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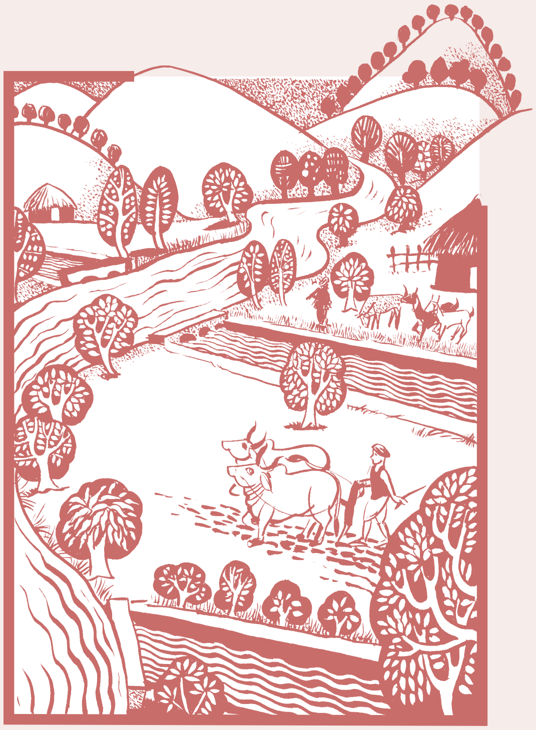
IWMI-TATA Water Policy Program



India's National River Linking Project (NRLP), which has been on the drawing board for some three decades, is the largest inter-basin water transfer planned to date in India or elsewhere. The idea has waxed and waned depending upon the political dispensation at any given point in time. Under the Challenge Program for Water and Food, IWMI undertook a broad strategic exploration of the basic idea of NRLP and its assumptions. This Highlight examines few contentious issues of the NRLP that received considerable attention in the national discourse. And it concludes that the donor basins may have surplus water to make NRLP technically feasible; however, there is need for nuanced analysis of whether, as the best possible option available to India, it is justifiable.

Water Policy Research

HIGHLIGHT

The National River Linking Project of India

Some Contentious Issues

Upali Amarasinghe

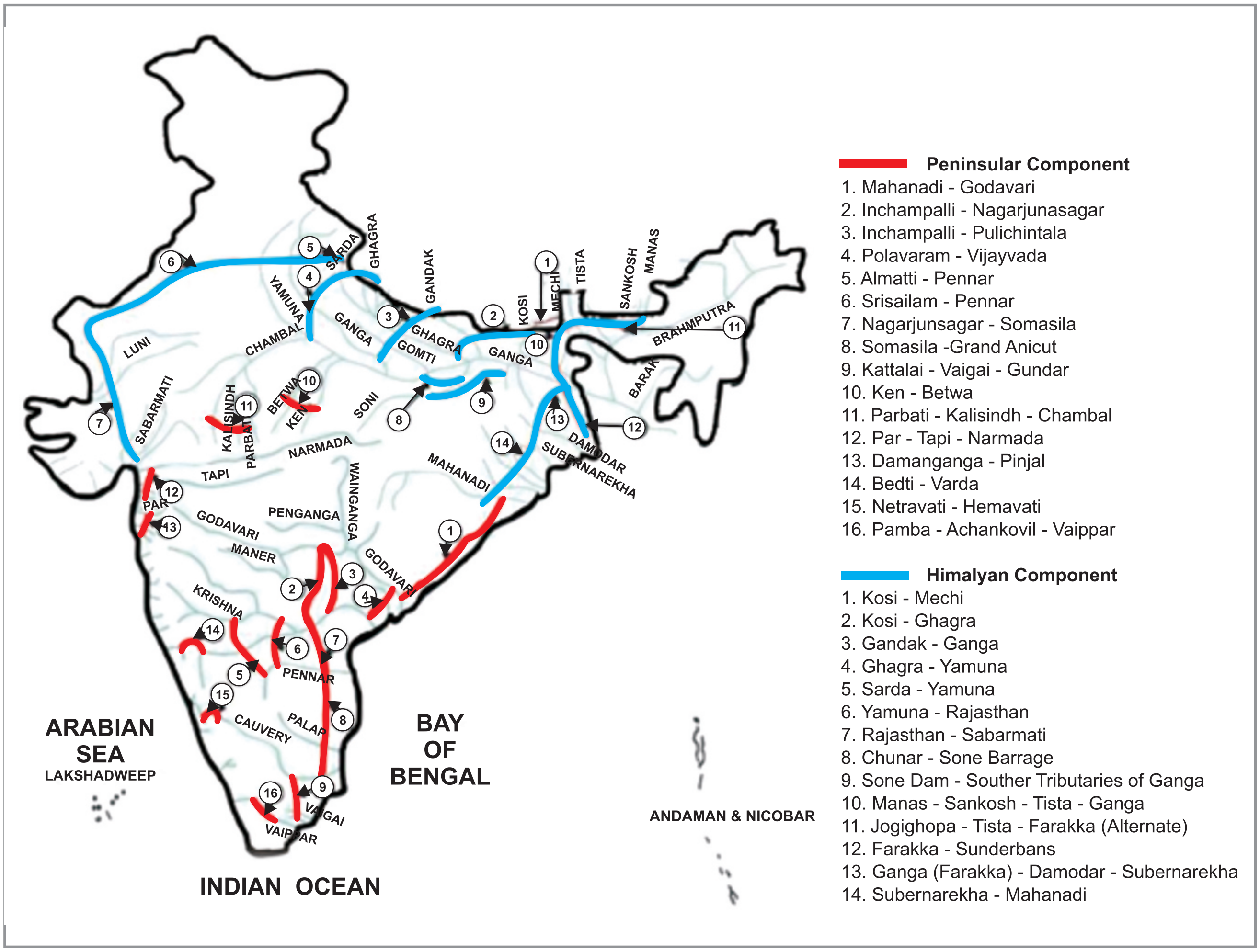
The National River Linking Project Of India
Some Contentious Issues[1,2]

Research highlight based on a paper with the same title[3]

Introduction

Coping with annual floods and droughts has been a paramount concern for India over the millennia. Such concerns will increase with a growing population and changing climate. Designed to address these concerns, the 'National River Linking Project' [NRLP] envisages transferring water from the potentially water surplus rivers to water scarce Western and Peninsular river basins.

