Draft

India's River Linking Project: The State of the Debate[1]

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Abstract

The idea of linking water surplus Himalayan rivers with water scarce parts of western and peninsular India has been doing the rounds for the past 150 years. However, the idea has now got detailed in the form of a mega-project for inter-linking of Himalayan and peninsular region. Never in the past has this idea generated as much discussion and debate as during the recent years after the Supreme Court of India enjoined the Government of India to implement the grandiose project by 2016, an impossible timeframe.

The Indian proposal for the mega project of inter-linking of rivers (ILR) has come at a time when large dams and canal infrastructure are facing an all-time low. Environmental groups are seriously questioning the ecological costs of large dams; and other NGOs are asking whether the human displacement and misery these cause, given India's poor track record of rehabilitation of the displaced populations, would permit these to pass an objective social cost-benefit test. To add to these, the performance of public irrigation projects has continuously been slipping. Finally, there is widespread questioning of the justification for such investment when agriculture is shrinking in water-scarce western and peninsular India and future food demand appear largely over-projected.

This paper takes stock of the debate so far that has emerged around India's ILR project. If the paper sounds lopsided in the critical picture it creates about the ILR project, it is because the debate itself has been hopelessly lopsided --with the protagonists of the project unable to take on the antagonists on either their rhetoric or their analytics.

In concluding this survey, we however argue that the idea of ILR may have come a decade too soon; and that a slew of upcoming contingencies will not only change the tenor of the debate around inter-basin water transfers but even make a compelling case for them, even if in a different form than the present proposal. Seven such contingencies have been identified:

[a] Just as a cash-strapped China cold-stored Mao's proposal for South to North transfers until mid-1990's, a US $ 2 trillion Indian economy around 2015 may take more enthusiastically to the idea of massive water infrastructure investment that amounts to more than the current US $ 700 billion Indian economy;

[b] Economy-wide demand for improved performance of public systems in infrastructure creation and management—in road, railways, power, etc—will also restore public confidence in the water bureaucracies' capacity to deliver on their promises, and ease the prevailing opposition to " sterile gigenticism";

[c] Similar economy-wide pressures to improve the rehabilitation of projected-affected people in roads, Special Economic Zones (SEZ) and such other dynamic infrastructure areas will raise the bar

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for R & R work in water infrastructure projects, alleviating the other major concern of civil society about large water projects;

[d] Increasing disposable incomes will prompt the 'median voter' to demand better water services and pay for them, transforming extant water scarcity into *economic* water scarcity; this will improve the financial viability and sustainability of water infrastructure; it will also mean water conflicts will be resolved through price negotiations rather than through political bargaining or through administrative processes;

[e] similar pressures in agricultural water demand will arise due to intensive diversification of Indian agriculture that generates higher output-value per m^3 of water; diversification will create *economic* demand for more reliable, on-demand irrigation service for which farmers will be willing to pay substantially more than they pay for canal irrigation today;

[f] rising energy costs will make pump irrigation increasingly unattractive and increase demand for surface water either for direct application to crops or for groundwater recharge in western and peninsular India; rising costs of fossil fuel will also make hydropower dams more attractive; and

[g] finally, rapid growth in urban agglomerations will seriously strain their groundwater-dependent water supply systems and make inter-basin water transfers for urban water needs economically viable and politically compelling.

India may or may not implement ILR as proposed; however, there seems no avoiding massive water infrastructure investments on a scale similar or even exceeding the ILR. Medium term water sector planning needs to take account of these seven contingencies rather than just making mechanical projections of future water demand.

I. *Introduction*

For a people reveling in discord, Indians have become increasingly one when it comes to sharing the dread of their water-scarce future. Also visible with this increasing concern is a growing sense of popular disenchantment with the inadequacy and apathy of governments in dealing with recurrent cycles of flood and drought occurring all at once in different parts of the country. So when the President of India, in a speech addressed to the nation on the eve of Independence Day 2003, declared- "The first mission (of my government is) on the Networking of Rivers … This will eliminate the periodical problem of droughts and floods ... and provide both water and power security", he was answering this popular concern.

For long notables have argued that the answer to the drought-proneness of western and peninsular India lies in the flood-proneness of the east, and vice versa. Sir Arthur Cotton, who restored the Grand Anicut on the Cauvery and remains a cult figure in the Deccan villages since the early decades of the 19^{th} century had thought of a plan to link rivers in southern India for inland navigation. More recently during the mid-1960's, Dr KL Rao, a well-respected technocrat, presented a crude proposal for a Ganga-Cauvery Link from a point below Patna. A few years later, Captain Dastur, a pilot speculated aloud about a lateral Himalayan canal from the Ravi to the Brahmaputra along a constant 400-metre contour interconnected with a Garland Canal girdling peninsular India. But ideas like the Garland canal and the Ganga-Cauvery Link were routinely dismissed as too grandiose for a resource-strapped nation. The Indian psyche was however never fully disabused of the idea; and as Prime Minister, Mrs. Indira Gandhi constituted the National Water Development Agency (NWDA) to start detailed planning of a mega-project which no one imagined would ever leave the drawing board.

Implementing the mega-scheme--pre-feasibility studies, feasibility studies, environment impact studies, and the lot--was destined to be a long-drawn out process. But in 2003, acting on an innocuous petition from a lawyer, the Supreme Court of India decided that the time had come for the nation to pull its act together on the water front, and enjoined the Government of India to complete all planning required to launch the project by 2006, and to complete the Project itself, by 2016. Without losing time, Prime Minister Bajpai of the then ruling NDA government—who had so far been an avid advocate of local rainwater harvesting--constituted a high-powered, multi-disciplinary task force to embark upon the Project forthwith and asked Suresh Prabhu, a young, highly regarded minister to lead it. Many expected the idea to fall by the way side when the NDA government fell. Moreover, a groundswell of opposition has emerged from environmental groups and civil society organizations that have begun to question the basic model of water resources planning and management based on large-scale dams and canal networks.The new UPA government has waxed and waned on the mega-project; but it is hard to tell when the idea will rise from its ashes like the phoenix and bestride the Indian discourse on water scarcity like a colossus.

