-nutrient deficiencies and increased incidence of soil toxicities; 3) formation of a hardpan (subsoil compaction); 4) decline in soil nitrogen supplying capacity; and 5) increased pest build up and pest related yield losses. However, by using inputs more efficiently coupled with adoption of good farm management practices, such as better fertilizer management and integrated pest management productivity effects of irrigation can be sustained. The seminal study conducted by Prabhu and Rosegrant (1994) had discussed this issue in 1994 itself.

The outcomes of implementing ILR project have greater policy implications. Generation of new irrigation facilities will lead to rapid growth in wheat and rice production. This in turn will result in substantial increases in the marketable surplus of wheat and rice. This will contribute to food security and may also induce decline in real price of grains. The fall in rice and wheat prices benefits the poor but does imply the need for sensitive policies to ensure that the producers are able to make adjustments in their strategies so that their own income in not reduced. In a related study, IFPRI, in collaboration with IARI projected cereal supply, demand, and net trade in India for year 2020. It was found that by year 2020, in the absence of creation of new irrigation facilities, India will face a shortfall of 23 million metric tonnes of cereals. This shortfall is to be met with imports. In that fashion, ILR project has benefits that can reduce the dependence on imports for meeting foodgrain requirement (Table 3.23).

Table 3.23
Projected Cereal Supply, Demand, and Net Trade in India in 2020

(million metric tons)

	Supply	Demand	Net Exports
Rice	120.5	124.5	-4.0
Wheat	107.6	111.0	-3.4
Coarse grains	42.3	57.9	-15.6
Total cereals	270.4	293.4	-23.0

Source: Kumar, P. et. al. (1995)

Irrigation, power and drinking water are the direct and readily quantifiable benefits of river valley projects like ILR. Benefits that come in the form of prevention of floods and droughts, additional resource generated from fishing and amusement purposes of dams and canals built for this purpose can't be easily quantified at this juncture.

Besides the above benefits, there are other benefits that are of both short-term and long-term nature, of investments in ILR project. The short-term benefits are primarily in the form impact generated by investment taking place in construction of ILR network. These benefits are indirect and arise due to backward and forward linkages of the construction sector.

Employment generation and enhanced income of households are the major long-term impact of ILR project. The Study estimated that rural and urban average household per capita incomes would increase by about 7.5 percent and 4.6 percent respectively, over and above the growth that would take place in the absence of ILR project. (Table 3.20). If we distinguish between agriculture and non- agriculture households, in rural areas the additional growth in income of agriculture dependent households would be in the range of 13 to 13.2 percent. The corresponding figure for non-agriculture dependent households ranges from 4.8 to 5.1 percent. In urban areas, income of agriculture dependent households would additionally increase by 9.8 percent, while it is 4.5 percent for non-agriculture based households. Table 3.21 contains figures related to poverty reduction in urban and rural areas. It has also been noted that the additional growth in the foodgrain production resulting from the ILR programme may lead to a decline in their relative prices which would help in strengthening food consumption by the poor.

One the other hand, as for cost of ILR project, the realistic calculation of annual recurring cost of capital investments (operating and maintenance expenditure + depreciation + interest payment on debt + return on equity) requires the actual composition of assets and the maintenance required for it[21].

Specific data on recurring expenses for the ILR are not available. However, for illustration one can use the broad relation between annual recurring expenditure and capital costs derived from the feasibility report of Inchampalli and Pulichintala Link.

The feasibility report of Inchampalli and Pulichintala link project observed the annual recurring expenditure of project as Rs. 646.57 crore, while the total capital cost was estimated as Rs. 5,04,608 crore. Thus, the annual recurring cost works out as 12.8 percent of capital cost. The total investment required for ILR project was estimated as Rs. 4,44,331 crore with MSTG link and Rs. 434657.13 crore with JTF link. (Table 3.6). The annual recurring expenditure on this capital investment, as observed from the feasibility report of Inchampalli and Pulichintala project 12.8 percent, is therefore arrived at as Rs. 56,934 crore and Rs. 55,694 crore with MSTG and JTF link respectively. Thus, the benefits from the project are in excess of the cost incurred.

[21] The study also assumes that all the costs are borne by the Central Government and the impact on state government finances has not been captured.

These calculations are illustrative but indicate that the benefits from the ILR program are significant.

One shortcoming of the above analysis is that it has not considered the issue of cost of resettlement of displaced people due to ILR Project. A draft National Rehabilitation Policy was prepared with the objective of minimizing development induced displacement of people by promoting non-displacing or least displacing alternatives for meeting development objectives. The draft policy is yet to be finalised by the National Advisory Council (NAC). The NAC intends to finalise a rehabilitation package that includes, inter alia, providing land for all agricultural families, implementing special employment guarantee programmes, providing homesteads and dwelling houses, bearing transportation cost, providing training and other support services, instituting a rehabilitation grant in order to compensate loss of income/livelihood. The ILR project has to consider displacement costs on the basis of norms stipulated in the National Rehabilitation Policy as and when it gets finalised.

Chapter 4

Issues Related to Cost Recovery from Irrigation

Introduction

India has made significant progress in agricultural production through the Green Revolution started in the mid-sixties. Adoption of high yielding varieties and certified quality seeds yielded good results; from being a foodgrain importer, India has now become a foodgrain exporter. One of the crucial inputs for this transformation is the availability of irrigation. Although irrigation intensity has increased from 17.11 per cent in 1950-51 to 39.22 per cent in 1998-99, Indian agriculture is still dependent on the monsoon. Over the years, the Government of India has made huge investments in the creation of irrigation-related infrastructure in the form of dams, canals, *et al.* However, cost recovery in irrigation remains poor with capital investment appearing to be a sunk cost (Gulati, Svendsen, Choudhury 1994a).

Performance of cost recovery in irrigation

Across states, the gross receipts by way of water charges per hectare account for less than 3 per cent of the gross productivity per hectare of irrigated area (Government of India, 1992). Recovery of working expenses through gross receipts of irrigation and multipurpose river valley projects declined from 93 per cent in 1976-77 to 34 per cent in 1986-87. The RR (recovery ratio—ratio of gross receipts to total working expenses) for India has declined steadily since the mid-1970s. The RR is seen to have fallen at an average rate of 3 per cent over 1960-61 to 1986-87 (Gulati, Svendsen, Choudhury 1994a). This despite the rise in gross receipts per hectare in major and medium irrigation schemes, and the rise in yields and prices of agricultural commodities. The decline in the RR has been due to the subsequent fall of gross receipts of irrigation departments (ibid).

If interest on capital outlays is included in working expenses, the recovery through gross receipts declines even further (Table 4.1). Recovery declined from 36.4 per cent in 1976-77 to 8.1 per cent in 1991-92. It increased to 13.2 per cent in 1993-94 before slipping to 6.3 per cent in 1998-99 (Government of India, 2002b). Figure 4.1 highlights the downward trend of cost recovery from 1976-77 to 1998-99.

Looking at the results for the states (Table 4.2), we find that from 1994-95 to 1998-99, overall percentage recovery of working expenses through gross receipts remains poor and has fallen. Only in the states of Bihar, Gujarat, Haryana, Kerala, and Orissa has there been an improvement. Andhra Pradesh had the poorest performance in cost recovery in 1998-99, followed by West Bengal and Maharashtra.

Table 4.1: Financial Results of Irrigation and Multipurpose River Valley Projects (All-India)

(Rs crore)

Year	Gross receipts	Working expenses, including interest on capital outlays	Profit/loss	Percentage recovery of WE through gross receipts
1976-77	104.7	287.7	-183.0	36.4
1977-78	96.9	342.7	-245.8	28.3
1978-79	108.1	410.7	-302.6	26.3
1979-80	100.7	432.8	-332.1	23.3
1980-81	103.4	527.2	-423.8	19.6
1981-82	120.2	680.9	-560.7	17.7
1982-83	117.1	1110.4	-993.3	10.5
1983-84	165.1	836.7	-671.6	19.7
1984-85	129.7	969.7	-840.0	13.4
1985-86	223.8	1168.6	-944.8	19.2
1986-87	166.7	1356.9	-1190.2	12.3
1987-88	138.7	1440.3	-1301.6	9.6
1988-89	166.4	2128.0	-1961.6	7.8
1989-90	207.6	2223.8	-2016.2	9.3
1990-91	228.9	2476.3	-2247.4	9.2
1991-92	227.3	2803.3	-2576.0	8.1
1992-93	320.2	3116.9	-2796.7	10.3
1993-94	477.4	3629.9	-3152.5	13.2
1994-95	445.1	4352.4	-3907.3	10.2
1995-96	498.2	4819.0	-4320.8	10.3
1996-97	458.4	5446.1	-4987.7	8.4
1997-98	363.3	6257.7	-5894.4	5.8
1998-99	455.8	7215.3	-6759.5	6.3

Source: Government of India (2002b)

Figure 4.1: Recovery of working expenses through gross receipts of irrigation and multipurpose river valley projects (All-India)

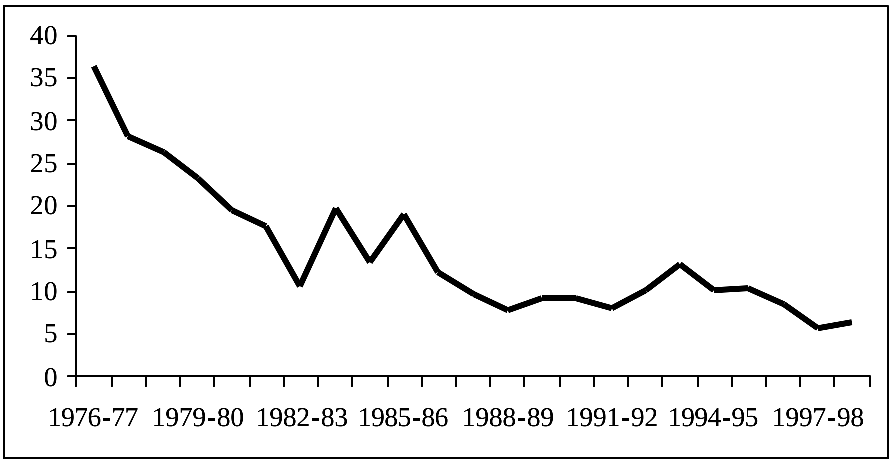


Table 4.2: State-wise Financial Results of Irrigation and Multipurpose River Valley Projects

(Rs crore)

State	Gross receipts		Working expenses, including interest on capital outlays		Profit/Loss		Percentage recovery of WE through gross receipts		Trend
	1994-95	1998-99	1994-95	1998-99	1994-95	1998-99	1994-95	1998-99	
Andhra Pradesh	103.80	5.10	613.80	1111.90	-510.00	-1106.80	16.91	0.46	Fall
Bihar	16.10	42.10	74.10	167.40	-58.00	-125.30	21.73	25.15	Improvement
Gujarat	42.60	132.10	577.30	1310.10	-534.70	-1178.00	7.38	10.08	Improvement
Haryana	19.20	61.10	440.40	260.80	-421.20	-199.70	4.36	23.43	Improvement
J&K	0.30	0.30	7.10	11.70	-6.80	-11.40	4.23	2.56	Fall
Karnataka	13.20	18.50	298.50	488.90	-285.30	-470.40	4.42	3.78	Fall
Kerala	1.80	6.70	33.00	42.30	-31.20	-35.60	5.45	15.84	Improvement
Madhya Pradesh	40.20	37.30	137.20	261.80	-97.00	-224.50	29.30	14.25	Fall
Maharashtra	71.00	33.70	883.30	1491.40	-812.30	-1457.70	8.04	2.26	Fall
Orissa	4.90	11.20	42.60	58.40	-37.70	-47.20	11.50	19.18	Improvement
Punjab	34.50	16.30	108.90	185.90	-74.40	-169.60	31.68	8.77	Fall
Rajasthan	21.10	23.40	297.20	532.00	-276.10	-508.60	7.10	4.40	Fall
Tamil Nadu	3.60	8.20	126.20	291.60	-122.60	-283.40	2.85	2.81	Slight Fall
Uttar Pradesh	65.50	49.10	556.90	703.70	-491.40	-654.60	11.76	6.98	Fall
West Bengal	3.00	2.90	76.50	140.80	-73.50	-137.90	3.92	2.06	Fall

Source: *Water and Related Statistics* (Government of India 2002b), p 268, Table 4.11

Why emphasise cost recovery?

An effective pricing mechanism can affect water use efficiency at both the individual and social levels. Raising prices is often met with concern on the likely impact this will have on farmer incomes. The Report of the Sub-group on Pricing of Water (Government of India 1999b) looked at the impact of increase in water rates on farm economics. They compared costs of production and input charges of principal *kharif* and *rabi* crops in Gujarat in 1997-98. It was seen that the cost of canal water varies from Rs 2.50 to Rs 3.50 per quintal in the case of cereals whereas the average harvest price of cereals was Rs 450-600. The percentage cost of water as compared to the price of production in all cases is of the order of only 0.6-0.7 per cent. They concluded that 'the cost of canal water is more or less an insignificant proportion of the total cost of production and even if the rates are increased by 200 or 300 per cent the farm economy will not be affected to any appreciable extent'.

Apart from the small proportion water tariff payments form of their income, it must be emphasised that farmers pay for many inputs—such as fertilisers, chemicals, implements, *et al*. water is yet another such input.

Deteriorating conditions of state and central finances along with the need to assure better quality services are putting pressure on governments and consumers to affect changes. Subsidies at the moment to irrigation sector are quite high amounting to nearly Rs 14,000 crore or one-eighth of total subsidies in 1994-95 (Vaidyanathan

2001). Major and medium projects, account for over half of this figure. Vaidyanathan (2001) cautions that this situation is unsustainable for states that are showing consistent budget deficits.

There is a need to stem the downward fall in cost recovery to develop better and more effective irrigation systems.

Irrigation Pricing in Past

Water charges in the form of land revenue were common before British rule in south Indian states. During that period, irrigation works in India were treated as commercial enterprises with water charges on the basis of rate of return (ROR) prevailing in the London money market. These water charges used to cover all cost and a return to capital. The ROR used to be reviewed from time to time. Till 1919, the ROR was 4 per cent, between 1919 and 1921 it was 5 per cent, and thereafter up to 1949 it was 6 per cent. Twice in the past (1854 and 1917), the volumetric measure of charging was tried but discontinued after it met with limited success. The charges for water were levied on the basis of the irrigated area, with differential area-based rates by crops and season to take in to account variation in water demand.

After independence, irrigation was viewed as infrastructure for agricultural development rather than a commercial enterprise. The ROR was subsequently reduced and was later replaced by the benefit-cost (BC) ratio for sanctioning of projects rather than financial criteria. A BC ratio of 1.5 was suggested as prudent precaution against likely increases in the cost of projects. The Second Irrigation Commission, 1972, further recommended that a lower BC ratio of 1 might be acceptable more on social grounds in drought-prone areas. In 1983, the Nitin Desai Committee forwarded the idea of the internal rate of return (IRR), suggesting that projects should normally earn a minimum IRR of 9 per cent. However, for drought-prone and hilly areas and in areas with only 75 per cent of dependable flows in the basin, a lower IRR of 7 per cent was recommended.