Figure 1 The Himalayan and Peninsular components of the NRLP



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[1]This IWMI-Tata Highlight is primarily based on the CPWF Project Number 48 (Amarasinghe 2009) and the five edited books published under the "Strategic Analysis of India's National River Linking Project" of the *CGIAR Challenge Program on Water and Food Project* (Amarasinghe et al. 2009; Amarasinghe and Sharma 2008; Saleth 2009; Kumar and Amarasinghe 2008; IWMI 2009).

[2]The research for this Highlight is carried out with funding support of the CGIAR Challenge Program for Water and Food Project and International Water Management Institute. It is not externally peer-reviewed and the views expressed are of the author alone and not of IWMI or its funding partners.

[3]This paper is available on request from p.reghu@cgiar.org

The NRLP proposes to build 30 river links and more than 3000 storages to connect 37 Himalayan and Peninsular rivers.

The NRLP concept was contentious from the outset. The key disputed issues were the drivers that justified the concept, the hydrological and technical feasibility, environmental concerns, peoples' displacement and rehabilitation and resettlement, socio-economic costs and benefits, and lack of attention to alternative water management options. Yet, addressing public interest litigation, the Supreme Court of India has enjoined the Government of India to complete the project by 2016.

The most recent Supreme Court order in early 2012 has once again aroused the nation's interest on the NRLP. The proponents want fast implementation of the project while opponents concentrate on the contentious issues. This paper examines the merits of only the following three contentious issues:

- water surpluses of donor river basins;
- key drivers of justification; and
- the potential of alternative options of water management.

The next section gives a brief synopsis of the NRLP and the subsequent sections address the above three issues.

The National River Linking Project - Synopsis

The NRLP water transfers envisage easing the water shortages in Western and Southern India, while mitigating the impacts of recurrent floods in Eastern India. It constitutes two main components - the links, which will connect the Himalayan Rivers, and those which will connect the Peninsular Rivers (Figure 1). When completed, the project would consist of 30 river links and 3000 storage structures to transfer 174 billion cubic meters (BCM) of water through a canal network of about 14900 km.

Components of the NRLP

The Himalayan component proposes to transfer 33 BCM of water through 16 river links. It has two sub component linkings:

1. Ganga and Brahmaputra basins to Mahanadi basin (links 11-14); and
2. Eastern Ganga tributaries and Chambal and Sabarmati river basins (links 1-10).

The Peninsular component proposes to transfer 141 BCM water through 14 river links. It has four sub component linkings:

1. Mahanadi and Godavari basins to Krishna, Cauvery and Vaigai rivers (links 1-9);
2. West-flowing rivers south of Tapi to the north of Bombay (links 12 and 13);
3. Ken River to Betwa River and Parbati, Kalisindh rivers to Chambal rivers (links 10 and 11); and
4. some West flowing rivers to the East flowing rivers (links 14-16).

Project benefits

The NRLP envisages to:

- provide additional irrigation to 35 million ha of crop area and water supply to domestic and industrial sectors;
- add 34 GW of hydro-power potential to the national grid;
- mitigate floods in Eastern India; and
- facilitate various other economic activities such as internal navigation, fisheries, groundwater recharge, and environmental flow of water-scarce rivers.

The NRLP when completed, will increase India's utilizable water resources by 25 percent, and reduce the inequality of water resource endowments in different regions. The increased capacity will address the issue of increasing India's per capita storage. It currently stands at a mere 200 m^3/person, as against 5960, 4717 and 2486 m^3/person for the USA, Australia and China, respectively.

Project Costs

The NRLP will cost more than USD 120 billion (in 2000 prices), of which

- the Himalayan component costs USD 23 billion;
- the Peninsular component costs USD 40 billion; and
- the hydro-power component costs USD 58 billion.

Water surpluses of donor river basins

Donor river basins of the NRLP

The NRLP has three major donor river basins: the Brahmaputra in the Himalayan component, and the Mahanadi and the Godavari in the peninsular component. Do these river basins have adequate surpluses of river flows for inter-basin transfers? The NRLP project thinks so. It proposes to transfer 12.3 km^3 from the Mahanadi to the Godavari basin (link 1 in the Peninsular component), and 21.5 km^3 from the Godavari to the Krishna basin (links 2, 3 and 4 in the Peninsular component, which includes 6.5 km^3 of water transferred from the Mahanadi basin (NWDA 2012). The proposed quantities of water transfer from Brahmaputra to Ganga, Ganga to Subarnarekha, and then from Subarnarekha to Mahanadi, however, are not available yet.

However, the issue of surplus surface water in the donor basins is a leading cause of disagreement in the NRLP discourses. An extreme view is that no river basin is water surplus. Some argue, "…from a holistic perspective there is no surplus water in a river basin, because every drop performs some ecological service all the time… there is no free surplus water in a basin that one can take away without a price."

A moderate view is that a river basin can have surplus water if there is excess river flow after meeting the potential demand of agricultural, domestic and industrial sectors and an adequate allocation for the environment.

Utilizable water resources

The agricultural, domestic and industrial sectors meet their water demand from the potentially utilizable water resources (PUWR). The PUWR is the portion of the total renewable water resources (TRWR) that can be potentially developed for human use.

The Brahmaputra has the largest TRWR - 622 (=562+24+36) km^3 (Figure 2). This is 27 percent of the TRWR of all river basins in India, although only three percent of the total population lives there. However, due to topographical constraints the basin can potentially develop only four percent of the surface water resources. Along with groundwater, the total PUWR is about 51 (=24+27) km^3 (Figure 2), which is only eight percent (=51/622) of the TRWR. The water availability under this PUWR will be only 890 m^3/person by 2050, which is significantly below what Falkenmark et al. (1989) defined as the threshold below which emerges severe regional water scarcities.

The Godavari and the Mahanadi river basins, on the other hand, have much lower TRWR, but larger PUWR (Figure 2 and 3). The total PUWR of Godavari and Mahanadi are 77 (=117/151) and 80 (=67/83) percentage of the TRWRs respectively. These basins have six and three percent of the total TRWR of India, and six and two percent of the total population. The per capita PUWR of Godavari and Mahanadi will be 873 and 2068 m^3 per person respectively, indicating emerging regional water scarcities in the Godavari basin.