II. *Resume of global experience*

Even as India has been procrastinating, the rest of the world has gone about inter-basin water transfer (IBT) projects at a brisk place during the past 50 years or so. Global and local opposition notwithstanding, China has steadfastly stayed course on its own scheme of transferring 48 km^3 of water from Yangtze to the Yellow to improve water availability in dry plains of North China. Elsewhere in the world, many IBT projects have faced a variety of problems and produced some unwanted side-effects; however, in overall terms, most have turned out to be beneficial in balance. Even a wary global environmental review of IBTs (Snaddon, Davis and Wishart 1999)—which advocates using precautionary principle, concluded that:

> *In many parts of the world, water transfers have become the lifeblood of developing and extant human settlements, for which no alternative is currently perceived to be available."*

If an IBT is viewed as 'the mass transfer of water from one geographically distinct watershed to another' (ibid), IBT has been central theme of the story of human development over the last 6000 years. Inter-basin water transfers are nothing new even in India. Colonial irrigation works in the Indus and Ganga basins were early successes in large-scale inter-basin water transfers. Elsewhere in the world, we find much older cases. China's Grand Canal, Roman aqueducts and *quanats*, or sub-surface water galleries from Spain through the entire middle-east down to Baluchistan represent. Diversion of the Periyar river in 1985 to augment the waters of the Vaigai in Tamil Nadu, the Krishna-Cuddapah (Pennar basin) Canal and the Telegu Ganga canal that provides Krishna water to increase drinking water supply to Chennai are recent case of IBT success. The Indira Gandhi Nahar (IGN) or Rajasthan Canal carries over 9.362 km^3 (7.59 million acre feet) of Ravi and Beas waters through the Bhakra for irrigation in the Thar desert. The Sardar Sarovar Project carries Narmada waters across seven basins to the arid areas of North Gujarat, Saurashtra and Kutch (Verghese 2003). With the growth of science and engineering and growing water scarcity, however, IBT projects during the past century have become increasingly large in the volumes handled and bold in their design. Moreover, with water and environment issues increasingly entering the public discourse, planning and executing IBT projects has involved not only engineering and technology but complex social management as well. We illustrate the issues with the help of two examples, one from a rich country context and another from an emerging economy context.

The first is the 50 year old Colorado Big Thomson, USA, which illustrates the life-cycle of a water infrastructure project over a period of rapid socio-economic change occurring around it. Relative to the scale of water transfers India is contemplating, the Colorado-Big Thomson is a minor intervention, yet it diverts approximately 0.284 km^3 /annum (0.23 million acre-feet) of water from the upper reaches of the western flowing Colorado river, one of the most "closed" basins in the World, and sends it eastward into the South Platte River Basin, which is part of the Mississippi-Missouri basin. This project, implemented by the United States Bureau for Reclamation (USBR), was constructed between 1938 and 1957. Its primary purpose was to provide water for irrigation, and municipal and industrial use along the front range of the Rocky Mountains in northern Colorado. It provides water to 29 municipalities, including Fort Collins, Boulder, Loveland and Longmont; over 100 ditch and reservoir companies (water users associations), and 251,000 hectares (620,000 acres) of irrigated land (Colorado State University, 2006). Hydropower is also generated as the water flows down the Big Thomson river, a portion of which is used to drive the pumps which lift the water on the western slopes into the diversion tunnel. In implementing the project, the USBR included the key stakeholders, particularly the irrigation districts (water users associations) who were to benefit from the increased and more reliable water supplies, and the relevant municipalities, which collectively formed into the Northern Colorado Water Conservation District (NCWCD). Even when this project was developed, the implementation had to navigate arguments between government agencies, protests from environmentalists concerned with the preservation of a National Park, disputes between the communities in the western and eastern slopes, heated arguments over water rights, and such things as labor and materials shortages brought on by World War II (Autobee, 1996). Over the years the project has evolved. The NCWCD, effectively the water users, now operates the entire system. Also, growing awareness and new legislation have resulted in increased attention to the environmental needs in both the receiving and "donating" river systems. Finally, while there remains a vibrant irrigated agricultural economy in the area that utilizes the bulk of the water supply, the relative role of agriculture in the regional economy has significantly diminished, and in the past two decades or so municipalities, including those further to the south in the urban conurbation of greater Denver, have acquired some of the water rights from the farmers to meet the growing domestic and industrial demands. Even today the Colorado-Big Thomson project has its detractors decades after it was developed. To take a quote from the local newspaper:

> *"New generations take an ample water supply for granted, and political clout has passed to environmental lobbies that have made water providers the goats instead of heroes." (Hornby, 1993).*

The second example, of the well-known Lesotho Highlands Water Project (LHWP), built and managed by Lesotho and South Africa, illustrates the dynamic of IBT in a developing country context. This was developed to divert water from the relatively economically poor yet water rich country of Lesotho, to the prosperous, water short South Africa, specifically the wealthy province of Gauteng. It transfers water from the upper reaches of the Orange/Senqu rivers, and diverts it into the Vaal River. Initial investigations for the project began in the 1950s. Attempts to subsequently implement a project failed as the two countries could not reach agreement. In the early 1980s further planning and then feasibility studies were undertaken with the involvement of both parties, and the project as conceived at that time formed the basis of the treaty between the two Governments, which was signed in 1986.

As designed, the LHWP would be one of the largest water transfer projects in the world, estimated to cost $8 billion. Phase 1, which was completed in 2004 at a cost of approximately $2 billion, diverts approximately 750 million m^3 per annum. It is comprised of three storage dams in the upper reaches of the Orange/Sengu river system, 110-km of transfer tunnels leading to the Vaal river via a hydropower station, 300-km of access roads, and, while not included in the original design, a number of environmental and social mitigation and enhancement measures (Earle and Turton, 2005). Royalties and hydropower revenues from Phase 1 contributed approximately $31 million to Lesotho in 2004, or about 5% of the GDP.

The location of the major works of the project is sparsely populated. The treaty allowed for the management of the environment, sustaining existing livelihoods and compensation mechanisms for those negatively impact by the project. The implementation of Phase 1a and 1b included environmental impact assessments and environmental action plans, which included resettlement and development, public health and natural environment and heritage components (Mochebelele, 2000). However, a thorough environmental flow analysis was not initiated until 1997, by which time Phase 1a was already constructed (IUCN, 2003). The initial concept had been to maximize the quantity of water transferred with limited regard for in-stream flows but the results from the EFA required that the releases from the already built facilities be increased and for design changes to Phase 1b, at least as much as could be done as it was already at an advanced state of implementation by the time the results were available (IUCN, 2003). The project had assumed that those most affected by the development of the project were the few people located within the inundation pools of the reservoirs and that there would be little impact downstream, whereas the EFA concluded that there would be significant hydrological, ecological and socio-economic effects of the peoples downstream with complex relationship to the riverine ecosystem. The EFA allowed for compensation for these impacted persons, resulting in a doubling of the portion of the implementation funds used for the environmental related works from Phase 1a to 1b. Also, the EFA has contributed to a major re-consideration of the next phases (2 through 5) of the project (IUCN, 2003).

The LHWP is infamous due to accusations of corruption and subsequently, an on-going, high profile court cases. While the presence of corruption is not new in large scale infrastructure developments and the victims are more-often-than-not those that are already marginalized, the positive outcome here is that the offenders have or are being prosecuted, which in turn has improved the overall efficiency and transparency of doing business in Lesotho (Earle and Turton, 2005). Earle and Turton (2005) concluded civil society needs to be equipped and empowered to report corruption, the authorities need the capacity to investigate, and the institutional arrangements have to be up to the task, including anti-corruption arrangements such as those which have now been established in Lesotho. This included mechanisms to ensure that contractors have no past involvement in corruption.