Successive Finance Commissions also stressed on recovery of certain percentage of capital investment apart from working (O&M) expenses (Table 4.3). The Eleventh Finance Commission has recognized that this would have to be done in a gradual manner. Receipts should cover not only maintenance expenditure but also leave some surplus as return on capital invested.

The Tenth Five Year Plan emphasizes that the pricing structure of water needs to reflect the scarcity value of water, with revenues earned by state governments covering at least the O&M costs. Emphasizing the poor condition of state finances, they make the observation that "…it is high time that the water sector also took appropriate steps to attract private investment as it may no longer be possible for State Governments to fund all water resources development projects" (Planning Commission 2002).

Table 4.3: Recommendations of Successive Finance Commissions for Cost Recovery

Finance Commission	Rate of return on capital invested	In addition to
Fifth (1969)	2.5	Working expenses
Sixth (1973)	1	Working expenses
Seventh (1978)	1	Working expenses
Eighth (1984)	—	At least cost of maintenance should be recovered
Ninth (1988)	—	At least cost of maintenance should be recovered
Tenth (1994)	1	Working expenses
Eleventh (1999)	Raise irrigation receipts over and above maintenance costs to recover 10-25% as return from capital invested	

Source: Government of India (1999)

Vaidyanathan (2001) counters the notion that merely O&M costs need to be met arguing that amortisation and interest on capital invested need to be included along with working expenses, with the government bearing some of the costs if they have substantial revenue surpluses in their budgets.

O&M costs remain the primary concern though. Previous policy documents, such as the National Water Policy (1987) and concerns of the National Conference of Irrigation and Water Resources Ministers in 1986, emphasize that O&M costs be covered at least. The Conference of Water Ministers suggested that a committee be constituted to examine the need for adequately maintaining the irrigation assets. The Jakhade Committee set up in 1987 recommended norms regarding the operation and maintenance grants to be given to different categories of projects. The National Water Policy 2002 states: "Adequate emphasis needs to be given to the physical and financial sustainability of existing facilities… water charges for various uses should be fixed in such a way that they cover at least the operation and maintenance charges of providing the service initially and a part of the capital costs subsequently. These rates should be linked directly to the quality of service provided. The subsidy on water rates to the disadvantaged and poorer sections of the society should be well targeted and transparent."

Issues involved in Irrigation Pricing

The general hypothesis in irrigation pricing remains that it should be able to cover its annual operation and maintenance (O&M) costs. These include establishment charges, maintenance charges, depreciation charges, and energy charges (Sangal 1991)[22]. Some of these charges (interest on capital cost and depreciation) are not time

[22] Sangal (1991) looked at the broad costs involved for minor irrigation projects.

variable, but others, like maintenance of works and energy charges do change over time irrespective of the capital cost incurred (*ibid*). Furthermore, there are differences on the extent to which capital-related charges should be covered in O&M cost.

The crucial issues related to irrigation pricing are:

1. How high water rates must be? Should the states/nation suffer a loss on account of provision of irrigation, should irrigation be provided on a no-profit-no-loss basis, or should profit be earned on the provision of irrigation facilities?
2. What should be the method of charging for irrigation — per unit of area or per unit of water consumed?

The proposition of volumetric measure for charging is advocated by the philosophy that it will reduce wastage of water, as in the area-wise method cultivator does not have any incentive for the optimal usage of water. The question is relevant from the point of view of crop-wise fixation of rate too. Total water requirement and number of irrigation required for different crops vary a lot. Hence, in the case of area-wise charging, crop-wise rates must be charged for different crops. In the case of the volumetric method, variation in usage of water by different crops exists and, hence, the problems of wastage are taken care of.

On the issue of the level of irrigation prices, three different pricing principles are advocated. These are:

1. The average cost principle (ACP),
2. The marginal cost principle (MCP), and
3. The net benefit principle (NBP).

In theory, the efficient price of water should be determined by supply and demand. Under marginal cost pricing, the price of water is equal to the marginal cost of supplying the last drop of water. In practice, non-market situations apply with the government setting the price for water. Assuming that the increase in the cost of supply is minimized and that the willingness to pay is not distorted by government policies, the economic price charged for water should be set equal to the average incremental economic cost (AIEC) of supply, or, if the AIEC is below the average incremental financial cost (AIFC) of supply, the financial price should be set equal to the AIFC of supply. The AIEC of water is equal to the present value (at the economic cost of capital) of the stream of future capital and operating costs at real economic prices divided by the present value of the future quantity of water consumed (but not necessarily paid for). The AIFC of water is equal to the present value (at the financial cost of capital) of the stream of future capital and operating costs at real financial prices divided by the present value of the future quantity of water sold (and paid for). Both the AIEC and AIFC should be based on the long-term, least-cost expansion path of the water enterprise.

According to the NBP, the rate should form some fixed proportion of the difference between the additional yield results from irrigation and the additional expenditure in the process (other than the irrigation charges which have to be determined). The question is whether the benefit yielded would be significant to enable cost recovery. This is the question that the average-versus-marginal cost pricing controversy has been concerned with.

The controversy of average-versus-marginal cost is related to the problem of pricing of any kind of services provided by the government. In general, it is assumed that the variable cost can be continuously increased till it becomes large relatively to indivisible cost and the marginal cost curve intersects the U-shaped average cost curve at its lowest point. In such cases, it is possible to fix the price at a point where average cost and marginal costs are same. Any deviation from this price means either a subsidy to or profit from supply of irrigation. However, in case of utility services, the variable cost never becomes sufficiently large relative to individual cost to result in rising average cost curve (Lewis, 1949). In other words, full utilisation of capacity is obtained before marginal cost curve has risen sufficiently to intersect the average cost curve. With marginal cost always below average cost curve, prices cannot be equated to both simultaneously.

There are many aspects of these pricing that make it difficult to implement. Dinar, *et al* (1997) highlight the problems involved in definition, collection of information to estimate and monitor benefits and costs, their multi-dimensionality, and period-specificity. Instead, other methods of price determination are employed. Four major categories of pricing methods can be discerned: volumetric pricing, non-volumetric pricing, quotas, and market-based mechanisms (Tsur and Dinar 1995, Johansson, *et al* 2002).

Volumetric Pricing: Water is charged based on direct measurement of volume of water consumed. Variation of the volumetric approach include (1) indirect calculation based on measurement of minutes of known flow (as from a reservoir) or minutes of uncertain flow (proportions of a flow of a river), and (2) a charge for a given minimal volume to be paid for even if not consumed. This method includes tiered pricing—multi-rate volumetric method, in which water rates vary as the amount of water consumed exceeds certain threshold values and the two-part tariff which involves charging irrigators a constant marginal price per unit of water purchased (volumetric marginal cost pricing) and a fixed annual (or admission) charge for the right to purchase the water. The admission charge is the same for all farmers. This (tiered) pricing method has been advocated, and practised, in situations where a public utility produces with marginal cost below average cost and must cover total costs (variable and fixed).

Non-Volumetric Pricing: Water is charged on the basis of various criteria. They could be on a per output basis where irrigators pay a certain water fee for each unit of output they produce; or on the basis of inputs where water is charged by taxing inputs and irrigators pay a water fee for each unit of a certain input used. This method is easiest to implement where water is charged per irrigated area, depending on the kind and extent of crop irrigated, irrigation method, the season of the year, etc.. In many countries, the water rates are higher when there are storage works (investment) than for diversions directly from streams. The rates for pumped water are usually higher than for water delivered by gravity. In some cases, farmers are required to pay the per acre charges also for the non-irrigated acres. Where a betterment levy is charged, water fees are charged per unit area, based on the increase in land value accruing from the provision of irrigation.

Water Markets: In some developed economies, markets for water or water rights have been formed to determine water prices. In such a situation, there exist water sellers and buyers, which trade water rights with each other. Once the water rights system are set up, water markets in water scare areas establish the market value of water, which is a reflection of the opportunity cost of water. For the markets to function and correctly reflect the opportunity cost of water. For the markets to function and correctly reflect the opportunity cost of water, the water rights exchange mechanism needs to be smooth and must low transaction costs in terms of both financing and time involved. If it is difficult for users to exchange their rights, the expected incentive to move water from low- to high-value uses will not materialise. Water markets are prevalent in countries such as Mexico and Brazil. Mexico made nationwide changes, whereas Ceara in Brazil developed a statewide system. In both cases, changes have been triggered by a government commitment to link the economic agenda with water management. The government decided to create a centralised entity — the CAN in Mexico and COGERH in Ceara — to implement the agenda of defining and allocating water rights, pricing water, and developing power to the river basin level, along with creating water user organisations (Dinar, 2000).

The proposition of volumetric measure for charging is advocated by the philosophy that it will reduce wastage of water, as in the area-wise and crop-wise methods of assessment, the cultivator does not have any incentive for optimal usage of water. In the case of volumetric method, variation in usage of water by different crops exists and, hence, the problems of wastage are taken care of. As seen from Table 4.4, volumetric measures of water charging are one of the first-best approaches to achievement of efficiency. However, it is costly and difficult to administer (Dinar, *et al*, 1997). It would require time to implement and, given the density of farmers in India, would be costly to set up. Imposition of volumetric pricing also would be seen by some as 'expropriation of traditional water rights', creating capital losses in established irrigated farms (*ibid*). Its implementation would become easier were it done through the setting up of water user associations (WUAs), so that at the distribution and collection stages, collective group responsibility would lead to greater efficiency.

Table 4.4: Aspects of various pricing schemes

Pricing scheme	Implementation	Potential efficiency achieved	Time horizon of efficiency
Single-rate volumetric	Complicated	First best	Short run
Output/input	Less complicated	Second	Short run
Per Area	Easy	None	N/A
Tiered	Relatively complicated	First best	Short run
Water markets	Difficult	First best	Short run/long run

Source: Johansson (2000)

Present Irrigation Pricing Practices

Variations in the water rates charged depend on the following factors in India (Appendix 4.1):

i. Actual area irrigated

ii. Agreement rate—agreements entered with farmers; are lower for longer-duration agreements

iii. Crop raised and area irrigated

iv. Type of land irrigated and crop

Except the seven north-eastern states, all other states impose charges, either directly or indirectly, for use of irrigation water from public sources. Water rates vary across and within states (Table 4.5, Appendix 4.1).

Table 4.5: Range of water rates during 1995-96 (Rs per hectare)

	Range of water rates (Rs)	Date of last revision
Andhra Pradesh	148.27-1235.55	1 July 1996
Bihar	74.13-296.53	14 November 1995
Gujarat	25.00-830.00	10 April 1981
Haryana	23.69-119.60	27 July 1994
J&K	7.71-289.12	1 April 1976
Karnataka	19.77-556.00	1 July 1985
Kerala	17.00-99.00	1 July 1974
Madhya Pradesh	14.83-296.53	October, 1992
Maharashtra	55-800	1 July 1990
Orissa	5.56-185.33 (flow irrigation)	24 September 1981
	129.13-4984.10 (lift irrigation)	1997-98
Punjab	14.83-98.84	1993-94
Rajasthan	19.77-143.32	March, 1982
Tamil Nadu	18.53-61.78	No change since 1962
Uttar Pradesh	20.00-474.00	18 September 1995
West Bengal	37.06-123 (flow irrigation)	January, 1993
	74.13-469.51 (lift irrigation)	19 November, 1984

Source: Table 4.13, Government of India (2002b)

In certain states (mainly Andhra Pradesh and Tamil Nadu), there is no separate water rate for areas under the old systems (including minor surface irrigation system). Lands irrigated by these systems are classified as 'wet lands' for purposes of land revenue. These wet lands are more productive and charged at a much higher rate than 'dry lands' (Government of India, 1992). Within wet lands, there is a differential charging according to the soil quality and irrigation source.

In rest of the states, lands irrigated by public system are charged separate water rates. These rates are levied on the area actually irrigated and are differentiated by season and crops. There are further differentiated by the quality of irrigation as reflected by the quantum, duration, and assurance of water supplies. Bihar differentiates between perennial and non-perennial canals and the sources which are assured and not assured.

Within states there are some notable variations. Orissa charges a basic water rate on all lands within the command area of a project for the supply of water, irrespective of whether or not it is used, for the staple *kharif* crop (mainly paddy) and individual water rates for non-staple crops. Bihar has differentiated between long lease, seasonal lease, and single lease. Maharashtra and Madhya Pradesh have differentiation between demand rate and agreement rate.

The crop-wise rates are generally higher for perennial cash crops such as sugarcane and banana and lowest for irrigated dry (ID) seasonals. Paddy is charged at a higher rate than ID. The rates are generally uniform within a state for a given class of irrigation works. However, Haryana has classified its canal system into three broad groups for rate differentiation. Rajasthan charges differential rates on the basis of canal system constructed pre- and post-1952. As mentioned earlier, in Tamil Nadu land irrigated by old irrigation systems has concept of wet lands and 'dry lands', separate rates for water cess and specific crop-wise rates exist for new irrigation sources; however, these rates are not same for all projects.

Apart from these water rates, few states levy general or special purpose cesses on irrigated area/crops. Maharashtra collects a local cess of 20 paise per rupee of water rate, an educational cess on select irrigated crops on per hectare basis, and an employment guarantee cess on a per hectare of irrigated agricultural land.

Lift irrigation from public sources (government canals or public tube wells) is charged at a higher rate as compared to surface irrigation. In the case of public tube wells, charges are based on the hours of watering rather than area irrigated (similar to volumetric pricing).

The Irrigation Commission (1972) suggested that water rates be fixed at around 5 per cent of gross income for food crops and 12 per cent for cash crops. However, in practice, in no Indian state does the water rate structure bear relationship to the cost and output (Government of India 1999). Under-pricing of irrigation is mainly responsible for deteriorating quality of irrigation services (Government of India 1992).

As can be seen from Table 4.6, although rates need to be revised, very few states undertake periodic revaluation[23]—notably Maharashtra. Punjab in 1997 decided to give water free, despite its poor financial situation. Political constraints often dominate decisions on water rate structures. Take for example Andhra Pradesh and Tamil Nadu: Andhra Pradesh (after a gap of 10 years) in 1996 increased the water user charges from Rs 60 to Rs 350 per acre and indexed it to the value of one bag of paddy. Due to pressure from various groups, the charges were reduced to Rs 200 and the indexation was withdrawn. It is estimated (Venkateswarlu 2002) that the new water charges will cover three-fourths of the required O&M needs. In Tamil Nadu, the water cess rates have been raised in 2003 after a gap of 41 years—the last revision being in 1962. The charges will be Rs 70 an acre for wet crops and Rs 60 for dry crops (Ramakrishnan 2003).

Vaidyanathan (2001) questions the feasibility of present water rate increases in meeting total costs and highlights that the water rate is the not only problem. Enforcement of rates is also lenient with collusion between officials and farmers leading to understatement of area irrigated, particularly misstatement of crops being charged higher rates. Furthermore, collection is lax, leading to shortfalls between assessment and collection.

[23] Maharashtra undertakes periodic five year evaluations (Government of India 1999).