Water demand of the agricultural, domestic and industrial sectors

The projections of the National Commission of Integrated Water resources Development (NCIWRD) are the first cut estimate for the development of the NRLP concept (GoI 1999). The NCIWRD scenario 1 and 2 correspond to low and high population projections of 1346 and 1581 million people by 2050 (Table 1). A recent projection by

Figure 2 Renewable water resources and demand in the Brahmaputra basin

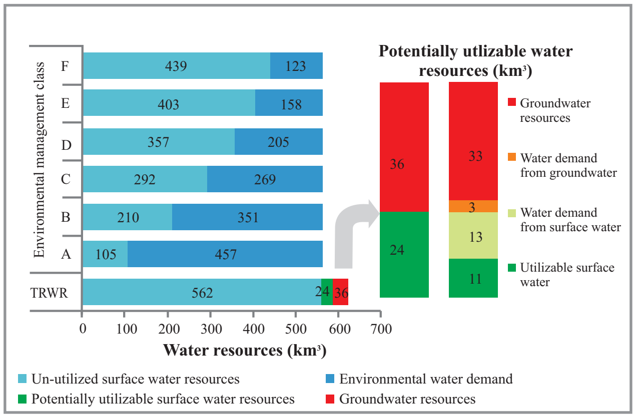


Figure 3 Renewable water resources and demand in the Godavari basin

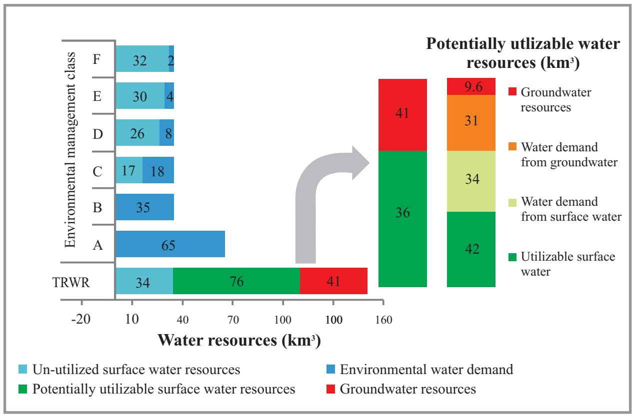
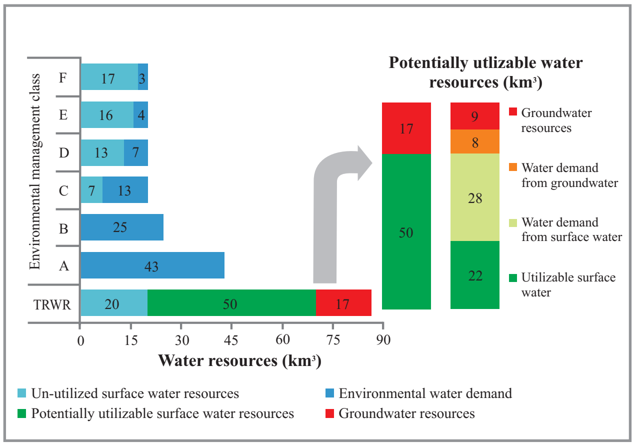


Table 1 Water demand of the agricultural, domestic and industrial sectors by 2050

River basin	Water withdrawals in 2000	Estimates of total water demand by 2050		
		Amarasinghe et al. BAU	NCIWRD Scenario 1	NCIWRD Scenario 2
Brahmaputra	7	21	-	-
Godavari	44	65	76	98
Mahanadi	20	35	53	60
India	694	905	973	1180

Sources: Projections of NCIWRD scenarios 1 and 2 are from GoI 1999; Estimate of water withdrawal in 2000 and BAU projections for 2050 are from Amarasinghe et al. 2007.

Figure 4 Renewable water resources and demand in the Mahanadi basin



Amarasinghe et al. (2007) also assumed a population projection of 1580 million by 2050 and considered recent trends of food consumption and water use patterns.

Except for the NCIWRD high demand scenario of Godavari, the PUWRs of the three basins are more than adequate to meet the future demands of the three sectors. Based on Amarasinghe et al. (2007) the total water demand by 2050 of the three basins are only 27, 56 and 54 percent of the total PUWR (second panels of Figures 2; Figure 3; Figure 4). The excess PUWR of 11, 42 and 22 km^3 are available for other sectors, including the allocations for the environment.

Environmental water demand

Environmental sector requires water for maintaining at least the minimum environmental flow (EF) of the river. Two factors determine the EF: natural hydrological variability of the river flow, which is an endogenous driver to the water system, and the environmental management conditions that the river ought to maintain, which often are exogenous drivers to the water system. The latter depends on human decisions on the qualitative importance they want to place on riverine ecosystems.

Based on the above factors, Smakhtin et al. (2006; 2007) have defined six environmental management classes (EMC-A to F) for river basins. The EMC-A maintains natural condition, where the riverine ecology is either pristine or has only minor modifications. Other classes - B to F - correspond slightly, moderately, largely, seriously and critically modified river conditions. The EMC-C has disturbed the habitat, but basic ecosystem functions are still intact. When a river reaches EMC-E or F, they destroy the basic ecosystem functions to the extent that the changes to the river ecosystem are irreversible. Thus, although the EMC-A is the ideal condition, the EMC-C is at least a desirable state for a river basin.

The Brahmaputra River can have surplus flow under any EMCs. The EMC-C requires only 46 percent {=269/(269+293+24)}of the mean annual runoff (MAR), which is well below the potentially not-utilizable portion of TRWR (Figure 2). This leaves a surplus surface flow of at least 293 km^3. The river can be maintained even at the most desirable condition of EMC-A, which requires 78 percent {=457/(457+105+24)} of the MAR. This still leaves 105 km^3 from MAR as surplus surface flow.

The Godavari River can also have surplus surface flow, but under slightly different conditions. The EMC-A in Godavari requires 31 km^3 (=65-34) of surface flow from the PUWR (Figure 3). This demand can still be met from the portion of PUWR (42 km^3) that humans do not require, which leaves only about 11km^3 of PUWR as surplus flow. However, EMC-C requires only 16 percent (18/(18+17+76) of MAR, which is well below the potentially not-utilizable portion of the river flow of about 35 km^3. This scenario leaves a surplus surface flow of about 59 km^3 (=17+42).