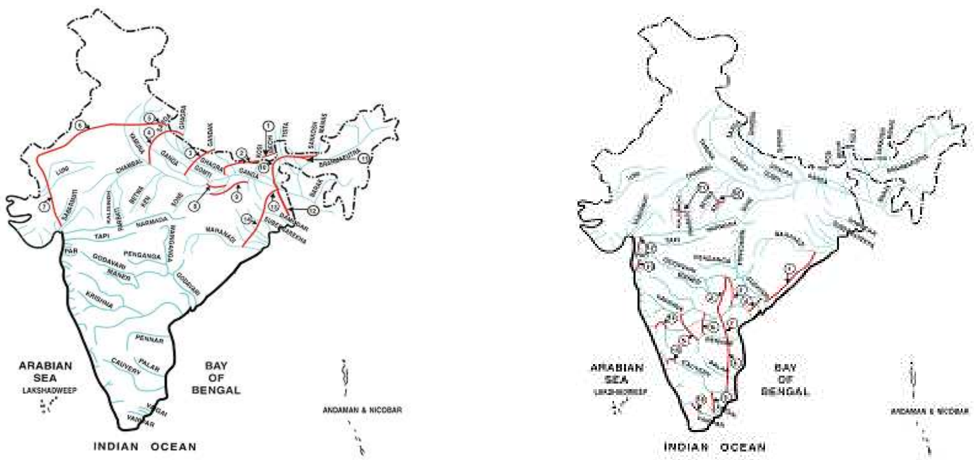
These two examples illustrate that implementing IBTs is challenging in social and political terms in best of environments; but if planned and executed in a participatory manner that takes into account voices of various stakeholder groups, sound IBT projects can become "the lifeblood of developing and extant human settlements." The challenge that India's ILR project faces is of negotiating and reconciling conflicting voices and aspirations around a water enterprise of a scale, scope and socio-ecological complexity the world has never encountered before.

III. *The Indian ILR Project*

The Project that the Supreme Court and the President have enjoined the government of India to implement may well be the largest infrastructure project ever undertaken in the world, to transfer water from the surplus river basins to ease the water shortages in western and southern India while mitigating the impacts of recurrent floods in the Eastern India (NWDA 2006). It will build 30 links and some 3000 storages to connect 37 Himalayan and Peninsular rivers to form a gigantic South Asian water grid. The canals, planned to be 50 to 100 meters wide and more than 6 meters deep, would facilitate navigation. The estimates of key project variables--still in the nature of back-of-the-envelope calculations—suggest it will cost a staggering US $ 123 billion (or Indian Rs 560,000 crore at 2002 prices), handle 178 km^3 of inter-basin water transfer/per year, build 12,500 km of canals, create 35 giga watts of hydro-power capacity, add 35 million hectare to India's irrigated areas, and generate an unknown volume of navigation and fishery benefits (Mohile 2003; Institution of Engineers 2003; GOI 2003). Some 3700 MW would be required to lift water across major watershed ridges by up to 116 meters. Far from 2016, most observers agree that the Project may not be fully complete even by 2050. Verghese (2003), one of its few champions outside the government, suggests it should be viewed as a 50-100 year project.

Figure 1 Himalayan and Peninsular component of the ILR project

Himalayan Component Peninsular Component



The ILR is conceptualized in two distinct components: the Himalayan and the Peninsular (Figure 1). The former will transfer 33 Km^3 water, and the latter will transfers 141 Km^3 water through a combined network of 14,900 km long canals (NWDA 2006). The Himalayan Component (HC), with 16 river links, has two sub-components: the first will transfers the surplus waters of the Ganga and Brahmaputra to the Mahanadi basin, for relayed thereon from Mahanadi to Godavari, Godavari to Krishna, Krishna to Pennar and Pennar to Cauverybasins. The second will transfer water from the eastern Ganga tributaries to benefit the western parts of the Ganga, and the Sabarmati river basins. Altogether, these transfers will mitigate the floods in the eastern parts of Ganga basin, and provide irrigation and water supplies to the western parts of the basin. The Himalayan Component needs several large dams in Bhutan and Nepal to store and transfer flood waters of the tributaries of the Ganga and Brahmaputra rivers, and within India to transfer the surplus waters of Mahanadi and Godavari rivers. The Peninsular component has 16 major canals with has four sub components: 1) linking Mahanadi-Godavari-Krishna-Cauvery-Vaigai rivers; 2) linking west flowing rivers south of Tapi and North of Bombay; 3) linking Ken-Betwa and Parbati-Kalisindh-Chambal rivers and 4) diverting of flows of some west flowing rivers to the eastern side. The en-route irrigation under the peninsular component is expected to irrigate substantial area proposed under the NRLP, which fall in arid and semi-arid western and peninsular India. The total cost of the project too has three components: the Peninsular component will cost US$ 23 billion (Rs 1,06,000 crore) ; the Himalayan component will cost US$ 41 billon (Rs 1,85,000 crore); and the Hydroelectric component will cost US$ 59 billion (Rs 2,69,000 crore). The quantity of water diverted in the Peninsular component will be 141 cubic kilometres and in the Himalayan component 33 cubic kilometres. The total power generated will be 34 GW – 4 GW in the Peninsular component and 30 GW in the Himalayan component (Rath 2003).

What makes ILR unique is its unrivalled grandiosity. If and when completed, ILR will handle four times more water than the China's South to North water transfer project, itself one of the largest inter-basin water transfer projects implemented in the world (R. Stone & H. Jia 2006). ILR will handle four times more water than the three Gorges project; 5 times all inter-basin water transfers completed in the U.S.A; and more than 6 times the total transfers of the 6 inter-basin water transfers project completed in India (Sharda-Sahayak, Beas-Sutlej, Madhopur-Beas link, Kurnool Cudappa cana, Periya Vegai Link, Telgu Ganga). ILR cost, as presently 'guesstimated' would be three times the cost of China's South-North water transfers scheme; 6 times the cost of three Gorges dam, and 20 times the estimated costs for the Red-Dead connection in the Middle East. ILR will mean larger investment than the sum total of all irrigation investments made by the government of colonial and free India since 1830. And this is based on numbers that are little more than a conservative guesstimate that likely excludes the cost of land acquisition. When the cost of land acquisition and rehabilitation and resettlement, besides endemic cost and the inevitable time overruns are factored in, the ILR will most likely cost several times more than the present US$ 123 billion estimate.

Only 9 of the 30 proposed links are independent, and can be executed without working on other links. In this first stage of the mammoth project, which won government approval last August, a 230-kilometer canal will be dug to divert water from the Ken River to the Betwa River in northern Madhya Pradesh province. A dam and small hydroelectric plant will be built in the Panna tiger reserve. Work on this $1.1 billion first component of the NRL project is under way and scheduled to be completed in 8 years (Bagla 2006).