Table 4.6: Canal-specific Rates for Irrigation in Major Indian States (1980-1997)

State	In 1989-90[1]		In 1997[2]		Developments
	Range (Rs per hectare)	Year rates last revised	Range (Rs per hectare)	Year rates last revised	
Andhra Pradesh	99-370	1986	148-1236	1996	
Assam			75-376	1992	
Bihar	30-158	1983	74-297	1995	
Dadra & Nagar Havelli			75-275	1973	
Daman & Diu			200	1980	
Goa			60-300	1988	
Gujarat	40-380	1981	Same	1981	
Haryana	17-99	1975	24-120	1995	
Karnataka	37-556	1985	Same	1985	
Madhya Pradesh	15-297	1990	15-297	1994	
Maharashtra	65-1000	1989	50-800	1994	
Manipur			22.5-75	1981	
Orissa	6-185	1981	130- 4980 (Lift irrigation) 6-185 (Flow irrigation)	1997	
Punjab	14-81	1974	Abolished	1997	In 1997 rates abolished
Rajasthan	20-143	1982	Same	1982	
Tamil Nadu	6-65	1962	Same	1962	After 41 years, in 2003 rates revised upwards
Uttar Pradesh	7-327	1983	20-474	1995	
West Bengal	74-593	1977	37-123	1993	

1 = Saleth (1997)
2 = Selvarajan, Shankar and Lakshmi (2001)

Changes Necessary

A revision of water rates is necessary in the interest of efficiency. However, it should go hand in hand with improvement in the quality of service (Government of India 1992). Specific recommendations were made by the Committee on Pricing of Irrigation Water (Government of India, 1992) with regards to pricing:

1. Water rates are a form of user charges, and not a tax. Users of public irrigation must meet the cost of the irrigation service.
2. As irrigation is one of the key inputs similar to seeds and fertiliser, its pricing should be addressed in the first step.
3. Under-pricing of irrigation is mainly responsible for the deteriorating quality of irrigation services. A revision of water rates is necessary in the interest of efficiency. However, it should go hand in hand with improvement in the quality of service.
4. Rates for non-agricultural users (domestic and industrial) should also be revised so that full cost is recovered.

5. Rates should be based on O&M norms and capital charges (interest and depreciation).
6. Averaging of rates by region and/or categories of projects is desirable. Categorization could be:
   - major and medium storage system,
   - major and medium projects based exclusively on barrages/diversion works,
   - minor surface irrigation works,
   - lift irrigation canals, and
   - lift irrigation from groundwater.
7. Distinction of rates in terms of tail and head reaches of a system, soil quality, and other criteria for rate determination should be approached with caution due to complexities involved with it.
8. Water rates should be applied on two-part tariff. All lands in command area should pay a flat annual fee on a per hectare basis for membership of the system and a variable fee linked to the actual extent of service (volume or area) used by each member.
9. The move to full-fledged volumetric pricing cannot be introduced immediately. The proposed rationalisation of water pricing will have to be accomplished in three phases.
10. In the first phase, rationalisation and simplification of the existing system of assessment (based on crop-wise irrigated area on an individual basis) to a system of season-specific areas rates should be taken up. The level of cost recovery to be aimed during the first phase should at least cover O&M costs and 1 per cent interest on capital employed. The irrigated area under a crop which spreads over to more than one season should be charged at the rates applicable to different seasons. However, in each season, distinction should be made between paddy, sugarcane, and perennial crops.
11. In the second phase, the aim should be on volumetric measure for irrigation water charging.
12. In third phase, the focus should be on people participation for improving water use and, thus, productivity.

The recommendations of the Committee on Pricing of Irrigation Water (also known as the Vaidynathan Committee Report) were further studied by the Group of Officers formed by the Planning Commission in October 1992. It recommended that the irrigation water rates should cover the full annual O&M cost in phases in the next five years. These recommendations and the Vaidyanathan Committee Report were, in February 1995, sent to all the States/union territories that had started taking action with several states revising water rates upwards.

As users have little financial responsibility for current irrigation practices, their involvement through water user associations will improve both the quality and cost of water supply. By entrusting responsibility with these associations for funding and execution of maintenance repair below the outlet level, cost recovery would be improved. Furthermore, Vaidyanathan (2001) points out interesting developments occurring with regards to distribution, particularly in Andhra Pradesh, where large-scale institutional reforms involving creation of WUAs is occurring. This programme is funded by the World Bank, NABARD, and the Accelerated Irrigation Benefit Programme (AIBP). Questions are, however, being raised on the sustainability of the programme once the funds have been exhausted (Reddy 2003).

Furthermore, the question of the degree of autonomy that will be given to these WUAs needs to be raised. Entrusting them with the responsibility without the required degree of empowerment will negate the entire exercise. Appropriate jurisdiction needs to be given to these WUAs to ensure smooth functioning.

Gulati, Svendsen, and Choudhury (1994a) emphasise that the level of water rates and their recovery form just part of the problem regarding cost recovery in irrigation. Poor physical conditions of irrigation systems, absence of staff and institutional incentives related to system performance, poor linkage to users, inadequate financial resources, and inappropriate allocation of resources among cost lines and cost centres are listed by them to highlight the surrounding institutional regime that needs to be revamped to ensure a more effective delivery system. The quality of water and its delivery will have an impact on the perceptions of farmers towards these canal systems and better quality services will in itself encourage payment and adherence to water charges.

The National Commission for Integrated Water Resources Development in its report (Government of India 1999a) emphasized that the value of the product must also be included when evolving rate structures for crops and water usage. The tariff should include the Vaidyanathan Committee definition (O&M and part of capital cost) along with the value of the product, which, the report says, should be 1 per cent of the gross value of the produce per hectare in respect of cereal crops with a higher percentage for cash crops. Overall, the National Commission recommends the rationalisation of basic principles of fixing water tariffs in states, encouragement of user group formation and a move towards volumetric pricing, adherence to equity considerations to protect small and marginal farmers, and higher user charges for industry. In the case of domestic supply, a progressive charge structure dependent on water use should evolve with a certain minimum provided free. It recommends the formation of a water pricing authority in each state by statute, on the lines of energy pricing authorities. These would be independent authorities whose recommendations would be binding.

The Report of the Sub-group on Pricing of Water of the Working Group on Water Management for Agriculture, Hydropower, Flood Control, and other Allied Sectors of the National Commission for Integrated Water Resources Development Plan (Government of India 1999b), while reviewing the assessment and collection of irrigation of water charges, made the following recommendations:

- Assessment should be done by irrigation departments
- Only single-part, variable tariff based on areas irrigated under various crops in different seasons should be pursued, as opposed to the two-part tariff proposed by the Vaidyanathan Committee Report. It found, "the concept of two-part tariff is not feasible in the opinion of state representatives and as such a single part rate structure should be evolved to take care of the Committee's recommendation". The states do not appreciate the idea of having a fixed charge for all lands in the command area.
- Ultimate aim is to charge on volumetric basis
- All additional revenue collected as a result of increase in the rates should be ploughed back into the system for improved O&M and modernization of the system. Improvement in quality of services from major and medium irrigation systems is a simultaneous requirement for higher water tariffs. With such an assurance, farmers would have no objection to paying higher water tariffs.
- An effective system for avoiding underassessment of water charges need to be developed. The use of remote sensing maps and technique is a possibility.
- Norms must be devised by states to ensure that the interests of small and marginal farmers are protected.

We must keep in mind that policy recommendations must also include frequent timely revisions of water charges taking into account factors such as inflation, covering of O&M, and capital costs. Efforts must be made to ensure that these are delinked from the prevailing political situation. Detailed provisions must also be there to deal with calamitous situations and downward revisions of water charges during this time only. State governments must also submit regular reports to the Centre to show that they are complying with the provisions and that cost recovery is on track.

Summing Up

The issues of water pricing and cost recovery is complex and politically sensitive. Many parties come to power by offering freebies—often in the form of free water and electricity to farmers—to vote banks. This puts a lot of pressure on the already-fragile fiscal condition of the state and central governments. The quality of irrigation services is deteriorating and one of the major factors for this is the low gross receipt from irrigation system due to lower water rates. However, increasing water rates is not the solution to the problem, the quality of these services also has to be improved. A two-tier rate structure as proposed by the Committee on Pricing of Irrigation Water (Government of India, 1992) should come in force. The roadmap suggested by the committee can tackle the problems faced by the irrigation system in India.

Appendix 4.1: State-wise variations in water rate determination for irrigation

Region	Nature of water rates
Andhra Pradesh	Crop-wise; rate per hectare of area irrigated based on type of land irrigated, and nature of crop (wet, dry, duffasal)
Bihar*	Agreement rates—long, season, single lease; differ for perennial and non-perennial sources
Goa	Crop-wise; type of scheme—lift/flow
Gujarat	Crop-wise and season; paying capacity of cultivator based on gross production value and net benefit to him for each kind of crop; local fund cess
Haryana	Crop-wise; paying capacity of irrigator; irrigation cess levied; canal system
Himachal Pradesh	Crop-wise; occupier rate by type of irrigation scheme (flow or lift); area irrigated
Jammu and Kashmir	Crop-wise and type of irrigation scheme
Karnataka	Crop-wise
Kerala	Type of land
Madhya Pradesh*	Crop-wise rate and type of irrigation scheme; demand rate and agreement rate
Maharashtra	Crop-wise, season, type of schemes (lift/flow); volume of water supplied; capacity of farmers to pay; demand rate and agreement rate; cess
Manipur	Crop-wise, betterment levy charged
Mizoram	Water rates available only for piped water supply; operation and maintenance cost of supplying water is taken into consideration while deciding the rates
Orissa	Crop-wise for staple crop; compulsory flat water rates per acre of land within the cultural command area; water requirement of crops
Punjab	Crop-wise and season-wise; canal system construction date
Rajasthan	Crop-wise
Tamil Nadu	Crop-wise rates; type of land irrigated—wet/dry;
Tripura	Crop-wise rate (proposed)
Uttar Pradesh*	Crop wise and season wise; type of schemes
West Bengal	Pre-paid crop-wise rate for minor irrigation; season-wise rate for major and medium projects;
Union Territories	
Dadra and Nagar Haveli	Season-wise for lift irrigation
Daman & Diu	Uniform for all crops
Delhi	Uniform for tube well; crop-wise for effluent; crop-wise for Yamuna Canal System as in Haryana
Pondicherry	Type of land irrigated; crop irrigated

*Before separation

Assam recently imposed water rates in 1992

No water rates are enforced in Arunachal Pradesh, Meghalaya, Nagaland, Sikkim, Andaman and Nicobar Islands, and Lakshadweep

Source: Government of India (1999)

Chapter 5

Institutional Issues Involved in the Interlinking of Rivers Programme

Introduction

In India, we have been witness to successful transfers of water to regions facing scarcity. Rajasthan has often been a beneficiary of these projects (such as the Bhakra Dam which forms a part of the Indira Gandhi Canal Project), despite being an arid region. These have been through multilateral agreements and state cooperation (Reddy and Char 2001). The waters from the *Periyar* river of Kerala were diverted to the Mula Periyar Dam to Tamil Nadu. After finalisation of the Krishna Water Disputes Tribunal, Karnataka, Maharashtra, and Andhra Pradesh gave water to Tamil Nadu's over-burdened city of Chennai.

The aim of this chapter is to draw out various policy aspects and suggest modes for evolving an institutional structure that will oversee a water management regime based on a river basin approach. The structure of this chapter is as follows. First, the Indian legal outline for water bodies is presented, with a discussion of the National Water policies of 1987 and 2002. This is followed by the role the river boards have played thus far. Next, there is a discussion on the theoretical doctrines surrounding the sharing of water, followed by actual practice in India. A note on the various aspects that need to be included when formulating policy follows, after which there is a note on possible institutional regimes that can be developed. The last section deals with a look at the international context for river basin management and India's experience with its neighbours thus far.

Legal Framework

The Indian legal framework surrounding rivers and water bodies revolves around the following legislations and reports:

a) Seventh schedule, Article 246, Constitution of India, that delineates roles of the centre and states (Constitution of India, 1950 and amendments)

b) National Water Policy 1987, 2002

c) Article 262, Constitution of India, that relates to disputes dealing with water (Constitution of India, 1950 and amendments)

d) River Boards Act, 1956

e) Inter-state Water Disputes Act 1956, amended in 2002

f) National Commission for the Review of the Working of the Constitution (NCRWC), 2002

Water falls in the state list (entry 17), subject to the qualification that the development and regulation of inter-state rivers and river valleys fall under the control of the Union (entry 56). Though being able to exercise legislative intervention, the role of the state remains largely in tact due to non-interference of the Union (Ramaswamy 2003).

Box 5.1: Constitutional Provisions

List I – Union List (Entry 56) "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 declared by law to be expedient in the public interest."

List II – State List (Entry 17) "Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power subject to provisions of List I."

List III – Concurrent List (Entry 20) "Economic and social planning."

Water also finds a place in 'economic and social planning' in the concurrent list (entry 20) and is, hence, subject to the provision of central clearance for inclusion in the national Plan. States are responsible for the development and apportionment of their water resources. There are state-specific laws for irrigation (Appendix 5.1).

The premise of river basin development is rooted in the National Water Policy 2002 that emphasizes the development and management of water resources at a hydrological unit level (para 3.3, NWP 2002) and stresses the need for a sub-basin approach to development of inter-state rivers. Furthermore, it calls for the creation of river basin organisations for the planned development and management of a river basin. The power and scope of these river basin organizations shall be decided by the basin states themselves (para 4.2, NWP 2002).

Box 5.2: Article 262

Article 262 grants the Indian Parliament the right to legislate on matter mentioned in Entry 56. It also says that Parliament's word has primacy over even Supreme Court decisions, though this has not been used.
"Parliament may by law provide for the adjudication of 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."
"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 (1)."

The need for coordinated development was stressed in as early as 1987, when the first National Water Policy was formulated. The need for an approach towards the management of drought and floods being guided at a national level was recognised. Resource planning would be optimal if it were done for a hydrological unit such as a drainage basin or a sub-basin (para 3.2, NWP 1987). The policy emphasised the importance of water and the role of states in optimal development—"Water is a scarce and precious national resource to be planned, developed and conserved as such, and on an integrated and environmentally sound basis, keeping in view the needs of the States concerned" (National Water Policy 1987).

Water transfers between basins are also subject to state requirements. "Water should be made available to water short areas by transfer from other areas including transfers from one river basin to another, based on a national perspective, *after having taken into account the requirements of the areas/basins*" (para 3.4, NWP 1987).

River Boards

The River Boards Act, 1956, that was passed by Parliament under the Union List (entry 56) has never been invoked, remaining a ghostly provision. Reddy and Char (2001) point out that the role envisioned by the River Boards under this Act is largely advisory with the National Commission for Review of the Working of the Constitution recommending the enactment of a new Act, termed the Integrated Participatory Management Act to replace it. The Board's jurisdiction should be clearly specified to allow the regulation, development, and control of inter-state rivers. At the moment, river boards do exist for specific projects. The Betwa River Board, Brahmaputra River Board, and Bansagar Control Board have been constituted but their role remains limited to supervision of projects and they do not have the status of river basin authorities (Table 5.1). Ramaswamy (2003) stresses that river boards can only function effectively in inter-state basin areas if states agree to endow the board with the requisite authority to take independent decisions. The Damodar Valley Corporation is a case in point. It was modelled on the Tennessee Valley Authority but could not function as envisaged as conflicts developed between the Corporation and the governments involved, which according to Richards and Singh (1996), "hampered its work".