However, the Mahanadi River has no surplus flow under EMC-A. The demand under EMC-A (43 km^3) is more than the sum of the portion of TRWR that is not potentially utilizable (20 km^3) and the portion of PUWR that human uses do not require (22 km^3). In fact, MAR in Mahanadi can barely meet the EF demand under EMC-A. However, EMC-C leaves 29 km^3 (=7+22) as surplus river flow after meeting human and environmental demand.

Surplus river flows

All three key donor basins in the NRLP can have surplus flow. Brahmaputra River has surplus flow under any environmental water demand condition. On the other hand, the Godavari and Mahanadi rivers can have reasonable surpluses of surface flows only under EMC-C. However, some water transfer to Mahanadi and Godavari can make them also water surplus while meeting both the potential demand of humans and EF demand of higher EMCs.

In fact, the NRLP concept proposes water transfers to Mahanadi and Godavari river basins. First it transfers water from Brahmaputra to Ganga and then from Ganga to Subarnarekha (links 10 and 13 of the Himalayan component in Figure 1). Water transfers from Subarnarekha to Mahanadi (link 14 of the Himalayan component) partly substitute for water transfers from Mahanadi to Godavari (link 1 of the peninsular component, Figure 1). The water transfers from Mahanadi to Godavari partly substitute water transfers from Godavari to Krishna (link 4 of the peninsular component). Because of these substitution water transfers, the Mahanadi and Godavari rivers can have substantial surplus even after meeting the EF demand under higher EMC classes.

However, there is a small caveat regarding the water surpluses estimated under annual flows. The monsoonal rains during May to September mainly determine water availability in the peninsular basins. Thus, most deficits of EF occur in the dry periods from October to April. Thus, estimates based on annual river flows could be perceived to be more than adequate to meet the EF and other demand. However, the actual surpluses depend on the deficits of EF in dry periods, which are critical for maintaining the desired ecosystem functions.

Key drivers of justification

Self-sufficiency

Cropping patterns and irrigation demand for achieving food self-sufficiency are key planks for the NCIWRD justification of NRLP. Three concerns dominate self-sufficiency assumption. First, India has a large population and food grain is the staple food; so no major grain deficits are acceptable. Second, agriculture is the main driver of economic growth and is the livelihood of a large part of the rural population. Third, low foreign exchange reserves do not permit large food gains imports.

Many do not have any dispute with these assumptions, and indeed, they are reasonable for a large country like India. The contentious issues, however, are the estimates of food and water demand emanating out of these concerns.

Food grain demand

The NCIWRD projects that India will have to produce 450 million tonnes (or 284 kg/person/year) of food grains by 2050, and an additional 45 million tonnes for feed, seed and waste. However, recent trends show shifts in food consumption patterns. There are discernible trends of declining food grains consumption since 1990s (Figure 5). The National Sample Survey Organization (NSSO) surveys show declining trends are common in both rural and urban areas, and even among the low-income groups. There are shifts from coarse cereals to superior cereals and to vegetables and fruit. Milk consumption is also increasing rapidly. As a result, while the share of nutritional supply from food grains is decreasing, the contributions of other vegetable and animal products in the diet are increasing (Figure 6).

Based on these recent trends, the likely projections of food grains demand could be significantly lower than the NCIWRD projections. India's total grain demand shall increase from 217 million tonnes in 2000 to about 380 million tonnes by 2050, which is an increase of 75 percent compared to 54 percent growth in population in the 50-year period. This projection includes the feed grain demand of 120 million MT, which is a 10-fold increase from the present levels, a factor that the NCIWRD study has significantly underestimated. Even then, the revised recent projections fall short of the commission's projection by 115 million tonnes. Indeed, the reduction of irrigation requirement for such a difference of food grains is significant, which is close to 30 percent of the additional irrigation demand under NCIWRD high demand projections.

Rural livelihood needs

Rural employment was a key driver of irrigation development in the past. However, today's younger generation in Indian villages have different perceptions and priorities. The likelihood that young rural farmers will move out of agriculture is high, or they will keep it as a secondary income activity, regardless of increased access

Figure 5 Per capita food consumption trends (kg/year)

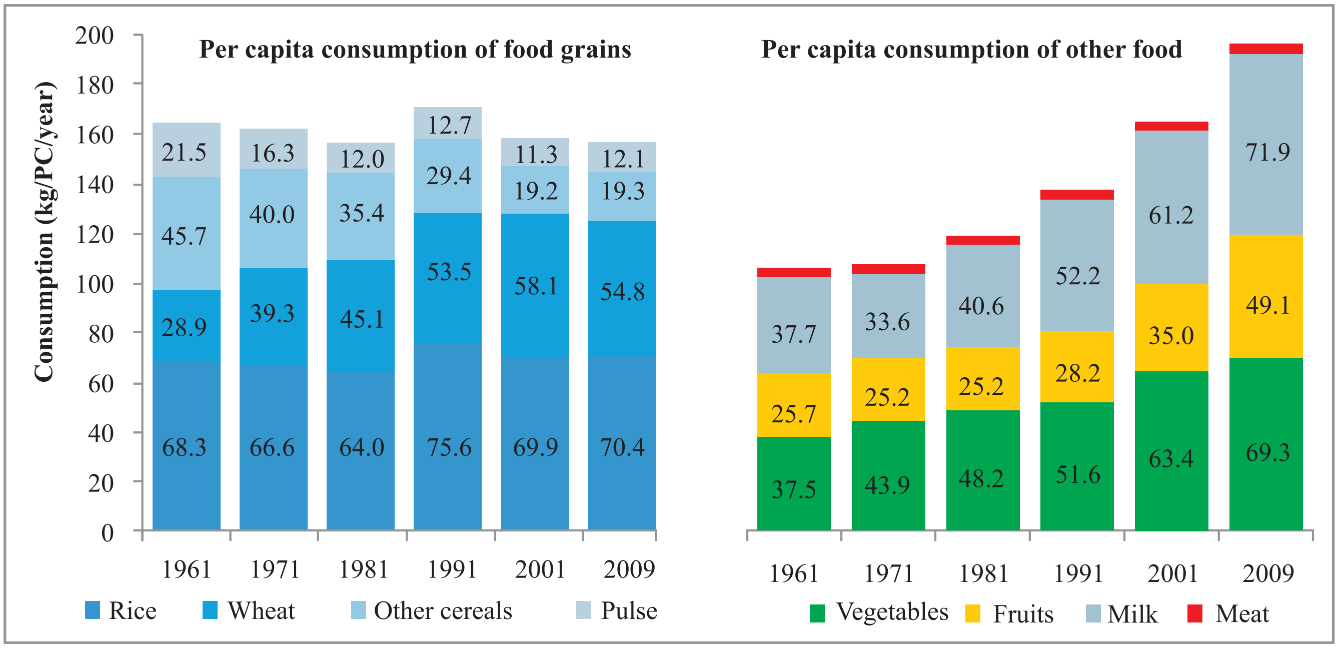
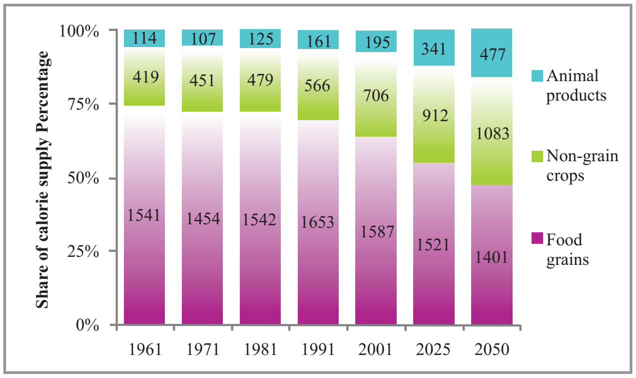