IV. Justification for ILR

The most important question being raised about ILR by critics is its justification. The *raison d'etre* of the project is the accentuating water scarcity in western and peninsular India. The low per capita availability of utilizable water, high spatial and temporal variability of rainfall and the associated drought and floods are other major factors. By 2050, the per capita water availability in India is expected to fall from the present 1820 m^3 to 1140 m^3, far less than the water scarcity thresholds of 1700 m^3/person defined by Falkenmark et al (1994) as necessary for civilized living. Spatial inequality is extreme, too: the Ganga-Brahmaputra-Meghna basins, which cover one-third of the total land area, are home to 44 percent of India's population, but drain more than 60 percent of the country's water resources.[2] In contrast,the Krishna, Cauvery and, Penner river basins and the easterly flowing rivers between Penner and Kanyakumari cover 16 percent of the land area, have 17 percent of the population, but drain only 6 percent of India's water (Amarasinghe et. al 2005). In India's 19 major river basins, only 55 percent of total water resources are utilizable. As a result, more than 220 million people have per capita water supply below 1000 m^3/ per year, indicating severe regional water scarcities emerge according to Falkenmark et al (1994).

Thanks to these unequal endowments, India's river basins are at different degrees of 'closure'. The indus basin withdraws more than 1600 m^3 per person/year; the Brahmaputra basin withdraws only 290 m^3. The Indus, Penner, Tapi, Sabarmati, the westerly flowing

[2] The Brahmaputra sub-basin alone, with only 6 percent of the land area and 4 percent of the population, drains 31 of the total water resources. And due to geographical restrictions, only 4 percent of the Brahmaputra basin's vast water resource is potentially utilizable within the basin.

rivers in the Kutch and Saurashtra and Rajasthan (Luni) and the easterly flowing rivers between Pennar and Kanyakumari suffer over-development (Amarasinghe et al 2005) and are physically water scarce (IWMI 2000). Their needs can be addressed, it is argued, by augmenting their natural flows with surplus waters of the Himalayan rivers.

Taking away some surplus flood waters from Himalayan rivers and dispatching them to drought-prone areas, it is argued, can only be a win-win proposition. Annual floods, on the average, affect more than 7 million ha, 3 million ha cropped area and 34 million people, mostly in the eastern parts, inflicting annual damage of well over US$ 220 million (Rs 1000 crores) (GOI 1998). In contrast, recurrent droughts affect 19 percent of the country, 68 percent of the cropped area and 12 percent of the population (Nair, R and Radhakrishna 2005).The reservoir storages and the canal diversions in ILR are expected to reduce flood damages by 35 percent (Sinha, S.K. et al 2005) and ease drought-proneness in semi-arid and arid parts, besides making 12 km^3 water available for domestic and industrial water supplies in these drought prone districts.

India is also blamed for having neglected storage creation, resulting in *economic* water scarcity which may impede its economic growth. Other arid and semi-arid regions of the World have invested heavily in storage. The U.S.A has per capita storage capacity at 5,961 m^3; Australia has 4,717 m^3, and Brazil has 3388 m^3. Even China has increased its storage capacity to 2,486 m^3/person, while India's storage capacity is a puny 200 m^3/person and declining. It is imperative, it is suggested, that India increases its storage for regulating the vast amount of runoff that otherwise cannot be beneficially utilized. The NRLP water transfers,of 178 km^3, will increase utilizable surface water resources by 25 percent. And most of the transfers are expected to increase access in water scarce regions.

As a concept, the ILR has been doing the rounds for over a century; however, as a serious proposition, it has 'not been recommended by anyone' (Iyer 2003). Even the National Commission on Integrated Water Resources Development (NCIWRD) which considered the proposal in great detail was lukewarm towards it and actually suggested caution in considering it. Who then are the proponents of the ILR project? This is a difficult question because besides a small vocal group of proponents of large-scale irrigation, the Supreme Court and the President of India, the votaries for NRLP are far less vocal in their advocacy of the project than a growing lobby of the Project's antagonists.

The NCIWRD report—which is widely viewed in lay circles as the first-cut justification of the NRLP idea-- emphasizes self-sufficiency in food production and improved rural livelihoods as two key justifications for the ILR project. Assuming the criticality of maintaining national food self-sufficiency and agricultural exports, the Commission projected grain demand for India by 2050 in the range of 425 to 494 million tonnes, and argued for increasing the country's irrigation potential to 160 million ha, 20 million more than what can be achieved without basin transfer. Thus, it is stated "….one of the most effective ways to increase the irrigation potential for increasing the food grain production, mitigate floods & droughts and reduce regional imbalances in the availability of water is the interlinking of rivers to transfer water from the surplus rivers to deficit areas..." (NWDA 2006). The surface irrigation of the river linking project alone expects to add 25 million ha irrigated land. However, the NCIWRD commission was not unanimous in its support for river linking; some of the members issued a dissenting view included in the report itself.

Improving rural livelihoods is advanced as another justification for the ILR project. The rural population in India is projected to peak at about 775 million by 2015 (UN 2004). The commission projects that the rural population will decrease to about 610 million by 2050, which is similar to the rural population levels in 1988. The agriculturally active population estimate in 1988 was 488 million (FAO 2006). With the present level of economic growth, one would expect that the population whose livelihood depend solely on agriculture to be much lower than today's level (548 million in 2001). Thus it is not clear how total agriculturally dependent livelihoods in the future can be a justification for the NRLP irrigation transfers.

None of the critics undermine the seriousness of the specter of water scarcity in western and peninsular India. But, according to them, just because the Brahmaputra, which accounts for the bulk of India's water resources, flows rather inconveniently in a remote corner of the country, this does not constitute a good enough reason for a canal and dam building spree on the scale proposed. Critics argue that there are other solutions besides ILR which have not been properly considered. A strong and strident army of 'water-warriors' argue that if the precipitation within the watersheds or sub-basins is harvested and conserved properly, satisfaction of domestic water needs will not be a problem in most parts of the country. They also argue that dams burn more water than our survival needs. While the whole country needed about 30 km^3 of water for satisfying annual domestic needs in 1997-8, India managed to lose 36 km^3 in that year alone through evaporation from the reservoirs.

Some critics point to desalination as a viable component of an alternative to the NRL, especially as it no longer considered prohibitively expensive.. Capacity for desalinating water has increased globally from 1.5 million m^3 per day to the current figure of more than 20 million m^3 per day. This has reduced the cost-price of desalinated water to less than US$ 1.00/m3 for seawater and less than US$ 0.50/m^3 for brackish water (Bandyopadhyaya and Praveen 2003). Arid countries such as Saudi Arabia already depend heavily on desalination for meeting substantial part of their non-irrigation water demand. Closer to home, companies are now ready to market drinking water at a price of 5 paise per litre. The emerging technology of rapid spray evaporation (RSE) is likely to cut costs further. However, with the recent escalation in energy costs, desalination will also have to be looked at with a more critical eye.