Table 5.1: Select river boards in India

Board	Organisational features
Damodar Valley Corporation	Now largely a power-generating body under the control of the Ministry of Power
Bhakra-Beas Management Board	System management body and not a basin planning organization; also under the Ministry of Power
Betwa River Board	Construction of Rajghat dam
Brahmaputra Board	Preparation of master plan and formulation of few large projects
Bansagar Control Board	Construction of Bansagar dam
Ganga Flood Control Commission	Preparation of master plan for flood control in Ganga basin
Narmada Control Authority	Narmada Waters Dispute Tribunal set it up to look at the implementation of tribunal award

We find that there is no consistency in the manner of formation of river boards, with some having been formed with members from respective states on their boards, some through statutory legislations, while others through memoranda of understanding. Although the Ministry of Water Resources remains dominantly the supervising administrative authority, in the case of the Damodar Valley Corporation and the Bhakra-Beas Management Board, the Ministry of Power has the leading administrative role. Hence, there is no consistency regarding its setup or functioning.

Doctrines surrounding sharing of river waters

The National Commission for the Review of the Working of the Constitution (NCRWC) 2002 listed various doctrines that shape river dispute resolution, internationally and domestically (Table 5.2).

Table 5.2: Doctrines on river sharing

Doctrines	Description
Doctrine of riparian rights	Emphasizes recognition of equal rights of water use by all owners of land subject to non-interference with rights of other riparian owners
Doctrine of prior appropriation	Gives rights based on seniority or historical use.
Territorial integrity theory or Theory of natural water flow	Every lower riparian is entitled to natural flow of river without interference from upper riparian
Doctrine of territorial sovereignty (Harmon Doctrine)	A state is free to dispose of, within its territory, waters as it deems fit without concern for harm or adverse impact caused to other riparian users
English Common Law principle of riparian right	Authorises a lower riparian to exercise a veto against abstractions upstream
Doctrine of community of interest	A river passed through states is deemed to be one unit and should be developed as such
Doctrine of Equitable Apportionment	Where an outside authority, such as a legislative assembly, decides the amount of water flow according to some criterion. NCRWC (2002) notes the vagueness associated with the scheme

Richards and Singh (1996) while determining what a reasonable and equitable share is under the doctrine of equitable apportionment have highlighted 11 factors:

a) Geography of the basin

b) Hydrology of the basin

c) Climate

d) Economic and social needs

e) Population dependent on water

f) Comparative costs of alternative means of satisfying economic and social needs of each basin state

g) Availability of other resources

h) Avoidance of unnecessary waste in utilisation of waters of the basin

i) Practicability of compensation to one or more co-basin states in event of conflict

j) Degree to which needs of a basin state may be satisfied without causing injury to co-basin

k) Past utilisation of waters in the basin and existing utilisation (what National water policy also says)

The NCRWC also noted that the following must be considered when distributing shares:

i. Agreements, judicial decisions, awards, and customs that already are in place
ii. Relative economic and social needs of interested states
iii. Volume of stream and its uses
iv. Land not watered
v. Physical and climatic characteristics of states
vi. Relative productivity of land in the states
vii. State-wise drainage
viii. Population dependent on water supply and degree of dependence
ix. Amount of water contributed by the state to inter-state stream
x. Extent of evaporation

As will be seen in the next section, no clear-cut precedents exist for water allocation. Rajasthan, in the case of the Narmada waters, was not entitled to a share but was favoured with an allocation based on an agreement among chief ministers. In some cases the award of the Tribunal holds status of law and, in others, mutually-agreed outcomes ensure success.

Various tribunals have also made findings on equitable share definitions. On the question of diversion of water by a state outside the river basin, the Narmada Tribunal observed "the need for diversion of water to another watershed may be a relevant factor on the question of equitable apportionment in the circumstances of a particular case".

The Krishna Water Disputes Tribunal report[24] took a different view when it stated that, "no state has a proprietary interest in a particular volume of water on an inter-state river on the basis of its contribution or irrigable area". This observation has deep implications for distribution and principles of equitable shares, according more power to a centralised authority. The same tribunal also emphasised that if there is any central legislation on the apportionment of inter-state rivers or river valleys that the

[24] As highlighted by the NCRWC 2002

law would apply to all states, setting up a role for greater central participation in resolution of disputes, and movement towards harmonisation in principles of water sharing.

Apportionment of water remains a contentious issue, as seen in the ongoing *Cauvery* water dispute. As will be highlighted in the next section, dispute settlement modalities vary across cases.

Inter-State River Disputes

Settlement of inter-state water disputes, should they arise, are dealt with in the Constitution under Article 262—via formation of tribunals. The Article also bars courts from extending jurisdiction in these matters, underlining the unique position of water. The Inter-State Waters Dispute Act 1956 (ISWD) was formulated to support Article 262 and lay down legal mechanisms to provide for the adjudication of disputes relating to waters of inter-state rivers and river valleys. The legislative competence of a State under Entry 17 must not prejudice the interests of other States and create a water dispute within the meaning of Article 262 (Ramaswamy 2003).

Hence, so far, the legal mechanisms towards water centre on cooperative arrangements being formulated with the creation of a tribunal (under Article 262) if the dispute cannot be resolved at a bilateral/multilateral level. Should a dispute arise it is up to the Centre to determine whether the dispute can be settled without a tribunal and if not, a tribunal must be initiated by the Centre, consisting of three Supreme Court judges according to the Inter-State Water Disputes Act.

Box 5.3: Inter-State Water Disputes Act Amendments, 2002

- One year for establishment of tribunal by the Centre after state government request
- Three years for tribunal to give its award; five years maximum
- Decision to have same power as Supreme Court judgement

Recently the National Commission for the Review of Working of the Constitution (NCRWC 2002) submitted its report to the government where in a separate chapter it addresses the provisions of Article 262. Two reasons highlighted for studying inter-state disputes are the unhappiness associated with resolution of these disputes and the "prima facie need to consider the matter afresh". From previous judgements, the commission observes that the Centre could take a greater role in legislating for the regulation and development of inter-state rivers and river valleys. The role of Article 262 and the continuing river disputes have led to the questioning of the efficacy of the present measures on dispute resolution. Delays that have arisen in the establishment and finalisation of proceedings of tribunals have led to recent amendments to the ISWD Act.

River disputes in India are bound to arise given the cross-cutting nature of our rivers. Appendix 5.2 gives an account of some ISWDs, showing the variety of ways in which disputes are resolved. In those cases where the dispute has been resolved, it has been either through a centrally-imposed tribunal or via bilateral and multilateral negotiations between the states themselves. The NCRWC (2002) noted that wherever parties have been able to come to an agreement that was endorsed by the Tribunal, the situation has been more satisfactory than in other cases.

Table 5.3 gives a brief synopsis of the various tribunals set up to highlight the lengthy processes involved. Successful cases include the Narmada Tribunal which led to creation of the Narmada Control Authority to implement the award of the tribunal for the optimal utilization of the waters. The chief ministers and the Prime Minister settled on a mutually-agreed solution with all party states accepting the principle of equitable distribution (Reddy and Char 2001).

Table 5.3: Time Line of Inter-state Disputes

River basin	Time line	Issues	Years*
Ravi-Beas	1966	Problems started after creation of Haryana	Unresolved since 1986
	1986	Tribunal set up	
	1987	First report given	
	Present	Final Award still not given	
Narmada	1969	Tribunal set up	10
	1979	Award given	
Godavari	1961	Krishna Godavari Commission set up	11
	1969	Tribunal set up	
	1980	States themselves reach a solution which is incorporated in tribunal award	
Krishna	1969	Tribunal set up	Award expired
	1976	Award given	
	2000	Award expired	
	Present	Rewriting terms of award	
Cauvery	1974	1924 agreement comes up for review	Unresolved since 1990
	1990	Tribunal set up after Tamil Nadu approaches Supreme Court	
	1991	Interim Order given by Tribunal	
		Order not accepted by Karnataka.	
	1995	Delayed monsoon leads Tamil Nadu to approach the Supreme Court on failure of Karnataka to uphold tribunal order. SC directs Tamil Nadu to tribunal	
		Supreme Court on petition by Tamil Nadu requests Prime Minister to intervene.	
		Cauvery River Authority formed headed by Prime Minister	
	Present	Tribunal award still awaited	

* Time elapsing between creation of tribunal and declaration of award

The Narmada Authority is authorised to enforce rules and regulations along with carrying out water accounting. The *Sardar Sarovar* project was the first to have detailed guidelines on resettlement and rehabilitation. The 2002 National Water

Policy has underlined the need to have a national policy with regard to resettlement and rehabilitation needs to be formulated so that project-affected persons share the benefits.

The Report of the Godavari Tribunal was an amalgamation of bilateral and multilateral agreements formed by the states themselves. Significantly, the tribunal held that on the question of trans-basin diversion, each of the states was at liberty to divert its share of *Godavari* waters allocated to it from the *Godavari* basin, to any other basin, hence supporting inter-basin transfers as long as there is state sponsorship.

There are disputes that are still undetermined. The Ravi-Beas Tribunal is a case in point. The tribunal was set up in 1986 and has yet to give its final award. Reddy and Char (2001) have blamed ‘electoral politics’ for its non-resolution.

The *Krishna* river dispute too faced trouble near the time of the tribunal’s award revision in 2000. The World Bank (1999a) termed it “a good illustration of how water tribunals could result in competitive, disjointed investments aimed at establishing claims when awards come up for review”. In 2001, Karnataka, an upper riparian state filed a petition in the Supreme Court seeking to restrain Andhra Pradesh from developing any new projects until the water sharing issue is resolved once again.

The *Cauvery* dispute is perhaps the best-known, with the states of Tamil Nadu and Karnataka being the key players. Non-agreement regarding terms of equitable distribution have been compounded by the failure of states to comply with the interim award of the tribunal, which has necessitated central and Supreme Court intervention. The award of the tribunal too is still awaited, even though it has been over 10 years since its formulation.

In all these cases, the absence of data sets regarding flows of rivers, lengthy time periods for tribunal decisions, non-inclusion of stakeholders in the case of the Sardar Sarovar, political complexities in the *Ravi-Beas* case along with renewal terms in the *Krishna* award have underlined the need to have clear cut defined river basin policies regarding its development and institutional structure, to prevent disputes from being long-drawn.

Most disputes have the following features:

i) Vagueness regarding the legal doctrine (NCRWC 2002)

ii) Acrimonious tension between parties (NCRWC 2002)

iii) Overall delay in completion of adjudication (NCRWC 2002)

Reddy and Char (2001) distinguish between two types of causes for disputes—the technical and the non-technical.

Technical

a) Water availability, especially lean season
b) Basic hydrological data and actual present utilization of water
c) Present and future water requirements for various uses
d) Openness and transparency in exchange of data and information
e) Approach to planning, design, construction, operation of joint projects on trans-boundary rivers
f) Different interpretation of operative clauses and sub-clauses

Non-technical

a) Riparian rights
b) Basis and modalities for water sharing
c) Violation of agreements by one party or the other
d) Rigid political and administrative strands

Richards and Singh (1996) point out that while the river basin approach appears the best to tackle issues of water sharing, investment and management, they often become the object of conflict rather than cooperation. While reviewing the river basin conflicts in India, they found that easily settled disputes centred on specificity and well-defined technical and cost issues. They also revolved around smaller river basins. Large river basins formed the core of unresolved disputes.

Better-defined agreements between states will be essential to ensure that benefits from interlinking schemes accrue to one and all. There is an urgent necessity on resolving existing disputes and determining excess water levels that can be shared, along with involving states in consultation with the Centre to determine how best these excess water levels can be distributed. Ramaswamy (2003) underlines this point when talking about the interlinking scheme.

State and Centre water bodies

There is a complexity of arrangements in place with regards to implementing water policy at the state and central levels. The Water Resources Department of the state government is in charge of state water resources, their development, and usage. Every state has an irrigation department for major and medium irrigation projects. As water is a state subject, irrigation too is a state subject. There are different irrigation statutes for different states and in most states there is a plethora of laws governing irrigation systems (Appendix 5.1). For efficient administration of irrigation, it has been suggested that existing irrigation laws of each state are consolidated into one statute to avoid multiplicity, and the consolidated statute apply uniformly to all regions within the state (Jacob and Singh 2004).

The role of the central government at present is limited to being one of a 'catalytic nature'. The Ministry of Water Resources, Government of India, lays down policy guidelines and programmes for water resource development and is also responsible for offering technical guidance and financial assistance. There are a myriad of organisations that operate under the Ministry of Water Resources (Figure 1). Furthermore, the ministry itself is large with a complex ministerial setup. Basin management is currently a subset within its overall structure, with the joint secretary (basin management) being located under the commissioner (projects), who is one of many officials under the additional secretary (Ministry of Water Resources) and further, secretary (Ministry of Water Resources). There is a need to revamp this thinking and introduce more flexibility into the ministry format.

Planning a project

Currently, water and multi-purpose projects involve the participation of a number of agencies at the central level where the Planning Commission along with various other government bodies are involved. The following bodies need to approve a project before the Planning Commission will allow it to proceed:

i. Central Water Commission (CWC) of the Central Water Resources Ministry
ii. Power Sector for projects costing more than a specified amount, requiring clearance from the Central Electricity Authority[25] (*present provisions*)
iii. Central Ministry of Environment and Forests
iv. Other ministries concerned if project impacts their jurisdiction

The Planning Commission examines the project from the point of view of accommodation and provision of funds, issuing a letter of acceptance (investment approval). If a state asks for financial support for a project, the Planning Commission is guided by the Central Water Commission's (CWC) recommendation. The CWC regulates the choice of technology for water resources development in the country.