Figure 6 Changing calorie supply patterns in India



Source : 1961-2001 data are from FAOSTAT; 2025 and 2050 are author's estimates

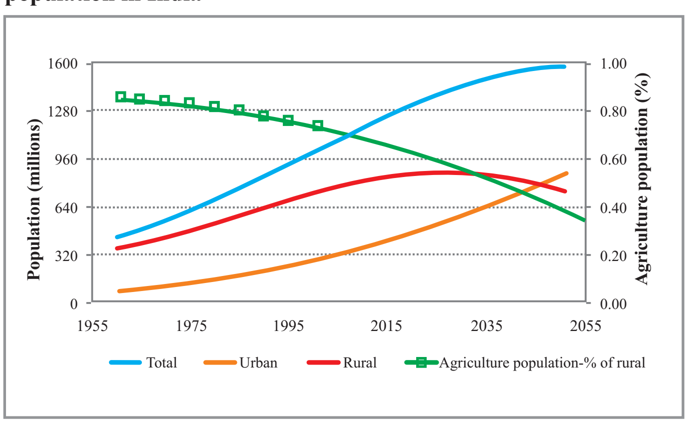
to irrigation. This is more evident among rural youth who have different skills and better education. The tendency of moving out of agriculture is also higher where the distance to travel to town or urban centers is less.

Certainly, the future generations of India will be more educated, and will be equipped with better skills. In addition, many rural centers will become small towns, and towns will become sprawling urban centers. Urban population will exceed the rural population before 2050 (Figure 7). Infrastructure facilities such as access to roads, electricity, and telecommunication are also increasing. Thus, migration from full time agriculture to nonfarm rural and urban livelihood will increase. In fact, there will be much less agriculture dependent population than today. This will be especially true in economically dynamic Southern states, which, in fact, are supposed to be the recipients of the NRLP water transfers.

Costs and benefits of irrigation water transfers

Another raging issue in the NRLP discourse is benefits and costs. The NRLP water transfers envisage benefiting irrigation the most. It plans to add 34 million ha of new irrigated croplands (24 mha through surface and 10 mha

Figure 7 Rural, urban and agriculturally dependent population in India



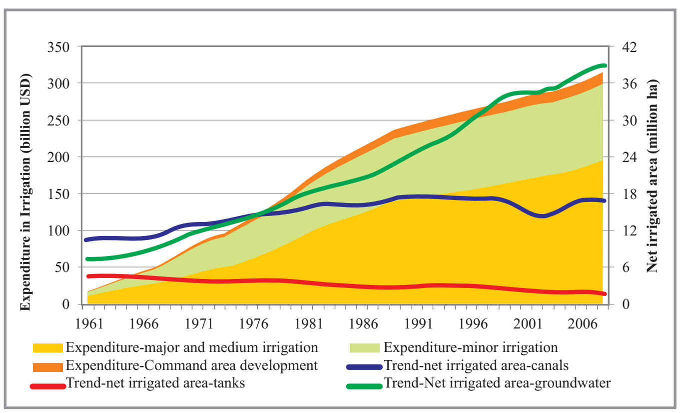
through groundwater). The financial and social benefits, both direct (crop production) and indirect (backward and forward linkages), of irrigation are major components of the benefits. However, achieving this would require committing an outlay of about Rs. one lakh[4] crores[5] (USD 24 billion) annually over the next 50 years. Given the past trends of investments and returns, whether the irrigation benefits that these would generate are worth the cost is indeed a moot point.

Past irrigation investments

Indeed, going by the past trends, returns to investments in the major/ medium irrigation show an abysmal picture. Since 1991, India has invested more than Rs. 1.88 lakh crores (USD 53 billion in 2005 prices) in major and medium irrigation alone, yet it has hardly resulted in any addition to net irrigated area by government canals (Figure 8).

Tamil Nadu and Andhra Pradesh, two of the key water recipient states of River Linking project, spent over USD 7 billion (2005 constant prices) in canal irrigation since 1991 but lost close to 5 lakh ha of net irrigated area under major and medium schemes (Figure 9). Similarly, Gujarat has already spent more than Rs. 20000 crores in the

Figure 8 Growth of public expenditure in irrigation and net irrigated area growth



Sardar Sarovar project, although the envisaged cost of construction in the planning was only Rs. 6840 crore (1986/87 prices). In spite of the enormous cost overruns, at present, it irrigates only 0.1 million of the 1.8 million ha of the proposed area.