Water demand management in agriculture offers enormous scope that remains untapped. According to Bandyopadhyaya and Praveen (2003), "Irrigation is no longer 'watering the land' but supplying water for growth of crops…"; and Iyer (2003) argues that "the answer to the sharing problem in the Cauvery lies in both Tamil Nadu and Karnataka learning to reduce their excessive demands on the waters of the river through a combination of measures; the 'shortage' will then disappear."

V. Emerging Critique of the ILR Proposal

ILR has generated a highly polarized debate on its pros and cons, with its supporters-a small band--coming largely from government advocates of large scale irrigation and the political class, and a much larger, vocal and strident group of critics and opponents from civil society and academia. In a single issue of *Himal,* a South Asian journal, Verghese (2003) found ILR variously described as "frighteningly grandiose", a "misapplied vision", "extravagantly stupid" "anihilatingly wrong", a case of putting the "cart before the horse", a "sub-continental fiasco", "a flood of nonsense", a "dangerous delusion" or a case of "hydro-hubris". According to Iyer (2003) "It amounts to nothing less than the redrawing of the geography of the country." According to Bandyopadhyaya and Praveen (2003), the proposal claims to package an uncertain and questionable idea as a desirable one. Some major criticisms of the project are about its socio-economic viability, environmental impacts, displacement of people and rehabilitation of project affected people, the challenge of resources mobilization, geo-political constraints as well as domestic political dynamic.

- ***Benefits and costs***

The ILR project envisages many benefits. It expects to: add 34,000 MW of hydro-power to the national grid of which 3500 MW would be used in various lifts; supply much needed drinking water to several million people and industrial water supplies to drought prone, water scarce cities in the west and south; mitigate floods in the east and droughts in the west and the south. The large canals linking the rivers are also expected to facilitate inland navigation too. Increased irrigation—25 m ha through surface irrigation and 10 m ha through groundwater-- in water scarce western and peninsular regions is the top benefit envisaged from the ILR project. This is expected to create employment and boost crop output and farm incomes, and multiplier benefits through backward (farm equipment and input supplies) and forward linkages (agro-processing industries).

This key plank of the project has come under scathing criticism. The most eloquent has been from Rath (2003). Based on simple, back of the envelope calculations, Rath shows that, assuming a 7 per cent interest rate per year, the annual capital costs and interest to recover the total capital over 50 years will be US$ 110/ha (or Rs 2,015/acre) in the Peninsular component and Rs.15,030/acre in the Himalayan component. For irrigating hybrid jawar (sorghum) in peninsular India, he shows the required annual capital recovery cost alone will be US$ 221/ah (Rs 4,131/acre). Similarly, the annual capital recovery cost, at 7 per cent interest over 50 years, comes to US$ 0.30 (Rs 13.3) per watt of hydro-power. If we assume a 7 percent interest rate to be charged on the capital during the construction period, the total cost of the three components will come to US$ 252 billion (Rs.11,47,873 crore), approximately double what is now suggested. And if we also assuming an annual rate of inflation of 5 percent, the project will commit India to a project outlay of US$ 22 billion (Rs 100,000 crore) a year.

- ***Environmental concerns***

Environmentalists are worried about the ecological impacts of the project of such massive scale. In May 2003, the Government of India's own Ministry of Environment and Forests raised 23 environmental concerns about ILR. Independent researchers worry on many counts.

Some have pointed to the dangers of the seismic hazard, especially in the Himalayan components (Bandyopadhyaya and Praveen 2003). Many worry about the transfer of river pollution that accompanies inter-basin water transfers. Loss of forests and biodiversity are of course recurring themes. Many have questioned the subjective concept of the availability of 'surplus' flows in some river basins that lies at the heart of inter-basin transfers. An extreme view, according to Bandyopadhyaya and Praveen (2003), is "from a holistic perspective, one does not see any 'surplus' water, because every drop performs some ecological service all the time. The ecosystems evolve by making optimal use of all the water available. If a decision is taken to move some amount of water away from a basin, a proportional damage will be done to the ecosystem, depending on the service provided by that amount of water…there is no 'free' 'surplus' water in a basin that can be taken away without a price." The water flowing into the sea is not waste; it is a crucial link in the water cycle. With the link broken, the ecological balance of land and oceans, fresh water and sea water, also gets disrupted (Shiva 2003). But others argue differently. They opinion that some Indian river basins have vast un-utilizable water resources, even after meeting all human and eco-system services needs. The Brahmaputra river basin's renewable water resource is about 584 km^3, about a quarter of India's total water resources. And only about a quarter of that is potentially utilizable within the basin. Water accounting of a few other basins also show significant un-utilizable water resources. A part of this un-utilizable water resource can be beneficially used for the rapidly expanding population, without a noticeable impact on the eco-systems.

The recent groundswell of worldwide opposition to large dams and irrigation projects that interfere with nature in a drastic manner has found a window of expression in the debates on ILR. Shiva (2003) considers ILR violence to nature: "Violence is not intrinsic to the use of river waters for human needs. It is a particular characteristic of gigantic river valley projects which work *against*, and not *with*, the logic of the river. These projects are based on reductionist assumptions which relate water use not to nature's processes but to the processes of revenue and profit generation… Rivers, instead of being seen as sources of life, become sources of cash. In Worster's words the river ends up becoming an assembly line, rolling increasingly toward the goal of unlimited production. The irrigated factory drinks the region dry." (Shiva 2003). Iyer (2003) is acerbic in his comment: "Are rivers bundles of pipelines to be cut, turned around, welded and re-joined? This is technological hubris – arrogance – of the worst description, prometheanism of the crassest kind. The country needs to be saved from this madness."

Yet more recently the pendulum has begun to swing back towards investments in water infrastructure, and in some countries, most notably in China which did not have to depend on external sources to secure the necessary financing, there have been many dams constructed in the recent past. The ICOLD World Register of dams show China has 4,434 dams (ICOLD 2000). Other sources estimates are much higher, as high as 22,000 large dams (WCD 2000). At WSSD in Johannesburg, recognition was given to hydropower as a renewable resource for power generation, and the World Bank water strategy (World Bank, 2005) laid the groundwork for a re-engagement of the multi-lateral banks in large-scale water infrastructure. Most recently the Comprehensive Assessment of Food and Agriculture (CA, 2006) determined that investments in large scale infrastructure will be necessary in regions where there has historically been under-investment, such as sub-Saharan Africa and parts of Asia.

That said, investment in large scale irrigation, even as a component of multi-purpose developments is generally economically unattractive. Also, while certain parties may again be attracted to investing in water infrastructure, the modalities to ensure that the infrastructure developed is effective and sustainable remains highly contentious.

- ***Social Costs***

ILR is likely to cause displacement of tribals and poor people on a massive scale; and India's past record in fair and just rehabilitation of Project Affected People does not inspire confidence among ILR critics that the Project will not ride roughshod over millions of displaced people. The construction of reservoirs and river linking canals in the peninsular component alone expect to displace more than 583,000 people and submerge large areas of forest, agriculture and non-agriculture land. Two of the proposed reservoirs, Inchampalli at Inchampalli-NagarjunSagar and the Polavaram at Godavri Polvaram –Krishna (Vijayawada) links are estimated to displace more than 100 thousand people each.