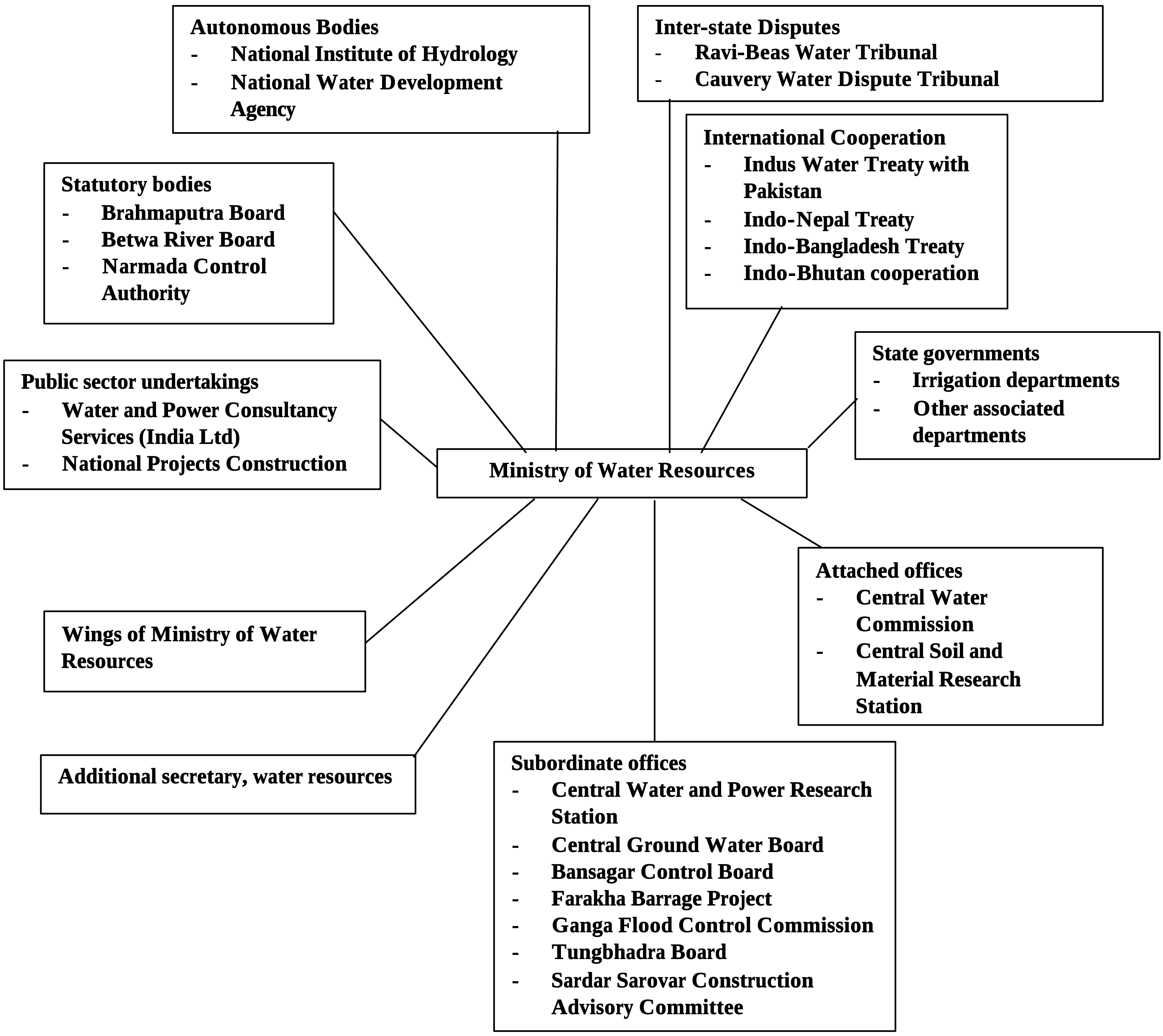
Any project which is large enough to need the Planning Commission's approval or financial help, has to abide by the CWC's demands. The Planning Commission also has the power to cancel a project on environmental grounds. Small and medium projects that have no inter-state ramifications may be cleared by the Central Design

[25] The Central Electricity Authority is a statutory organization constituted under section 3(1) of the Electricity (Supply) Act, 1948. It was established as a part-time body in 1951 and made a full-time body in 1975. It is attached to the Ministry of Power. In all technical, financial and economic matters, the Ministry of Power is assisted by the CEA. The CEA is responsible for technical coordination and supervision of programmes and is also entrusted with a number of statutory functions.

Organisations of the state governments; only a perfunctory advance report of such schemes have to be forwarded to the Central Planning Commission for final approval.

The central government needs to be consulted by state governments for final approval and all major (above 10,000 ha CCA) and medium (2000-10000 ha CCA) irrigation projects and all multi-purpose river valley projects should be included in the National Plan (Sengupta 2000). The new institutional framework will need to keep this current format in mind when evolving a new mode of operations. Roles of central and state authorities will need to be clearly defined.

Figure 5.1: Organizational Chart of Irrigation Administration in India



Source: Chaurasia, Pratik Ranjan (2002), 'India (2)', in *Organisational Change for Participatory Irrigation Management*, Asian Productivity Council

New approaches

Two changes have occurred with regards to planning water resources. The first comprises the inclusion of participatory irrigation management (PIM) approaches in irrigation policy. Chaurasia (2000) points to the encouragement given by the Ministry of Water Resources to promote participation of stakeholders in irrigation management via conferences, preparation of manuals, and grants to create WUAs. The World Bank (1999a) points to the need for promoting irrigation management transfer to WUAs to improve the productivity of irrigation systems and ensure their sustainability. The advantages of WUAs lie in the better management abilities these institutions offer at the grassroots level. They can play a greater role in maintenance, distribution, and collection of user charges.

The second development is the greater role accorded to *panchayats* through the 73rd and 74th amendments to the Constitution. Operations ranging from maintenance to tax collection of village sources of irrigation are being handed to *panchayats.* Though the 2002 National Water Policy talked of participatory approaches to irrigation and water resource management, it was silent on these constitutional changes that have taken place.

General problems associated with mega projects must also be taken into account when designing the institutional structure of the scheme. Box 4 gives details regarding most common problems associated with canals and dams. Adequate preventive measures along with safeguard mechanisms need to be evolved within the project design itself to avoid these negative aspects. Furthermore, the National Water Policy 2002 itself, while building on the previous policy, highlighted three areas that require further study and effort:

Box 5.4: General Problems of river projects

i. Environmental degradation
ii. Rehabilitation of project-affected people, livestock
iii. Public health consequences of water impoundment
iv. Dam safety
v. Time and cost overruns
vi. Water-logging
vii. Soil salinity
viii. Alkalinity
ix. Degradation of agricultural land
x. Equity and social justice
xi. Cost recovery—financial losses
xii. Pricing of water
xiii. Faulty designs
xiv. Under-utilization of irrigation potential
xv. Lack of dependability on irrigation
xvi. Indifferent quality of irrigation
xvii. Wastage of irrigation water
xviii. Sustainability of irrigated farming

From National Water Policy (1987), Chaurasia (2000)

i) Need for a better, well-developed information system for water-related data at the national/state level (para 2.1, NWP 2002) along with standards for coding, classification, processing of data and methods/procedures (para 2.2, NWP 2002).

ii) Skeletal national policy with regard to resettlement and rehabilitation needs to be formulated so that project affected persons share the benefits (para 10, NWP 2002).

Proper organisational arrangements at the national and state levels for ensuring safety of storage dams and other water-related structures are needed and dam safety legislation is being called for to ensure proper inspection, maintenance and surveillance of existing dams (para 24, NWP 2002).

Furthermore, the National Water Policy 2002 emphasises the development of inter-basin transfers along with artificial re-charge of groundwater, desalination of seawater, and traditional water conservation practices like rainwater harvesting (para 3.2, NWP 2002) as means of non-conventional methods for utilisation of water. In light of the above, however, inter-basin transfers would appear to be constrained by existing agreements within basin states. There needs to be a way of reconciling para 3.3 which stresses honouring existing awards and agreements and the inter-linking agenda[26].

There is also a need to include the participation of all stakeholders in IWRM at all levels—from local to regional, build capacity of these stakeholders, and develop institutions for the protection of aquatic habitats and ecosystems (Water Vision 2025).

There is, hence, a need to combine these key features in any policy framework being sought for river linking, as at the operational and distribution stage these units will play a primary role. Integration of these aspects with the broader ambit of river basin management will prove challenging. In-depth consultation with all stakeholders—governments, local communities impacted by the building of the canals, environmentalists, scientists (on long-term feasibility)—is required. As seen in examples from other countries, the elements of community endorsement and cooperation play key roles in successful river basin development.

The success of the TVA in the United States has been partially due to its commitment to working cooperatively with other federal, state, and local agencies; regional and national interest groups; and residents of the Tennessee Valley. Its distinct characteristics focused on integrated regional water resources and economic development; regional autonomy and control over natural resources; centralised policy-making implement through decentralised decision-making; high standards of excellence within the operating arms; grassroots participation and support; strong regional identify; and an action orientation with early tangible results.

[26] As the Policy has not mentioned whether international or national awards need to be kept in mind, both will be assumed to have been implied.

International agreements

While talking of inter-linking there is a need to develop multi-disciplinary institutions in respective countries for integrated water resource management, as river basins span borders. Common problems face all countries—shortage of water supply, food security, paucity of electricity, and environmental degradation. A regional vision must take into account the needs of all countries in the region and also balance national priorities (2025 Water Vision). *Treaty regimes are in place currently for several of India's shared rivers. All these treaties are bilateral in nature.*

General Principles

There is no universal treaty in force that regulates non-navigational uses and protection of international watercourses. Table 5.4 gives an overview of various principles that have emerged historically.

Table 5.4: Principles of River Sharing in International Domain

Principle	Definition	Features
Absolute Territorial Sovereignty (Harmon Doctrine)	State free to use waters within territory without concern for adverse impacts on other states	Mired in controversy as individualistic in nature and ignores externalities
Historical Use	First-come-first-serve policy; water use based on historical rights	——
Absolute Territorial Integrity	Riparian state can demand continuation of natural flow of an international river into its territory from the upper riparian, but imposes a duty on such a state not to restrict flows to other lower riparians	Tolerates only minimal uses by upstream states
Action without harm	Every riparian state has a right to use waters of an international river, but ensure no harm comes to other states	
Community of co-riparian states	Entire basin treated as economic unit with rights lying with a collective body of states or divided among them by agreement or proportionality	Overlooks political boundaries; idealistic
Equity and need	Based on equitable utilization	Liable to dispute, which Salzburg Resolution recommends should be settled via dialogue, failure of which should point to judicial settlement or arbitration
UN Convention	Codified a number of customary principles, including principle of reasonable and equitable utilization, obligation not to cause significant harm, notification of requirement for planned measures, and environmental protection	India and Pakistan have refrained from voting.

Source: Salman and Uprety (2003)

India being an upper riparian state, vis-à-vis Pakistan (on the *Indus*) and Bangladesh (on the *Ganges*), has greater degree of control over river systems and this, as can be seen from Appendix 5.3[27], often frames the reconciliation proceedings. The principle of equitable utilisation of river waters forms the dominant theme in most policy recommendations that deal with international rivers. We find that this indeed has been the case in almost all treaties signed, with prolonged negotiations being associated with final outcomes.

The most overriding task would be to develop an effective institutional framework to implement river basin management. All the institutions must be backed by legal cover; be multi-disciplinary, accountable, transparent; and be created at community, sub-national, national, regional, and global levels for functions relevant at their levels.

However, as seen in Appendix 5.3, developing frameworks for water sharing across boundaries is difficult. The recent experiences with Pakistan's reaction to the Tulbul Navigation Project in India and Bangladesh's reluctance to allow the use of *Brahmaputra* waters underline the difficulty in implementing regional agreements. This despite that much is to be gained by both sides—for example, in the case of Pakistan and India, hydro-electric power generation using *Indus* waters would benefit consumers at both ends (Reddy and Char 2001).

The South Asian Association for Regional Cooperation (SAARC) could play an important role in developing a common water usage agenda and encourage the development of river basins. The *Colorado* river basin has evolved an International Boundary and Water Commission (IBWC) to oversee water and boundary issues for the two countries. Similar arrangements exist in India with the formation of commissions that make recommendations and oversee treaty provisions, such as the Indus River Basin Commission. However, a more consistent approach is needed rather than the present ad hoc arrangements.

Institutional framework

An ideal river basin authority would incorporate the concerns highlighted in policy formulation itself, from addressing the negative impacts river projects can have to incorporating the new directions the 2002 National Water Policy has recommended, including the need for a comprehensive data base on water resources in the country. The need for participatory irrigation management systems at the ground would facilitate questions of cost recovery and maintenance of local irrigation structures.

The NCRWC (2002) finds that, as resolutions via tribunals have been unsatisfactory, other alternatives should be sought. They suggest the creation of a commission by the

[27] Appendix 5.3 reviews India's policies with its neighbours regarding water sharing.

President to investigate the dispute and prepare a report that would be acceptable to all parties. Alternatively, another more radical step is suggested: greater responsibility could be entrusted with Parliament which could then appoint a commission in case of a dispute. The commission could give its report within three years, failure of which would result in Parliament stepping in and passing appropriate legislation. The most extreme step suggested is that irrespective of the position of states regarding the commission's final report, legislation would be enacted to give the report Parliamentary sanctity. However, the NCRWC does not talk about a central body coordinating river basins, but only Parliament's role as a central agency in dispute mediation.

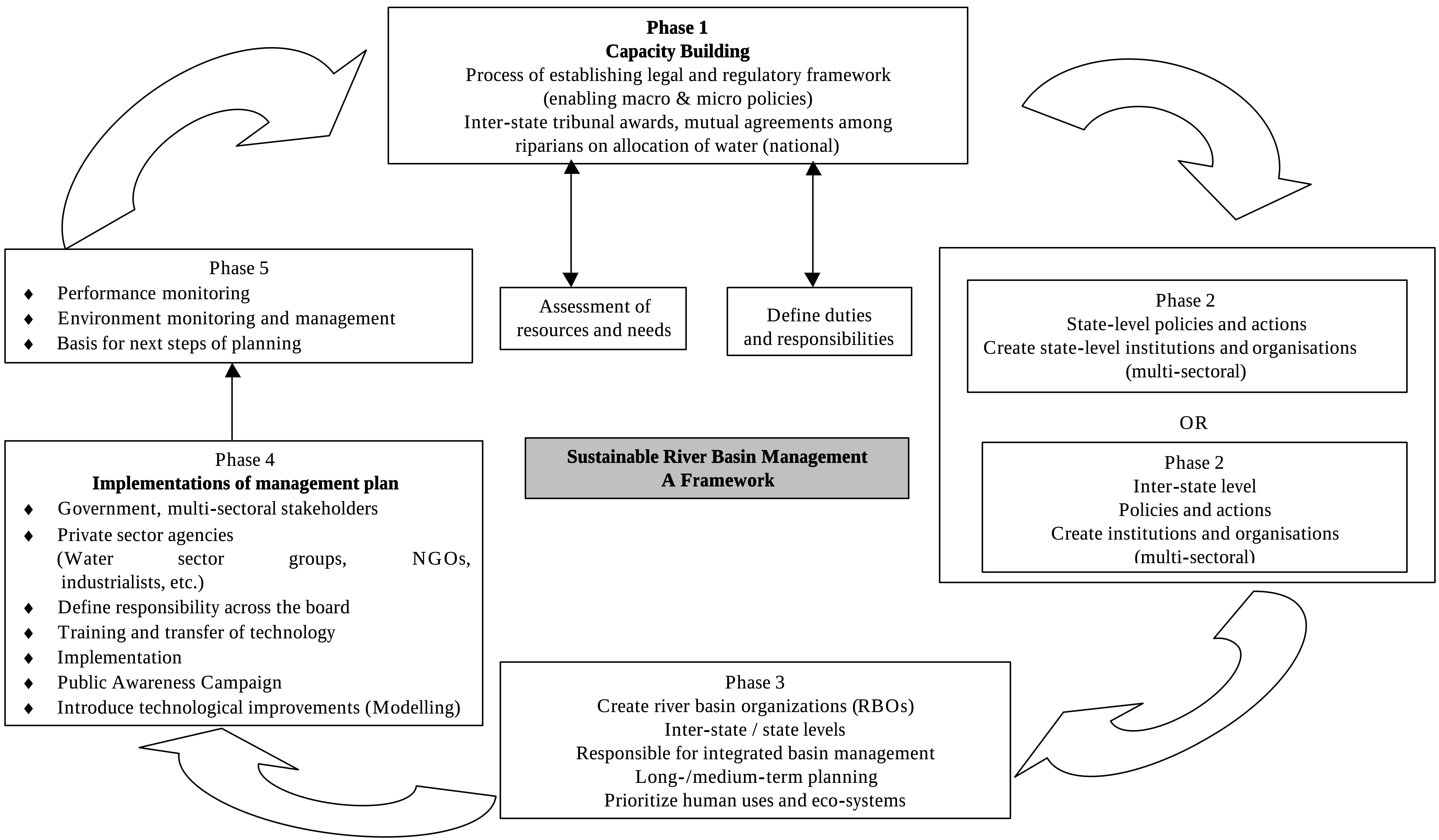
Strengthening central institutions to ensure that they play a significant role in determining planning and management of water resources is essential according to the World Bank (1999a). Greater interaction between the various government bodies under the water ministry is also needed, along with clarification of roles.