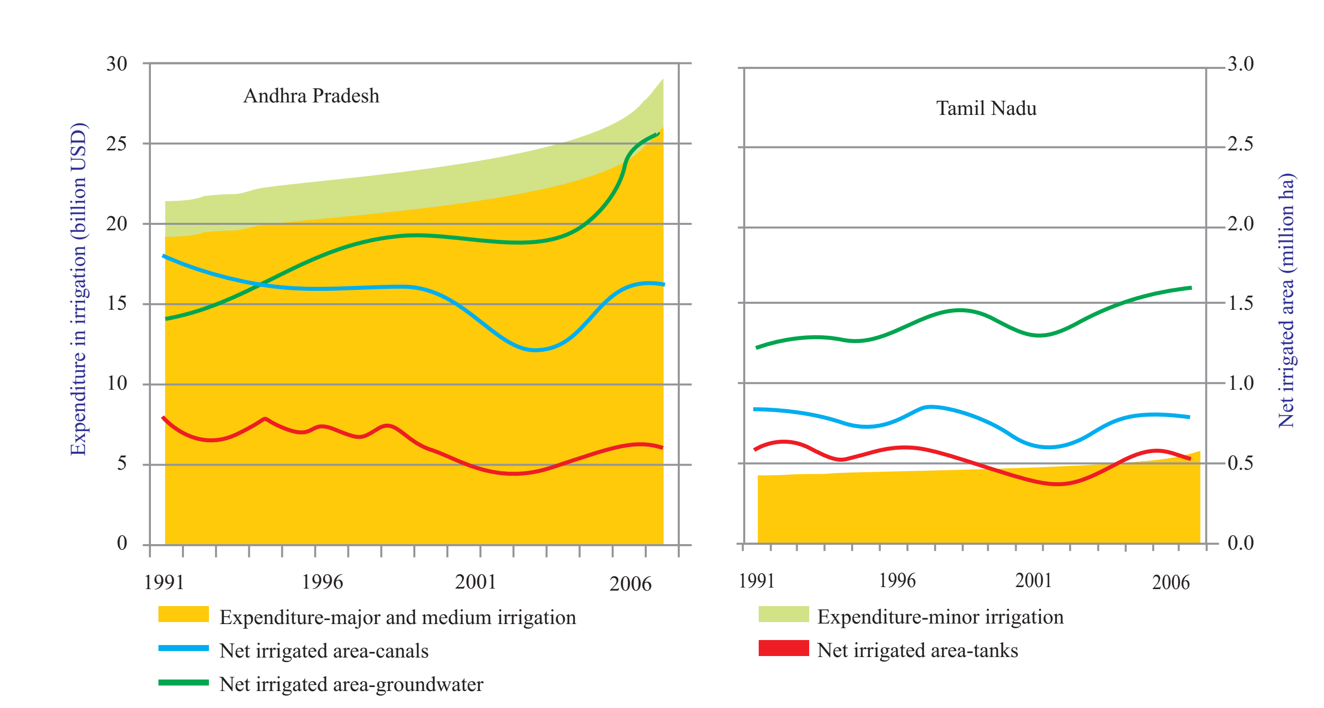
Cost and benefits of irrigation in the NRLP links

If considered independently, some links of the NRLP could have low returns. For example,

- In the Godavari (Polavaram)-Krishna (Vijayawada) link of the Peninsular component, irrigation already meets water demand of a major part of the proposed

[4] 1 lakh = 0.1 million
[5] 1 crore = 10 million

Figure 9 Growth in public expenditure in irrigation and in net irrigated area in Andhra Pradesh and Tamil Nadu



command area. At present, groundwater irrigates more than 90 percent of the en-route command in the Godavari-Krishna link. Thus, the estimated additional net value added economic benefits per additional cubic meter of proposed water transfers is low.

- In the Ken-Betwa link command of the peninsular component, South-West monsoon meets almost all water demand in the *kharif* season. However, a substantial part of the proposed irrigation transfers is for the *kharif* season. Moreover, rice is a dominant crop in the proposed cropping pattern, whereas rice cultivation in this area, even under present irrigation conditions, has decreased significantly in recent years. Thus, the direct and indirect benefits per every cubic meter of water consumed or delivered are rather low even under most optimistic scenarios of cropping patterns.

However, if considered together, the inter-dependent links of the peninsular component can have higher benefits than cost. The proposed water deliveries of the peninsular links (Figure 1) start from the Northern-most link, Mahanadi, to Godavari. It substitutes water demand for the Godavari downstream, so that it can transfer the surplus water from the upstream of Godavari basin to Krishna basin. Similar substitutions occur in water deliveries from Godavari to Krishna, Krishna to Pennar and Pennar to Cauvery. Thus, this system of link canals is inter-dependent. Although the net value added financial benefit of water transfers to en-route command areas of some individual links exceeds the cost, peninsular system taken together has higher financial benefits than cost.

In fact, if water transfers are for irrigating new high value crop areas, even the command areas of individual link could be highly beneficial, financially. If the irrigation cropping already exists in the proposed command areas, then appropriate high-value cropping pattern could make the system of links financially viable. This finding is consistent with the irrigation cost and benefits of existing schemes. That is, the large projects with many smaller schemes do perform positively from an economic perspective. Additionally, projects with diversified cropping patterns or those managed by farmers' or Water Users Associations (WUAs) tend to have better economic performance.

However, these ex-ante studies on irrigation cost and benefits have some limitations. First, they did not incorporate the cost of resettlement and rehabilitation of a large number of displaced people, and second they did not take into account the cost of environmental services lost to donor basins due to large water transfers. Finally, they did not factor the benefits of hydropower generation at various storage sites. Without them, the social cost benefit analysis would not be complete.

POTENTIAL OF ALTERNATIVE WATER MANAGEMENT OPTIONS

Many have criticized NRLP for inadequate attention given to alternative water management strategies. This section considers three potential areas: increasing water productivity, improving rainfed agriculture in managing the water demand and artificial groundwater recharge in managing the supply.

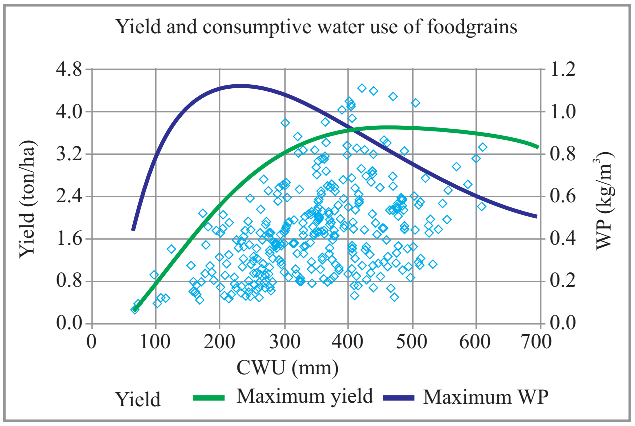
Water productivity improvements

Water productivity improvements could reduce the water demand, reduce the surface and groundwater over-draft and protect the environment. In Indian agriculture, potential exists for both improving water productivity (WP) and increasing food grain production.