According to one estimate, the network of canals extending to about 10,500 kms alone would displace about 5.5 million tribals and farmers (Vombatkere, 2003). To this number, we must add the people to be displaced by the various reservoirs planned. The plight of these is serious if anything because the government of India does not even have a sound and clearly spelt out resettlement and rehabilitation policy (Bandyopadhyaya and Praveen 2003).

A major lesson to be drawn from the recent history of large-scale water resources projects in India and elsewhere, is that despite government policies and procedures, that include due appeals process, displaced populations still suffer unduly. While we can promise to mitigate the social impacts of such projects, it has proven difficult to do, although it is not insurmountable.

Although many often focus on the social impacts of people's displacement in IBT's, the multipurpose water transfers brings significant social benefits too. Many water transfer projects requires both skilled and unskilled labour and the training provided for the local and sometimes for the regional or national workforce is a major advantage for future endeavors. Often, the large water development projects increase the access to new infrastructure: roads, which otherwise takes hours to reach to a decent mode of transport; markets, which otherwise is even not reachable in several days; clean water supply- without which people, especially women and children, trek hours to find a potable water source. The large irrigation projects not only enhance the livelihood of the farming families in the command, but also brings substantial multiplier effects to the region, and in some cases at the national level too (WCD 2000). The Bhakra irrigation project's regional multiplier is 1.3 (Bhatia and Malik 2005). And the Indus basin, where irrigation is an integral part of the crop production system meets more than 80 percent of the food production deficits of other basins in India. It is not a secret that irrigation was a major factor in transforming the major food deficits in India in the 1950's and 1960's to food surpluses now.

- ***Resources Mobilization***

Rath (2003) called the ILR a 'pie in the sky' because he, like many others, are skeptical of the government's capacity to mobilize the kind of investable funds ILR demands. Budgetary provisions made so far for water development are far from enough to complete ongoing projects. During recent years, under a special Accelerated Irrigation Benefits Scheme, the government has been setting aside funds for the so called 'last mile' projects, projects which are nearly complete but have been languishing for years for the lack of relatively modest funds to complete minor residual work. So many incomplete projects dot the country that the NCIWRD estimated that the country needs Rs.70,000 crores during the Tenth Plan, Rs.110,000 crores during the Eleventh Plan just to complete these 'last mile' projects. Senior researchers like Iyer (2003) quip, "We have had great difficulty in completing even single projects successfully and we want to embark on thirty massive projects at the same time."

- ***Domestic Politics***

Domestic and regional geo-politics plays a key role on the discussions on ILR. For one, for the Indian political class, ILR has provided a vehicle for grandstanding. As Iyer (2003) suggests, "Gigantism always casts an irresistible spell on our bureaucracy and technocracy as well as on our politicians." What are now recognized as the Supreme Court's unpremeditated casual remarks were zealously adopted by senior NDA government leaders as the court's order by the government "with uncharacteristic promptitude and enthusiasm". The successor UPA government is procrastinating on the Project; however, there is little doubt that political push at a sufficiently high level will be enough for the technocracy to brush aside all the debates and launch the country headlong into ILR implementation quite like Lin Piao, China's Premier launched his country in the South-to-North water transfer project in 1995. Such a rushed scenario at best would result in developments that are less than economically, socially and environmentally optimum for India's future, and, more than likely, would fail to deliver on the promised water secure future.

But politics may also act as a barrier to ILR. Even within India, creating a strong political consensus around the project will take some doing. Neither political negotiations nor arm-twisting of the kind Mrs. Indira Gandhi used to settle water disputes among states promise such consensus; economics may help wrench open a window to co-operation. Bihar refused to let Ganga waters to be transferred arguing that if her farmers are unable to use its water today does not mean they will remain unable to do so for ever; its leader Lalu Prasad Yadav however did a volte face when someone mentioned Bihar might get paid for the Ganga water it allows to be transferred.

Even more serious political issues arise when the dynamics in riparian countries-Nepal, Bangladesh, Bhutan-- are considered. The realization of the Himalayan component is critically dependent on the agreement of neighbouring countries of Nepal and Bhutan to the proposed construction, especially of dams, in their respective territories. Bangladesh, as a downstream country, will be an affected party, and needs to be taken into confidence. Under the India-Bangladesh Treaty of December 1996 on the sharing of Ganga waters, India has undertaken to protect the flows arriving at Farakka, which is the sharing point. West Bengal has only reluctantly agreed to the large allocations to Bangladesh under the Ganga Treaty and has been pressing the needs of Calcutta Port. On the other hand, Bangladesh may feel threatened that a diversion of waters from the Ganga to the southern rivers will not be consistent with that undertaking.

Thanks to this geo-political conundrum, the planning of the Himalayan component of IRL—as well as discussions about it are shrouded in opacity. Even as a National Commission, the NCIWRDP could not have access to data related to the Himalayan component (NCIWRD, 1999:187). This opaque data environment obfuscates several critical issues. For instance, how can one estimate the minimum flows in Padma or Meghna or the Hooghly-Bhagirathi required for sustaining fishing livelihoods in southern Bangladesh and the state of West Bengal. Or as Bandyopadhyaya and Praveen (2003) asks: "What will be the impact of the diversion of the 10 percent of the lean season flow from 'surplus' river basins on the groundwater resources and saline incursion in the downstream areas?"

Protagonists of ILR, like Verghese and Prabhu are the first to accept that ILR as a concept is a non-starter until India offers its co-riparian countries a deal they can not refuse. Verghese (2003) suggests the project can be a win-win opportunity for all neighbours. However, civil society players in Nepal and Bangladesh do not share this positive view with Verghese, at least not yet.

V. Questioning Core Assumptions

It would be wrong to say that the arguments for and against ILR are evenly balanced. Even the available sketchy arguments based on superficial information and analytic base raise serious questions about: [a] what precisely are the problems that ILR would help resolve; what is the ILR? [b] is ILR the best available alternative for resolving those issues; and [c] are the problems ILR is currently designed to resolve likely to stay that way when the Project is commissioned, 50-70 years hence?