Reddy and Char (2001) suggest that river basin organizations (RBOs) be set up for integrated development of river basins. They suggest the revision of the ISWD Act, to take "cognisance of stakeholder participation". A phased process is envisioned with changes being instituted in legal and regulatory framework, state level and inter-state organisations, and implementation and monitoring. In the case of ISWDs, these RBOs would play a prominent initial role in bringing forward a solution, failing which recommendations for a tribunal could be made. The RBOs themselves, according to Reddy and Char (2001), would be gradually developed as monitoring institutions. Their first task may lie in collecting and analysing data along with preparing plans for basin development. Next, they could assist tribunals following which they could be authorised to supervise the development of basin plans. Figure 5.2 gives a schematic detail of the framework for a river basin management they recommend.

The World Bank (1999a) calls for an amendment to the River Boards Act to enable the setting up of RBOs. Again, like Reddy and Char (2001), it suggests the gradual development of these RBOs, which may begin as informal structures and then evolve into organized institutions with substantial regulatory and monitoring powers. It also calls for suitable amendments to the ISWD Act where the final decision of the tribunal should be followed by a mechanism for enforceable implementation and monitoring. At the state level, the World Bank suggests establishing a State Water Resources Board (SWRB) and a technical support wing called a State Water Planning Organisation (SWPO). These would reorient current thinking on state water planning towards river basin management, interacting with river basin boards to enable the capture of optimal benefits. They could also evolve river basin plans in coordination with other states. Furthermore, creation of RBOs that cut across state lines would enable the proper estimation of surplus waters, which would then be used for basin transfers (Figure 5.3)[28].

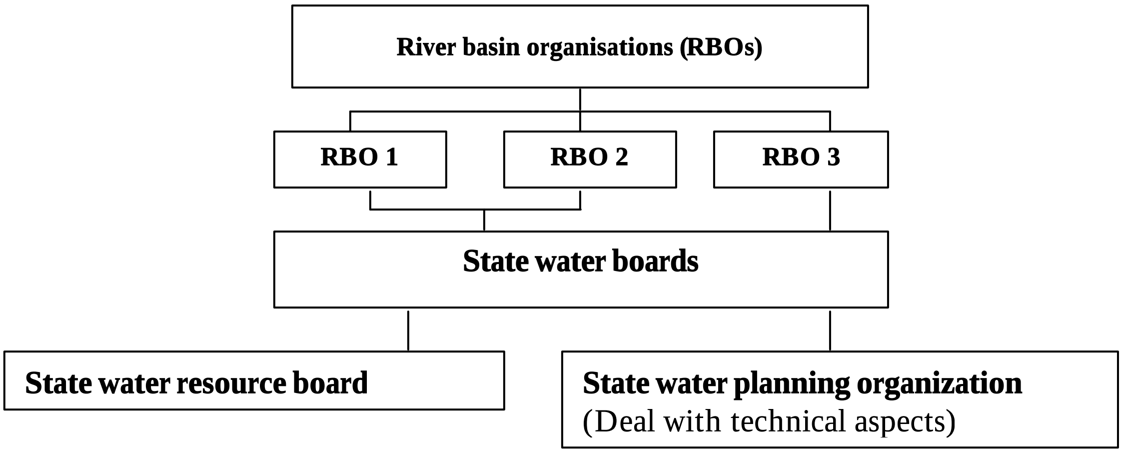
[28] The Ministry of Water Resources has proposed a phased approach to the formation of RBOs: In the first two years of the Eleventh Five Year Plan the Central Water Commission would identify potential basins where RBOs can be established and interact with the co-basin states of the identified basins for creation of RBOs. Study tour and visit to some of the successful RBOs by a high level delegation comprising of the Ministers and enior Officials of the Co-basin states along with concerned officials of Ministry of Water Resources would also be undertaken. Efforts would be made to reach a consensus with the co-basin states for the establishment of RBOs leading to agreements, (2) Three RBOs would be established during the Eleventh Five Year Plan period one each during 3rd, 4th and 5th year of the Plan. Implementation of this proposal, indicated in a comment by the Ministry, on the earlier version of this report, represents a very significant step forward in achieving an appropriate institutional design for the program.

Figure 5.2: Suggested Framework for a River Basin Organisation



Source: 1.A. Hewage-2000; 2. World Bank India-Water Resources Management Sector Review-1998, cited in Reddy and Char (2001)

Figure 5.3: Possible institutional structure for basins and states



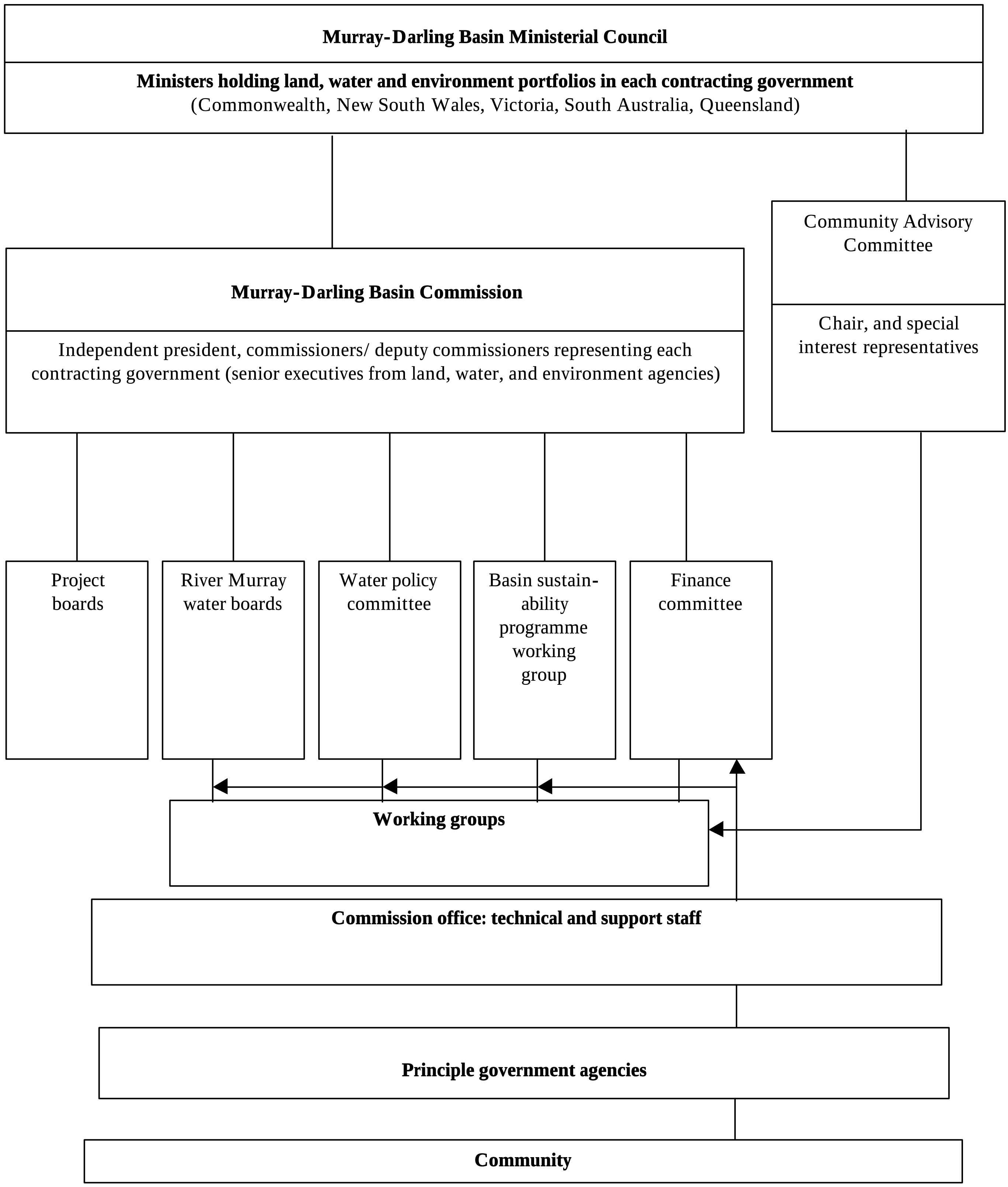
Source: World Bank (1999a)

Often, it is argued that water should be shifted to the Concurrent list. This proposal would meet adverse reaction from states. Currently, provisions of Item 20 on the concurrent list which highlight 'social and economic planning' are used; this translates into clearance requirements being needed from the Centre for all major and minor irrigation projects along with projects involving generation of hydroelectricity, control of floods, and multipurpose projects.

There are lacunae in the present institutional setup for water management and development (Richards and Singh 1996, Ramaswamy 2002, World Bank 1999a, 1999b). Richards and Singh (1996) suggest the creation of specialised permanent institutions to regulate the allocation of water across states, including the resolution of water disputes. Inefficiencies have arisen due to the induction of these hazards in the political process. There is a need to clarify and streamline procedures, reduce delays, and improve enforcement. The Murray River Commission in Australia[29] is a possible option (Figure 4), where states and central government have equal representation. Overseeing all the basins, it finds, requires an institution that will provide an umbrella for actual river boards of basin authorities.

[29] http://www.mdbc.gov.au/about/governance/overview.htm

Figure 5.4: Overview of the Murray Darling Basin Structure

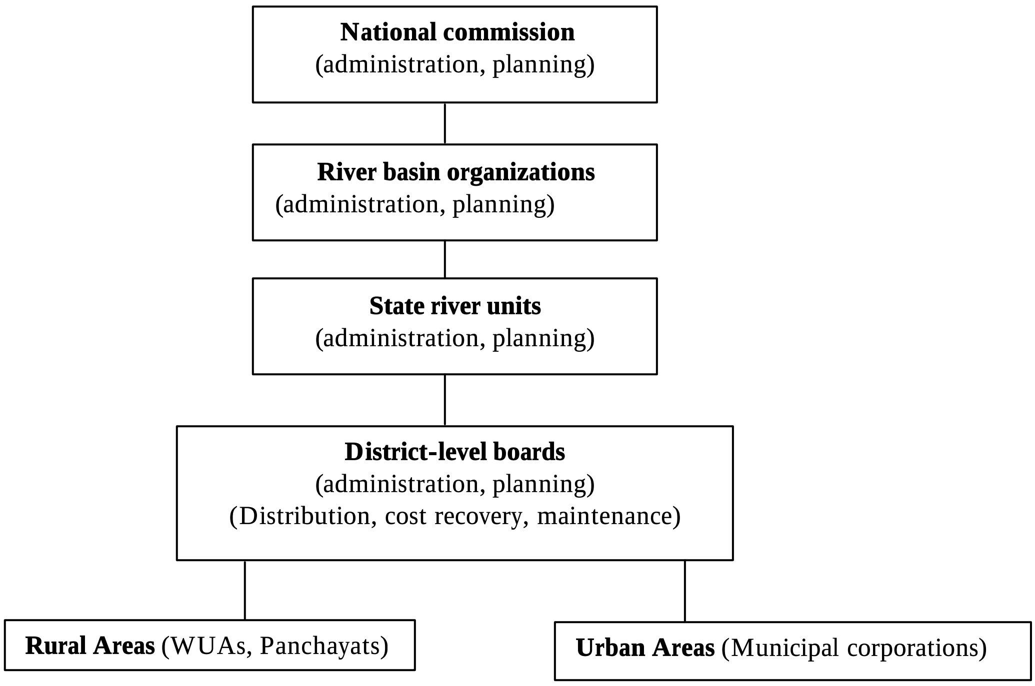


Source: http:// www.mdbc.gov.au/

The commission suggests a hierarchy of water management institutions, with river basin authorities being immediately below the national commission. The national-level water institution would incorporate the tasks of dispute resolution, perspective planning, information gathering, and maintenance. These tasks are, at the moment according to the authors, scattered among tribunals, NWDC (National Water Development Council) and the NWDA (National Water Development Agency). This planning combined with state- and basin-level units can co-exist with decentralized modes of distribution and management as highlighted in Figure 5.5.

These units at the lowest levels that function at the village/rural area through WUAs will play a key role, and their incorporation underlines the role played by *panchayat* legislation and greater community participation in resource management.