The total Consumptive Water Use (CWU) from irrigation by food grain crops in 2000 was only about 155 km^3, while irrigation withdrawals for food grains were about 430 km^3. The irrigated area contributed to two-thirds of the food grain production of 200 million tonnes. Figure 10 shows a significant cross-district variation of land productivity with respect to consumptive water use (CWU). Thus, the water productivity varies significantly across districts too (Figure 11).

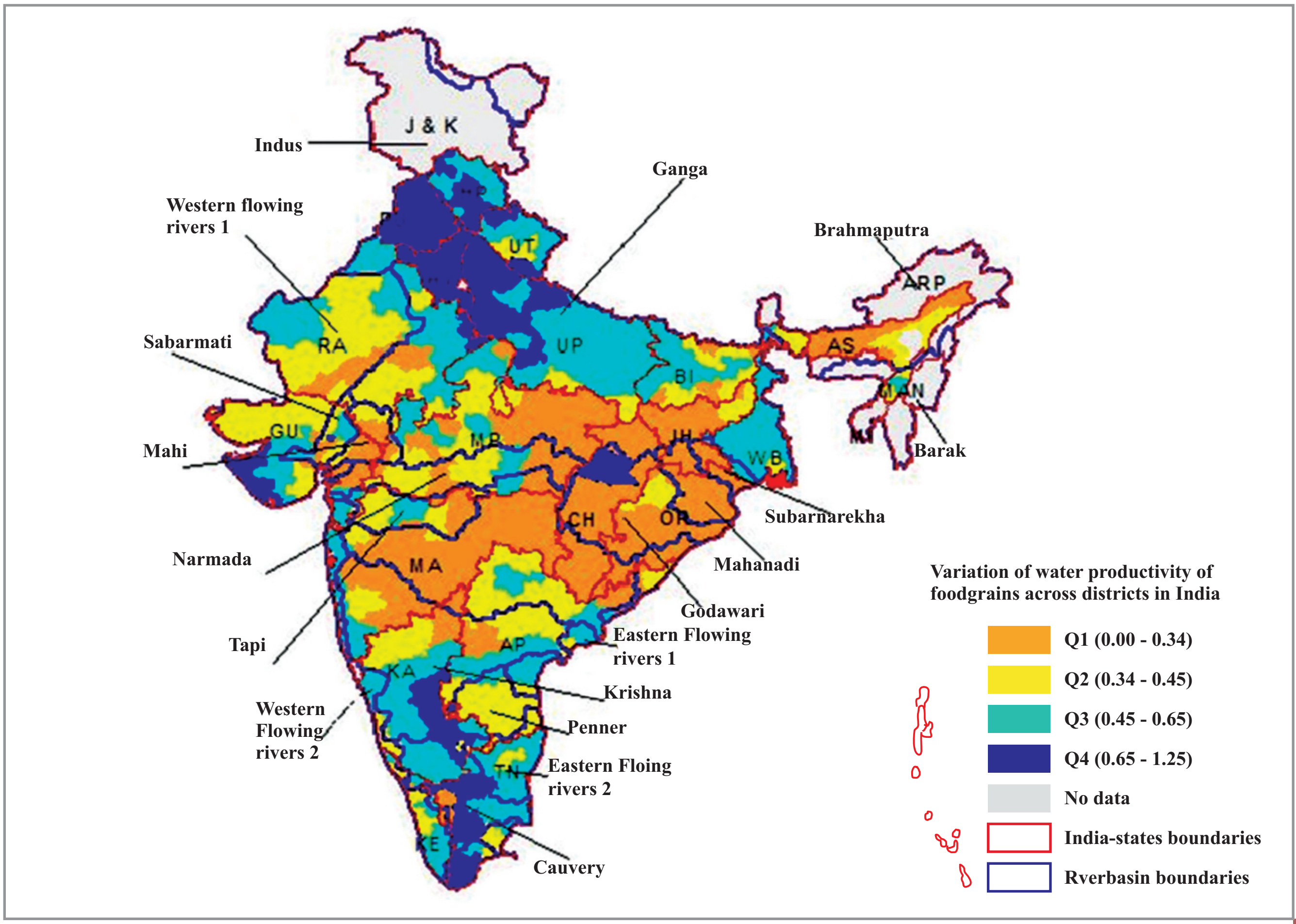
If each district reduces the gap between actual and maximum attainable grain yield by 25 percent, total grain production increases by 50 million tonnes. A reduction of yield gap by 50 percent, 75 percent and 100 percent could increase production to 300, 349 and 397 million tonnes respectively. The latter require only little over one percent increase annually in average yield, and the resultant total production is adequate for meeting the grain demand in 2050.

Figure 10 Yield versus consumptive water use of food grains



Because irrigation CWU is only 36 percent of the irrigation diversion, a significant increase in production is possible without additional irrigation. Because of the large variation of yield at different levels of CWU, better input and water management alone can reduce a large part of the gap between actual and maximum attainable yield. This requires no additional irrigation and perhaps no additional CWU too.

Figure 11 Variation of water productivity across districts in India



Rainfed agriculture

The rainfed agriculture contributes meagrely to current food production. It covers about 60 percent of the crop area but contributes to only one-third of the of the food grain production. Did the NCIWRD ignore the potential in rainfed regions, where much of the area will not receive the NRLP water transfers?

In fact, the commission did consider rainfed agriculture in food demand projection, but they projected only a modest growth of rainfed grain yields from 1 tonne/ha in 1993 to 1.5 tonnes/ha by 2050. However, by doubling the rain-fed yield, to about 2.0 tonnes/ha over the next 50 years, the grain production on the existing rain-fed lands can alone be increased by 81 million metric tonnes. This increase in grain yields - a proposition seemingly possible in 50 years - can meet a substantial part of the future food demand.