Some recent work by IWMI and partner researchers throws some new light on these questions. Many of the factors that the NCIWRD projections were based on have already undergone significant changes and could alter future water supply and demand projections. For instance, the justification for as well as the cost-benefit calculus of the ILR in its broadest conception is critically hinge upon projections of population growth, urbanization patterns, and occupational diversification. And contrary to NCIWRD prognoses, recent data suggests all these are experiencing significant turning points. The NCIWRD projected state-wise population growth by pro-rata distribution of national population projections from the 1991 population census. New regional population growth projections, incorporating age size structure, HIV/AIDS and adjusted fertility and mortality estimates using 2001 census, show vastly different emerging patterns (Mahmood et al 2006). According to these new estimates, India's population is projected to increase from 1027 million in 2001 to 1190 million by 2051 and stabilize thereafter. Although the total population is not much different from the NCIWRD projections, many states, especially those which are water scarce, have significantly different growth patterns. Andhra Pradesh, Kerala, Karnataka, Punjab, and Tami Nadu are expected to face appreciable declining population trends before 2050. Haryana, Gujarat, Maharashtra, Orissa and the West Bengal will experience moderate decline. However, Bihar, Jharkhand, Madya Pradesh, and Chattis Garh will still have increasing population. These are the states where pressure on farm lands and demand for irrigation will continue to be high. This new regional demographic calculus needs to be incorporated into the future water demand estimations, although even at this stage the differences between these estimates and those used in the overall conception of the NRL project does underscore the need to revisit the basic idea.

NCIWRD's prognosis of food demand too has been roundly questioned. The food grain demand projection (279 kg/person and 450 million mt/year total by 2050) of the commission was a major driver for irrigation demand estimation. At this rate of food grain consumption, the total calorie intake per person is estimated to be at least 4000 Kcal/day (assuming a 63% share of grains in the total calorie supply). These estimates are way above the average calorie intake of even the most developed economies at present, and are clearly out of line with the changing consumption patterns. A recent study (Amarasinghe et al 2006), incorporating a number of most significant aspects of the changing consumption patterns over the past decade and their consequences for the future, projects India's total grain demand to increase from 209 million Mt in 2000 to about 380 million Mt by 2050. This projection includes 120 million Mt of feed grain demand, a 10-fold increase from the present levels and something that was not considered in the earlier estimates, and is yet 114 million Mt lower than the NCIWRD's projections.

It is argued by many that to heighten the need for expanding irrigation, the NCIWRD took an unduly bleak view of the potential to increase food grain yields. They assumed average grain yield growth from 1.5 tonnes/ha in 1993 to 3.1 tonnes/ha in 2050 (2.3 and 1.0 tons/ha on irrigated and rainfed yields in 1993 to 4.0 and 1.5 tons/ha by 2050). Critics argue that 50 years is a long period and India can easily outdo the Commission's unrealistically low projections of yield growth with far cheaper and simpler interventions than ILR. China and India had similar grain yields in the early 1960's, but China's present level of yield is two and a half times India's. Over the same period, the USA's grain yields increased by almost 4 tonnes from 2.5 tonnes/ha in 1961. Can't India's average yield be increased to 4.0 tonnes/ha, China's present level, even over a 50 year period? If yes, India will be self sufficient in food without *any* additional land for grains.

NCIWRD's prognosis of how India's future of irrigation shapes up is also a contentious issue. According to the commission, surface water supply would be the dominant form of irrigation by 2050. And they project the surface and groundwater irrigated area will change from 55% and 45% of the gross irrigated area in 1993 to 45% and 55% by 2050. However, the developments over the last two decades show a completely opposite trend. There was no appreciable increase in surface irrigated area. But, due largely to private small scale investments, the groundwater irrigated area recorded a rapid growth. Today, groundwater contributes to 33 million ha- 63% of the net irrigated area, and covers over 64 percent of the gross irrigated area. And largely due to this increase, the gross irrigated area projection of 79 million ha by 2010 is already achieved by 2000. How far can groundwater irrigation grow without any surface irrigation growth?

Many contend that the groundwater irrigation cannot be increased without surface irrigation recharge. But a substantial part of the groundwater irrigated area growth in the last decade is in districts outside the command areas (Shah et al. 2003) and show no significant spatial dependence with surface irrigated area growth (Bhaduri et al 2006). Our analysis show, that if the 10 million ha of net surface irrigated area from the projects under construction; and another 25 to 35 million ha of net groundwater irrigated area added to present level, the gross irrigated area will increase to about 130 to 140 million ha. This is the area required for achieving the commission's projections of, and perhaps the bloated, self sufficiency targets of grains. With this increase, groundwater irrigation by 2050 will cover more than 70 percent of the gross irrigated area. Such a change will significantly reduce the total irrigation demand due to differences of efficiencies of surface irrigation (60%) and GW irrigation (77%). But, can the commission's optimistic assumptions on irrigation efficiency increase be realized by 2050?

The commission assumed significant increase in irrigation efficiencies- from 35%-40% to 60% for surface irrigation and from 65%-70% to 75% for groundwater irrigation across all river basins. The little information we have today on the variation of irrigation efficiency across river basins is not adequate to predict the future directions. However, they show the ground water irrigation efficiency is already around or even higher than the commission's projections (Kumar et al. 2006). But the surface irrigation efficiency has shown virtually no increase over the last decade. In water scarce river basins approaching high degrees of closure, there are no flows to the sea for many days of the year. In these, efficiencies of surface irrigation are low, but they have high basin efficiency. Thus increasing irrigation efficiency in one location, and then using the saved water for new locations or for other purposes, would certainly affect some other users elsewhere. We need to know more on the interactions of the efficiencies at the system and basin levels before making firm statements on the potential improvement of efficiency in surface systems. Or, at least we need conservative assumptions on the potential increases based on the information currently available.

To what extent the young generation today will take to agriculture as the primary occupation in the future? NCIWRD commission assumed that many rural people would stay in agriculture and the access to irrigation is necessary for adequate livelihoods for them. However, according to recent research on the agriculture demography of India (Amrita et al 2006), today's young generation perceived it differently. There is a high likelihood that today's young rural farmers will move out of agriculture, or at least keep it as a secondary income activity, regardless of the increase access to irrigation. This is more evident in the group who has different skills and better education. The tendency is higher if the distance to travel to town or urban centers is less. Certainly, future generations of India will be more educated, and will be acquainted with better skills. And many rural centers are being transformed to small towns and towns to sprawling urban centers. The infrastructure facilities such as access to roads, electricity, and telecommunication are also increasing. Thus, the migration from permanent rural agriculture to other primary income generating activities will increase. So we also need a better understanding of the emerging trends of agriculture demography and the resulting land use patterns to project future agriculture water demand.

Did the commission's report overlook the potential of rainfed agriculture? They projected only a modest growth from 1.0 tons/ha in 1993 to 1.5 tons/ha by 2050. At present, rainfed area accounted for 56 percent of the grain crop but contributed to only 39 percent of the total production. If the rainfed yield can be doubled over the next 50 years, the grain production on the existing rainfed lands can alone be increased by 81 million metric tons, and this meets a substantial part of the future demand. IWMI research shows that supplemental irrigation, especially in the water stress period of the reproductive stage of crop growth, can benefit a substantial part of the rainfed area (Sharma et al 2006). And this requires collecting only 18-20 km^3/year water through rainwater harvesting using small scale structures. They argue, that water harvesting of this magnitude would have no effect on the downstream users.