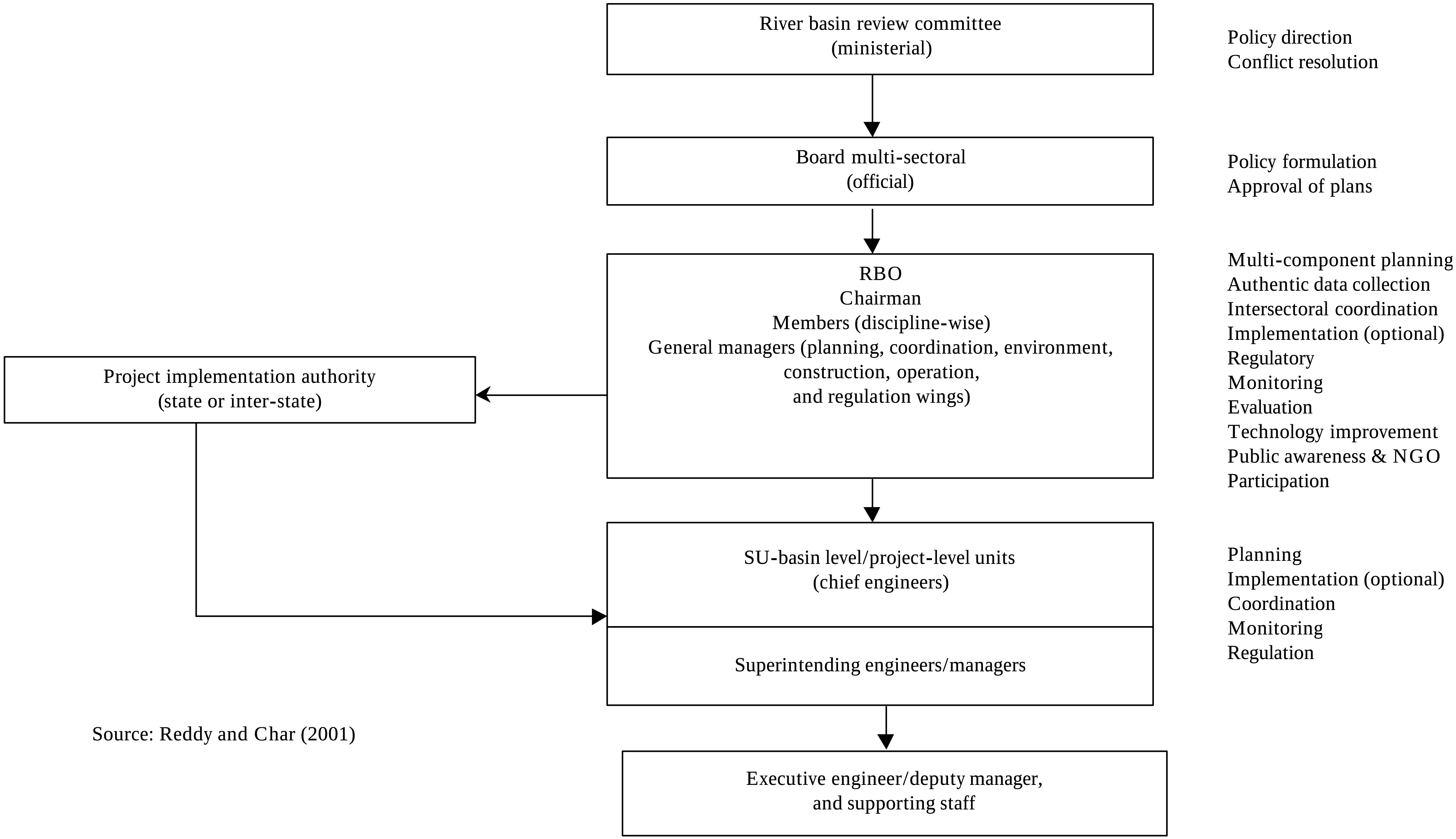
Figure 5.5: Possible Institutional Structure for Administration and Distribution



Source: Richards and Singh (1996)

Reddy and Char too envisage a vertical chain of officials that would encompass functions such as policy formulation, approval of plans, implementation, coordination, data collection, etc.. They highlight a 'project implementation authority' that would be either state or inter-state. However, unlike Richards and Singh (1996), they have not emphasized the role of WUAs and *panchayat* (Figure 5.6).

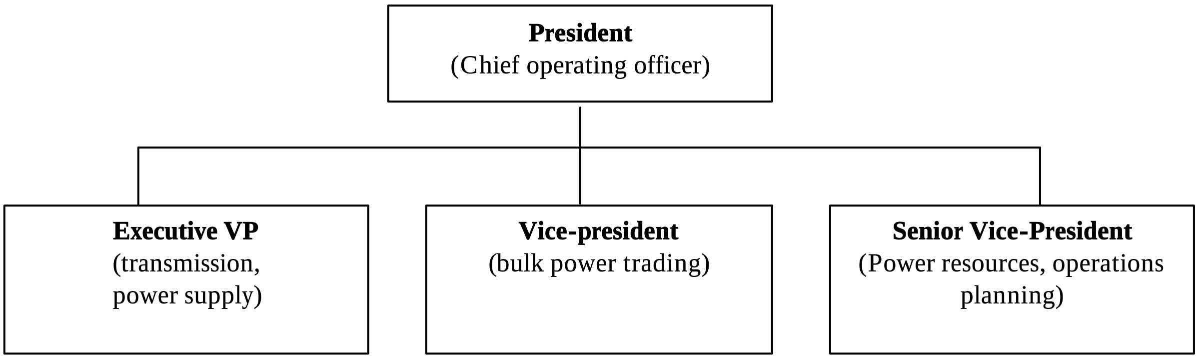
Figure 5.6: Framework for Organisational Structure



Source: Reddy and Char (2001)

The TVA is an example of a successful basin development programme. It remains the one energy provider with no federal state or local regulatory oversight. It is operated as a wholly-owned-and-financed corporation of the US. Congress controls appropriated funds provided to the TVA to carry out non-power programmes, but the board is under no obligation to follow these. The President of the United States directly appoints the board members. The TVA Act allows the agency to function as a government corporation with the flexibility of a private enterprise. The organization structure that emerged consists of an appointed board of three directors, a general manager, and a strong operating divisions (Figure 5.7).

Figure 5.7: Administrative Structure of the TVA



(Each subsection has further sub-divisions with well-defined roles)

The board's responsibility is to set policy, coordinate by a general manger, and carried out by professionals. While policy-making remains centralised, planning, management, and implementation have remained decentralised and are the responsibility of the operating arms. There has never been a master development plan—planning has been tied to operations and physical development programmes (USAID 2002). The decision-making process has relied on self-coordination and healthy tension. Even the board members have long fixed tenures of nine years, ensuring stability. Problems and conflicts are resolved at the lowest possible working level. The institutional framework has kept the agency action-oriented and grounded on impacting the lives of the inhabitants of the areas. This emphasis with a history of working through local agencies has built widespread grassroots support for the agency.

Dispute Resolution

Viewing the history of river development in India, the issue of dispute resolution is paramount when dealing with transfer of resources. This issue has been discussed above with the implicit understanding that the framework within which the scheme for monitoring the river basins will function will have a built-in mechanism for dispute settlement. In case of the Murray River Commission in Australia, equal representation to the Centre and states assures confidence in the resolution procedure.

Richards and Singh (1996) suggest the creation of specialised permanent institutions like the NWDC (National Water Development Council) and the NWDA (National Water Development Agency) with which states could lodge their disputes. Reddy and Char (2001) within the overall RBO framework emphasise the importance of dispute resolution, where the “river basin review committee” would deal with conflict resolution. However, details regarding the exact composition of such a committee are not underlined.

As experience with dispute resolution has shown, tribunals that fail to deliver quick judgements often compound the issue leading to acrimony and attrition of relations between states. Appropriate forums where the states can address their complaints to RBOs, where the aggrieved parties can redress their grievances—must be fitted into an overall framework. Adequate empowering measures must be given to the decision-making body to ensure compliance with the judgement. Furthermore, enforcement of the ruling must be ensured along with the provision for a court of appeal.

This could be carried forward through a reinterpretation of the Inter-State Water Disputes Act, where tribunals could find replacement by permanent independent Regional Monitoring Committees (RMCs) that would oversee 2-3 river basin organisations. These RMCs would not be directly involved with the overall day-to-day functioning of the river projects, but would be kept informed of key developments. Should a state have a particular dispute, it could lodge its complaint with the RMC which would promptly investigate the claim. Parties involved with the dispute would have a given fixed time period not exceeding a month to give its answer. The decision taken by the RMC would be final, with the provision for appeal. The whole process should not take more than two months, with appeals requiring to be made within 15 days of the judgement, following which none will be entertained.

The exact composition of the RMC will have to be determined. Serving/retired Supreme Court and high court officials could head the committees, being assisted by technical teams that would go into the intricacies of the dispute. The RMC could have a representative from the Centre that would report to the Secretary of Water Resources on the condition of inter-state and inter-basin relations.

Entries 17 and 56 of Schedule 7 relating to Article 246 which delineates the role of the Centre and states underlines the ambiguity present at the moment with regards to inter-state water usage and its development. Steps will have to be taken to clarify the position of the states with regards to development of water resources for national purposes.

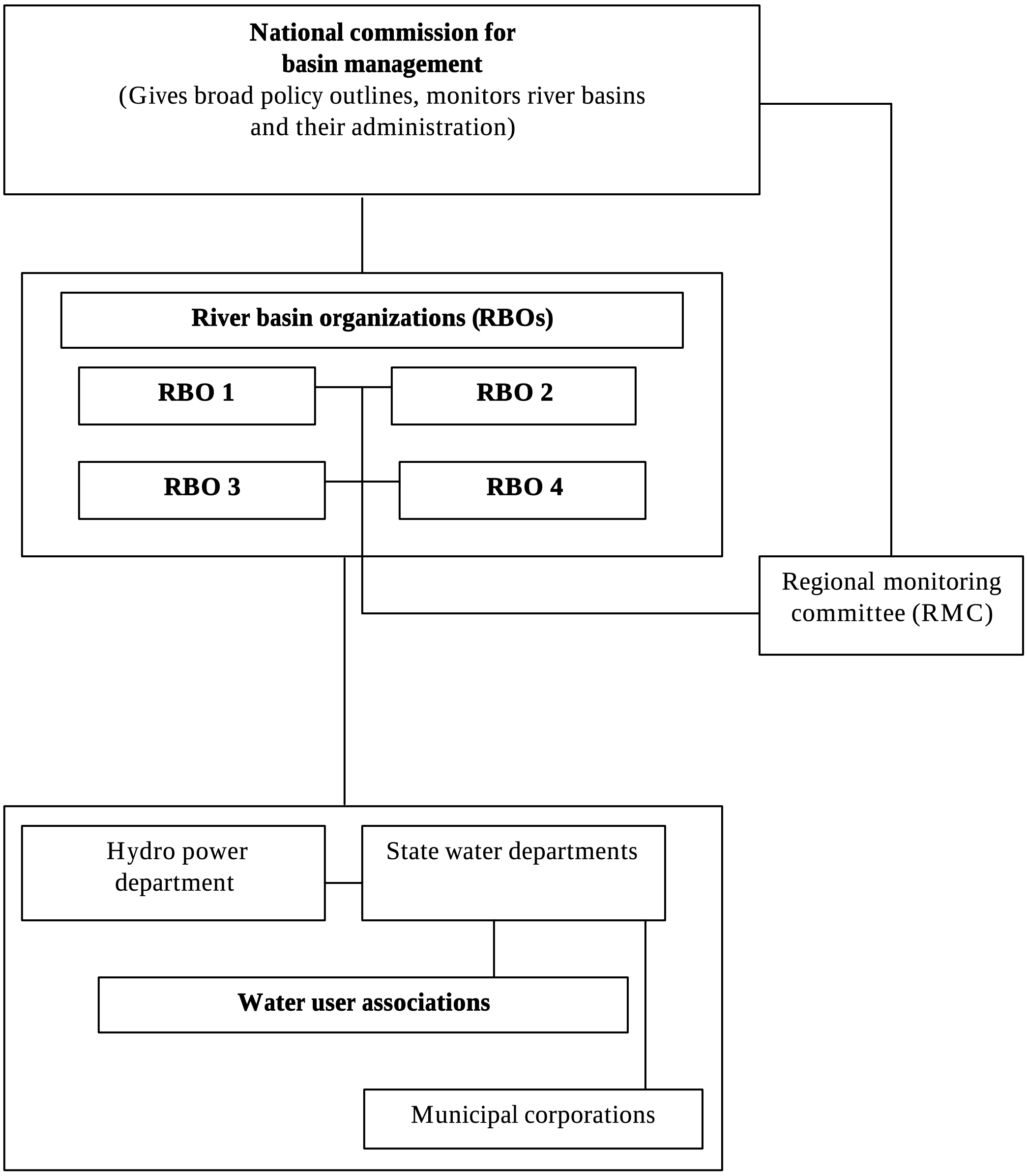
Suggestions for Institutional Framework

This chapter has highlighted a vast number of issues. As illustrated by Figure 1, there needs to be a reorientation of the current thinking in the ministry structure to reorient itself to the needs of river basin and participatory management. Furthermore, at the state level, the NCRWC (2002) and Reddy and Char (2001) emphasise the importance of negotiation as being the way forward in solving any conflict. Present political compulsions where multi-party democracy exists underline the need for co-operative solutions.

The Indian context will require a homegrown institutional structure. However learning from failures of river boards in the past and from their successes, as highlighted earlier we can strive to develop a homegrown institutional structure that would incorporate important elements such as WUAs, *panchayat*s and state irrigation boards.

Only with a framework that has a well-built in grievance redressal system, can faith be incorporated into the organizational structure. It is important to ensure that the common interests of all parties are met and proper representation—both Centre and state, is given in the institutional setup (Figure 5.8).

Figure 5.8: Possible Framework



Appendix 5.1: Some State-specific Laws for Irrigation

Andhra Pradesh

Andhra Pradesh (Andhra Area) Irrigation Cess Act, 7 of 1865.
Andhra Pradesh (Andhra Area) Canals and Public Ferries Act, 2 of 1890.
Andhra Pradesh (Andhra Area) Irrigation Works (Repairs, Improvement and Construction) Act, 18 of 1943.
Andhra Pradesh (Andhra Area) Irrigation Tanks (Improvement) Act, 19 of 1949.
Andhra Pradesh (Andhra Area) Land Improvement Schemes (Contour Bunding and Contour Trenching) Act, 22 of 1949.
Hyderabad Irrigation (Betterment Contribution and Inclusion Fees) Act, - 5 of 1952.
Andhra Pradesh (Andhra Area) irrigation Works (Levy of Compulsory Water Cess) Act, 24 of 1955.
Andhra Pradesh (Telangana Area) Irrigation Act 24 of 1957 F.
Andhra Pradesh Irrigation (Levy of Betterment Contribution) Act, 25 of 1965.

Tamil Nadu

Madras Irrigation Cess Act, 7 of 1865.
Bhavani Reservoir Irrigation Cess Act, 16 of 1933.
Periyar Irrigation Tanks (Preservation) Act, 5 of 1934.
Madras Irrigation Works (Repairs, Improvement and Construction) Act, 18 of 1943.
Madras Land Revenue and Water Cess (Surcharge) Act, 34 of 1965. Malabar Irrigation .works (Construction and Levy of Cess) Act, 7 of 1947.
Madras Irrigation Tanks (Improvement) Act 19 of 1949.
Madras (Additional Assessment and Additional Water-Cess) Act of 1963.
Mettur Canal Irrigation Cess Act, 17 of 1953.
Madras Irrigation (Levy of Betterment Contribution) Act 3 of 1955.
Madras Irrigation Works (Construction of Field Bothies) Act, 25 of 1959.
Madras Land Improvement Schemes Act, 31 of 1959.

West Bengal

Bengal Canals Act, 5 of 1864.
Bengal Embankments Act, 6 of 1873.
Bengal Embankment (Sunderbans) Act, 4 of 1915. Bengal Irrigation Act, 3 of 1876.
Bengal Drainage Act, 6 of 1880.
Bengal Embankment Act, 2 of 1882.
Bengal Development Act, 16 of 1935
Bengal Tanks Improvement Act, 15 of 1939.
West Bengal Closing of Canals Act, of 1959.
West Bengal Irrigation (Imposition of Water Rates Valley Corporation Water) Act, 26 of 1959.