Frequent occurrences of mid-season and terminal droughts are the main causes for low yield or crop failures in Indian rain-fed croplands. Small supplemental irrigation, especially during the water-stress period of the reproductive stage of crop growth, can benefit a substantial part of the rain-fed area. This requires collecting only 18-20 km^3/year of rain water for supplemental irrigation.

Water availability is not a constraint for supplemental irrigation in large parts of rain-fed areas. There is 28 million ha of rainfed lands that can benefit from supplemental irrigation. These lands generate about 114 km^3 of runoff annually. Only a fraction of this runoff can provide critical supplemental irrigation to 25 million ha of croplands during normal monsoon and 20 million ha during the drought seasons. Supplemental irrigation of this harvested water during the later stages of crop growth has the potential to enhance rain-fed production by more than 50 percent.

Artificial groundwater recharge

For many centuries, surface storages and gravity flow has been the main source of irrigation for Indian agriculture. However, over the last four decades, while surface irrigation has been gradually declining, groundwater irrigation through small private tube wells has been flourishing (Figure 8). By 2005, groundwater contributed to 61 percent of the gross irrigated area, but this contribution could be even more if it accounts all the conjunctive water use in the canal command areas.

Contrary to what most claim, groundwater irrigation has spread everywhere, even outside canal command areas where recharge from surface return-flows could not have reached. The tube well boom has made a significant part of India's agriculture production and rural livelihoods depend on groundwater irrigation, but also made large areas prone to over exploitation.

Sustaining groundwater irrigation is essential for a country like India for many reasons. Groundwater irrigation:

1. gives large spatially distributed social benefits to vast rural areas, which surface irrigation has not reached or cannot reach, and benefit a large number of smallholders in Indian agriculture;
2. is more efficient, thus allowing better application of agriculture inputs and crop intensification and diversification. This gives higher yields and income per unit land than in canal command areas, and
3. is a better mechanism for drought proofing. It can also mitigate impacts due to climate change.

For sustainable groundwater irrigation, India needs to invest more in artificial recharge in many locations and better managements of aquifer storages. India already has in place a National Master Plan for Groundwater Recharge, augmenting the resources annually by another 38 BCM. The program, costing Rs. 24500 crore (USD 6 billion at January 2008 exchange rate), can achieve its potential benefits by addressing the shortcoming of the master plan.

Conclusion

The key donor river basins in the NRLP have surplus river flows under different environmental management conditions. The Brahmaputra River has surplus flows under any environmental flow management regimes. The Mahanadi and the Godavari can have surpluses under moderately modified environmental conditions. However, inter-basin transfers to Mahanadi and then to Godavari allow them to have surplus river flows, while managing them under slightly modified environmental flow conditions. However, if these surpluses are to transfer elsewhere, the overriding requirement is to safeguard their environmental flow requirements in the low-flow months.

The irrigation demand projection by NCIWRD, justifying the NRLP concept, seems an over-estimate. Even under business as usual conditions there is no question that India will need more water supply than the current level of irrigation withdrawals. However, this could be significantly lower than the demand of the high-projection scenario that was used to justify the NRLP. Much of this is due to large over-projections for food grain demand. Unlike in the NCIWRD assumptions, much of the additional water demand in the future could be non-agricultural. They include the rapidly increasing water demand for the industrial and domestic sectors and for ecosystems services.

Alternative supply and demand options have a significant potential for meeting part of the future demand. Land and water productivity improvements, both in the irrigation and the rainfed sectors, beyond the assumed levels by the NRLP, could reduce the additional demand. The productivity improvements in irrigated and rainfed lands have large benefits. It not only reduces the demand for additional irrigation, but also generates significant distributional benefits to large areas and many farmers in distress. Artificial water recharge, wherever possible, can augment the water supply and reduce the requirement for inter-basin transfers. This is important because, contrary to what the NCIWRD has projected, the groundwater irrigation has outpaced surface irrigation by a huge margin in the last two decades.

The requirement of magnitude of water transfers or returns to investments in irrigation in individual links as proposed in the NRLP are indeed contentious issues. However, the benefits of irrigation in the interdependent links as proposed in the NRLP, but with a high-value, agricultural production patterns could exceed the cost.

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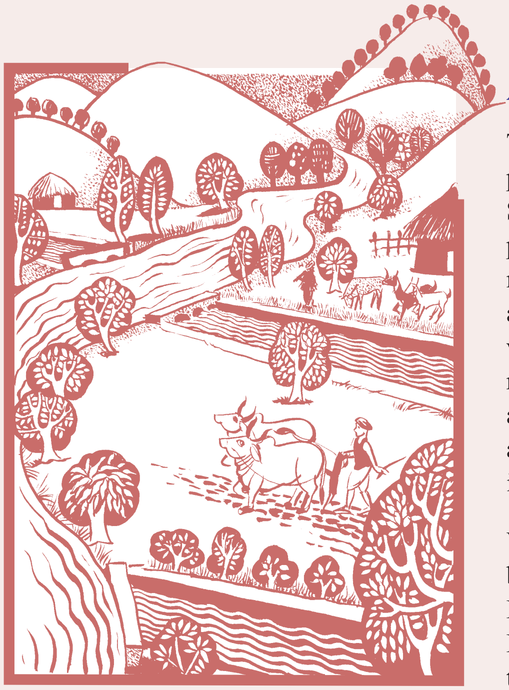

About the IWMI-Tata Program and Water Policy Highlights

The IWMI-Tata Water Policy Program (ITP) was launched in 2000 as a co-equal partnership between the International Water Management Institute (IWMI), Colombo and Sir Ratan Tata Trust (SRTT), Mumbai. The program presents new perspectives and practical solutions derived from the wealth of research done in India on water resource management. Its objective is to help policy makers at the central, state and local levels address their water challenges – in areas such as sustainable groundwater management, water scarcity, and rural poverty – by translating research findings into practical policy recommendations. Through this program, IWMI collaborates with a range of partners across India to identify, analyze and document relevant water-management approaches and current practices. These practices are assessed and synthesized for maximum policy impact in the series on Water Policy Highlights and IWMI-Tata Comments.

Water Policy Highlights are pre-publication discussion papers developed primarily as the basis for discussion during ITP's Annual Partners' Meet. The research underlying these Highlights was funded with support from IWMI, Colombo and SRTT, Mumbai. However, the Highlights are not externally peer-reviewed and the views expressed are of the author/s alone and not of ITP or either of its funding partners.

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