The commission's eco-system water demand estimate is an anathema to environmentalist and a concern to many others too. And, perhaps, they have every reason to be critical. Even the commission has admitted that the eco-system water demand estimate - 20 km^3 – 1 percent- of the mean annual runoff of all river basins- is not an adequate figure. Preliminary research by IWMI on environmental water demand show that in many basins, depending on their hydrological variability, a healthy river ecosystem may be maintained even with 10 - 20 percents of the environmental flow allocations from the average annual runoff (Smahktin et al 2006). Many argue that the environmental water demand should include the needs of wetlands, for cleaning the polluted rivers, for fisheries needs in the down streams etc. All these, and the resulting ecosystem water needs will have significant impact on inter-basin water transfers, because, the ultimate decision of the surplus or the level of closure of river basins are decided on what part of the utilizable water resources are required for the eco-system water needs.

V. Concluding Remarks

If the fate of ILR were decided on the shape of the present national debate around it, the dice are heavily loaded against it. However, this intensely polarized ongoing Indian debate about ILR is a product of a plurality of prevailing conditions and past experiences. A classic example is the turn the debate takes over different years: in a year of widespread monsoon failure and hydrological drought, when concerns of water scarcity dominate media attention and public debate, demand for state intervention through grandoise schemes like the ILR gather momentum. In contrast, in years of nation-wide good monsoon—such as 2005 and 2006—water infrastructure issues fade from public spaces.

It is possible to argue that the present proposal for ILR has come a decade too soon. Many factors may change which are likely to create conditions favorable for a comprehensive solution of the kind the ILR's proponents promise, although it is likely to be quite different in nature to the ILR that is presently conceived. In particular, the following seven contingencies may be important in determining how the country will plan its water infrastructure investments over the coming decade or two:

- ***Economic growth:*** Many bold infrastructure investment proposals appear financially infeasible in a low-income economy with limited capacity to generate investible resources. It is no accident that over 90 percent of the IBT projects that Snaddon, Davis and Wishart (1999) review are from the US, Australia, New Zealand, Europe or other rich economies. Mao proposed China's South-to-North water transfer project in early 1950's; however, it was the government of only a much richer China in mid-1990's that began putting their money on an idea that Mao had mouthed. The ILR proposal of investing US $ 120 billion sounds outrageously bold for an Indian economy of US $ 700 billion; however, if the Indian economy keeps growing at 8-9 percent/year, the proposal may not appear outlandish in a decade or so, especially if its proponents can produce a convincing justification for it;

- ***Improved public systems**:* Implicit in much civil society opposition to ILR is the abysmal track record of water bureaucracies to deliver on their promise. Even though India has very low storage per capita, it is ironic that most of its dams seldom fill up to the full, canals never reach designed command areas; public irrigation systems cost many times more per hectare to build than they ought to; and hydro-electric plants seldom perform at par. This chronic underperformance-caused in part by poor capacity and in part by lack of accountability mechanisms-- has created a crisis of confidence in public systems. However, with creeping improvement in other infrastructure sectors-notably, roads, railways and power- new institutional models for infrastructure creation and management is likely to restore the country's confidence in its capacity to create and manage large infrastructure projects.

- ***Rehabilitation:*** By the same token, the question of managing displacement and rehabilitation of project-affected people in water infrastructure projects will increasingly get benchmarked against road, SEZ and other high-stake infrastructure projects where economic costs of delays or inaction are far higher than irrigation projects. Unless the country puts into place a more humane and widely acceptable rehabilitation policy, infrastructure projects in economically more dynamic sectors are likely to run into road blocks. Much better rehabilitation packages recently offered by some private sector players, such as Reliance and Tata, is an indication of movement in this direction.

- ***Economic water scarcity**:* What responses India forges to respond to water scarcity will depend critically on the revenue model that it can implement to make water infrastructure viable in economic terms. The litmus test of scarcity of anything is its increased price that buyers pay. Ironically, growing water scarcity in India's countryside and towns is still producing only weak and fragmented price signals, especially for the water services delivered by public systems. This raises big questions about how a huge infrastructure investment that ILR implies would be financed and sustained. Financing its construction and O & M wholly through taxes would be hard to sell, especially if the revenue generation model can not even take care of maintenance and repair as has been the case with much public irrigation infrastructure. Arguably, the ability as well as willingness to pay for better water service is linked to disposable incomes in domestic uses and water productivity in irrigation. With economic growth, as the 'median voter' with higher disposable income demands better water services and is willing to pay for it, large-scale investments in water infrastructure will become more viable in financial terms. Economic water scarcity—in terms of willingness to pay for scarce water—will also affect the political dynamic of water sharing. So far, water scarce states are increasing their share in national water resources using adjudication or central government's authority; however, as water-scarce states get richer, they will be willing to pay water-rich poor states for water imports just as Gauteng paid Lesotho and Singapore paid Malaysia.

• ***Agricultural Diversification**:* In purely economic terms, public investments in irrigation can hardly be justified in today's India. At the aggregate level, the difference in gross value of output on an irrigated and unirrigated hectare is just about US $ 100-120/year while it costs US $ 3500-4000 to bring an additional hectare under public irrigation. This is because most command areas are used to grow food grains, while high value crops are grown outside the command areas. In California, Spain, and Victoria in Australia, irrigation supports gross value of farm output of the order of US $ 5000-9000/ha because irrigated land is generally used for high value export crops. Movement in this direction—of using reliable irrigation for growing high value crops for urban markets and exports—is gathering momentum in many parts of India. Farmers using irrigation for value-added farming demand better, more reliable irrigation service and are willing to pay for it. Should such a trend gather momentum, farmers in water-scarce western and southern India will make stronger economic and political demand for ILR type interventions.

• ***Rising Energy Costs:*** Irrigation expansion in India—South Asia in general—during the recent decades has come not from public investments in surface irrigation projects but from private investments in small lift irrigation systems using mostly ground but also surface water sources. These offer the advantage of flexible, reliable, on-time irrigation that most surface sources are unable to provide. However, this mode of irrigation development is highly energy intensive; and as energy prices—electricity and diesel—rise relative to farm product prices, we should expect growing preference from farmers either for superior irrigation from surface water sources or supply of surface water for groundwater recharge. Rising relative energy prices may have a dramatic impact on rural India's support for an investment proposal such as the ILR.

• ***Urbanization**:* Most Indian towns and cities depend largely on groundwater for running their water supply systems. Experience around the world shows that a village grows into a town and thence into a city, its areal extent grows at a much slower pace compared to its population; and as the population density of a settlement rises, its groundwater fails to keep pace with water demand regardless of water harvesting and recharge. Beyond a stage, a city invariably has to source its water from a distant reservoir. This is becoming increasingly evident in India, but more so in China whose urban water supply trends present a leading indicator to India. Indeed, growing cities and hydro-power generation provide a much stronger socio-economic justification for IBTs than need for producing more food. Urbanization will thus make IBT's economically viable and politically compelling. The shape of these IBTs may be different from the proposal currently under discussion. However, there seems little India will be able to do to avoid either IBTs or water infrastructure investments scales comparable to—or even exceeding—the present proposal.

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