Source: Jacob and Singh (2004)
http://www.saciwaters.org/db_irrigation_laws.htm#1

Appendix 5.2: Inter-State Water Disputes in India

River basins	State of dispute	States involved	Main problem/s	Agreement or institutional framework	Tribunal	Board	Extra information
Ravi-Beas Basin	**Unresolved**	Punjab, Haryana, Rajasthan	Rights and liabilities wrt BNP and Beas project		Yes	Bhakra Beas Management Board (Ministry of Power)	"Simply electoral politics" - No problems until separation of Punjab
Ganga							
Yamuna sub basin (Ganga basin)	**UNRESOLVED as courts intervene often**	UP, Delhi, HP, Haryana, Uttaranchal, Rajasthan	Ensuring Delhi gets its share to meet M&I needs as UP and Haryana can withdraw water upstream	Upper Yamuna Agreement May 1994		Upper Yamuna Board - for allocating flows among basin states, within overall framework of MoU	Interesting was that the total demand of the basin states was over three times the available flow in the river - purely political
Chambal River (Yamuna sub-basin, Ganga Basin)	**RESOLVED**	MP and Raj	Good example of mutual agreement	Entire development taken place by mutual consent without a formal agreement		Chambal Control Borad (Raj+MP+CG) resolves inter-state issues on ad-hoc basis	For Irrigation and power development - Although UP is a riparian, not staked claim on Chambal waters under "a tacit understanding with CG"
Son sub basin (Ganga Basin)	**Bansagar RESOLVED Rihand UNRESOLVED**	MP, UP, Bihar	Rihand dam's water releases to Bihar vis-à-vis hydropower emergency needs of UP power grid; Bihar's non acceptance of assessment of availability of basin yield			Bansagar Board (with Central Govt)	Utilisation plans for river have been formulated and specific agreements reached among co-sharing states for sharing of waters and benefits from identified projects
Damodar sub basin (Ganga Basin)	**UNRESOLVED**	Jharkhand, West Bengal and Central Government	Conflicting uses - DVC - power optimisation - WB govt - Irrigation - Jharkhand does not allow full flood storages in reservoirs as submergence effect in their state - coal mines submerged	Damodar Valley Corporation, set up under an Act of Parliament as a semi-autonomous organisation		First basin where integrated river basin development started, patterned on lines of TVA	"It will be difficult to reconcile the conflicting interests of the basin states and to develop the basin as envisaged originally".
Upper Ganga sub basin / Ramaganga sub basin (Ganga Basin)	**NO PROBLEMS YET**	Uttaranchal	Tehri dam controversial due to submergence issues; sharing of costs and benefits could be conflict prone	Ganga Management Organisation to come up under control of the Central Government - Uttaranchal and UP			

Contd..

Appendix 5.2: Inter-State Water Disputes in India (Contd..)

River basins	State of dispute	States involved	Main problem/s	Agreement or institutional framework	Tribunal	Board	Extra info
Brahmaputra basin	**NO CONFLICTS**	Arunachal Pradesh, Assam, Meghalaya, Nagaland, Sikkim, West Bengal	Sharing of benefits	Brahmaputra Board was set up under an Act of Parliament		Flood and erosion problems in the valley are endemic. Highest water resource potential	**No water sharing dispute as such -** issue of sharing of benefits from multipurpose projects only area of discord
Barak Basin	**UNRESOLVED**	Meghalaya, Manipur, Mizoram, Nagaland, Assam and Tripura	Reservoir submergences areas and sharing of benefits				Tipaimukh multipurpose project languishing due to disagreement amonst states on sharing of benefits
Narmada Basin	**UNRESOLVED**	Madhya Pradesh, Maharashtra, Gujarat	Resettlement; livelihood of people affected by submergence of lands; ecological considerations	Mutually agreed settlement (1974) worked out through PM, CMs on assessment of total available flows – principle of equitable distribution	Yes	Narmada Control Authority set up to implement decisions of Tribunal	Rajasthan included on grounds of social justice; Resettlement policy made for first time
Godavari Basin	**RESOLVED**	Maharashtra, Andhra Pradesh, MP, Orissa, Karnataka	Bilateral and trilateral agreements in the end solved the disputes (1975)	Krishna Godavari Commission set up in 1961 to determine dependable flow for sharing;	Yes		Largest basin in South India
Krishna Basin	**UNRESOLVED**	Maharashtra, Karnataka and Andhra Pradesh	Water utilisation in proposed projects, trans-basin diversion restriction, equitable distribution, dependable yield estimates	Projects cleared by Planning Commission even though states (such as Mysore) did not ratify agreements.	Yes	"….good illustration of how water tribunal awards result in *competitive disjointed investments* aimed at establishing claims to water when the awards come for review."	Second largest basin in South India; KG Commission found that without more data not possible to determine the dependable flow

Contd..

Appendix 5.2: Inter-State Water Disputes in India (Contd..)

River basins	State of dispute	States involved	Main problem/s	Agreement or institutional framework	Tribunal	Board	River basins
Telegu Ganga Dam (Krishna Basin)	**UNRESOLVED**	Andhra Pradesh, Karnataka and CWC	Prescriptive rights of states over project				
Cauvery Basin	**UNRESOLVED**	Karnataka, Kerala, Tamil Nadu, Pondicherry	Relevance of treaties made pre-independence; Allocation of waters; right of states; Trans-basin diversions should not be permitted; Revision of yield and utilisation figures		Yes	Cauvery Water Scheme and CR Authority set up 1998	
Pennar Basin	**UNRESOLVED**	Karnataka, Andhra Pradesh	Tank improvement and diversions				
Brahmani-Baitarani Basin	**NO DISPUTES**	Orissa, Jharkhand, MP	Basin has surplus water	All projects taken up by mutual agreement			
Subernarekha Basin	**NO DISPUTES**	Bihar, Jharkhand, West Bengal and Orissa	Well defined rights; costs and benefits				
Mahi Basin	**NO DISPUTES**	Rajasthan Gujarat MP		Project-specific agreements for sharing water, costs, resettlement, rehabilitation			
Tapi Basin	**NO DISPUTES**	Maharashtra, MP, Gujarat		Project-specific agreements		Intersectoral board	

Appendix 5.3: India and her Neighbours: Status of River Sharing

River system	Countries	Problem/s	Solution	Water principle
Ganga (*Mahakali* river)	Nepal	Reservoir submergence due to construction of Tanakpur Barrage and power project in India, sharing of power benefits, terms of power sale, rights of irrigation and sharing of water	Mahakali Treaty (1996) on basis of dialogue	Equitable principle recognising existing uses in India; Community of co-riparian states
Ganga (*Kosi* and *Gandak*)	Nepal	Conflicting interests as India wants to provide flood relief to Bihar and Nepal feels it will conflict with its optimal development	Negotiations and investigation continuing	-
Ganga (Farakka Barrage)	Bangladesh	Barrage built by India to augment flow of Hooghly River in West Bengal. Bangladesh feels leading to environmental instability and in times of low flow, below minimum water levels reaching Bangladesh	1996 Treaty on basis of dialogue	Community of co-riparian states; Absolute Territorial Integrity
Brahmaputra	Bangladesh	Refuses to allow development of water river system and diversion of water	Negotiations and investigation continuing	Ecological considerations; historical rights
Brahmaputra *(Tista)*	Bangladesh	Quantum of water sharing	Unresolved	Equitable basis
Brahmaputra *(Chukha* and *Tala)*	Bhutan	No problems - Power projects	-	-
Indus	Pakistan	Basin not treated as a single unit. Pakistan objects to Tulbul Navigation Project as it views it as a storage project - India views it as a control structure	Indus River Treaty 1960	Equitable basis

Chapter 6

Summing Up

Water is essential for production of food, economic growth health and support to environment. Its main contribution to economic well being is through its use for agriculture to improve food security. Water is essential to increase agriculture productivity under modern technology. Nearly 64 per cent of the population in rural areas and 4 per cent in urban areas depends on agriculture as their principal source of income. Incidences of poverty for agriculture dependent households are higher than other categories of households. Declining agriculture growth increases vulnerability of these households and these are more susceptible to shocks as compared to others. Despite experiencing a slowdown in growth and a decline in its share in GDP, agriculture is still one of the major growth drivers of Indian economy. Since 1950-51, Indian economy grew by more than 8 per cent only in four years. Each of these years coincides with high growth in agriculture sector.

The ILR programme although an ambitious programme certainly requires attention of policy makers. Experience of Pakistan in the area of interlinking of river could be an inspiration for India. Pakistan, built a network of river links as a part of Indus treaty works, which functions as replacement links to irrigate those areas, which after partition got deprived of irrigation when three eastern rivers of Indus system were allocated to India. Pakistan built ten links, six barrages and two dams during the post-treaty period of 1960-1970. Most of the links built are unlined channels. The total length of the links is 899 km and built at a cost of Rs 400 crore. These links have the aggregate capacity of 140,500 cusecs.[30] If Pakistan can manage to complete the interlinking of its river in 10 years, it should not be difficult for India to complete the task of interlinking of rivers.

The analysis carried out in this study shows that the ILR programme has the potential to increase the growth rate of agriculture, which declined from 4.4 per cent in the eighties to 3.0 per cent in the nineties and is still susceptible to the vagaries of rainfall.

[30] Dhillon, G. S. (2003), “The Pakistani Experience”, The Tribune, Chandigarh, June 29, 2003

In order to put economy of high growth path, and improve quality of life of people in the rural areas, a mixed policy of increased availability of irrigation and increasing non-farm activities is required. The experience of Haryana and Punjab in improving the standard of living in rural areas after Bhakra dam was constructed is a pointer to this. The construction of the Bhakra dam not only improved the quality of life in these two states, it also reduced the adverse effect of floods in these two states. A similar impact is also demonstrated by IGNP on the economy of Rajasthan. At the international level, too, there is a lot of evidence of improvement in economic conditions of people after the implementation of river valley projects.

The ILR programme is a major endeavour to create additional storage facilities and expected to provide additional irrigation in about 30 million hectares and net power generation capacity of about 20,000 to 25,000 MW. Other fringe benefit of programme includes mitigation of flood and drought to a certain extent, fishing at dams and reservoirs. In this backdrop, study evaluated impact of ILR programme.

It has been estimated that in short-term (during construction phase), major impact of this programme would be on employment and growth of cement and steel sector, which would generate demand in the economy. The impact of a Rs 10,000 crore investment in the construction sector will result in growth of construction sector by 3.80 per cent. However, due to its forward and backward linkages, the value added of cement would increase by 2.46 per cent, structural clay products by 2.37 per cent and basic metal and metal products by 0.65 per cent. The increased income in the economy would demand more goods and services and thus all sectors of economy would experience growth in their value-added. It is estimated that the incremental value-added generated in the economy would be Rs 17,424 crore (0.91 per cent) by Rs 10,000 crore of additional investment in construction. Direct employment in the construction sector would grow by 22.74 per cent. Sectors such as coal tar products, cement and electricity, gas and water supply would experience higher growth of employment than the construction sector. Total employment in economy would increase nearly by 4 per cent.

The ILR programme has the potential to reduce the vulnerability of Indian agriculture to rainfall and put agriculture on sustained growth path. It is expected that the ILR is capable of increasing foodgrain production growth by additional 2-percentage point over the baseline scenario foodgrain production is expected to be 305.66 million tonnes in the baseline scenario (without ILR programme). However, due to additional 2-percentage point growth in foodgrain production, it is expected to touch 393.88 million tonnes mark with MSTG link and 393.70 million tonnes mark with JTF link. The foodgrain production growth during 2008-09 (year when benefit of ILR programme in the form of increased irrigation benefit would start) and 2018-19 is expected to be double than that of baseline scenario. This could result in improving growth potential of the entire economy. As shown in chapter 3, increased irrigation availability could supplement overall economic growth by 0.37 percentage points and agriculture growth by 1.65 percentage points. Higher agriculture and overall growth could reduce the average inflation by 0.2 percentage points. Agriculture growth has strong poverty alleviation effects and incidence of rural poverty could decline by nearly 0.9 percentage points. However, the impact at the micro level, i.e., at command area level will be much larger as compared to macro level impacts. In order to evaluate impact of a particular link on regional economy, separate studies for individual links are required.

There is a general declining trend of agriculture productivity since the eighties. To meet the food requirements of the growing population, food production must grow faster than the population growth. The ILR programme would increase irrigation intensity of Indian agriculture. Augmentation of irrigation is crucial for second green revolution. The cost on not doing ILR programme would be slower growth of agriculture and will tantamount to forgoing 0.37 percentage point growth that ILR programme could generate. Other costs would be in the form of government expenditure on account of flood relief and drought mitigation.

Reduced poverty in rural areas would also reduce migration of the rural poor to urban areas and thus reduce the growth of urban slums and improve the environment in the urban areas. However, the ILR programme could lead to the average fiscal deficit of the central government increasing by 0.42 percentage points.

It is difficult to quantify economic impacts of benefits such as the mitigation of drought and floods, the increased income because of fishing and amusement parks at the dams and reservoir sites and so on. After the construction of Bhakra dam, Govind Sagar become a source of livelihood for oustee agriculturist of the area. Large number of local children, women and adults are catching fish in Govind Sagar. The fishing generates an income of Rs 5,000 per month for the locals and main profit goes to fishing federation of Himachal Pradesh.[31]

Indian irrigation suffers from the problem of low cost recovery. The issues of water pricing and cost recovery is complex and politically sensitive. It has been observed that

[31] Mohan, Lalit (2004), “From Farmers to Expert Fishers”, The Tribune, New Delhi, May 22, 2004.

many parties come to power by offering freebies—often in the form of free water and electricity to farmers—to vote banks. This puts a lot of pressure on the already-fragile fiscal condition of the state and central governments. Cost recovery from irrigation projects must improve and it should at least cover O&M cost. The quality of irrigation services is deteriorating and one of the major factors for this is low gross receipt from irrigation system due to low water rates. However, increasing water rates is not the solution to the problem, the quality of these services also has to be improved. A two-tier rate structure as proposed by the Committee on Pricing of Irrigation Water should come in force. The roadmap suggested by the committee can tackle the problems faced by the irrigation system in India. Emphasis should be laid on water users associations' and volumetric measure of water pricing for better collection of water charges and efficient usage of water.

Inter-state water disputes and problems faced by riparian states is not new, Cauvery water dispute is unresolved since 1990. These disputes arise due to no-agreement regarding terms equitable distribution of water within a river basin (intra basis water transfer) and further compounded by failure of states to comply with awards.

There needs to be a reorientation of the current thinking in the ministry structure to reorient itself to the needs of river basin and participatory management. Present political compulsions where multi-party democracy exists underline the need for co-operative solutions. The Indian context will require a homegrown institutional structure. However learning from failures of river boards in the past and from their successes, one can strive to develop a homegrown institutional structure that would incorporate important elements such as WUAs, panchayats and state irrigation boards.

Only with a framework that has a well-built in grievance redressal system, can faith be incorporated into the organizational structure. It is important to ensure that the common interests of all parties are met and proper representation—both Centre and state, is given in the institutional setup. Looking at inter-state water disputes and time taken to resolve these issues, the study recommend that there should be a national commission for basin management. This commission should give broad policy outlines, monitor river basins and their administration. Different river basin organisations should come under this national commission. There should be a regional monitoring committee to monitor different river basins in different regions. State hydropower department, water department should be under river basin organisations. Water user associations should be formed at micro level. These water user associations should have responsibility distribution of water and collection of water user charges.

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