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POLICY ANALYSIS:

INTER-LINKING OF RIVERS: A SOLUTION FOR WATER CRISIS IN INDIA OR A DECISION IN DOUBT?

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Executive Summary

The acute spatial and temporal variations in precipitation patterns have greatly influenced water resources planning, management, and development in India. Specifically, these patterns have led to the development of several water transfer projects in the country. The Inter-Linking of Rivers (ILR) project is a grand example of such a water transfer project. In this paper, we will discuss major justifications and challenges to the implementation of the ILR project and discuss potential alternative policy recommendations for water resources management and planning in India.

Regional water transfer is an attempt to redistribute water from "surplus" to "deficit" zones within India. The ILR project in India envisions linking 37 rivers of 20 major basins in the country through 31 links and canals. The project has been promoted as a solution to the 'paradox of floods and drought' in India and will also provide water for irrigation and power generation. However, several issues have been raised and debated on the basis of technical feasibility, environmental, social, ethical, institutional, financial, and political criteria, which question the very rationale, viability and decision-making process of the project. These concerns make it difficult to determine when water transfer can be justified as desirable.

This paper looks into the history of adoption of the ILR project, its current status, and future implications and presents a critique of the existing debates that support or question its feasibility. A brief discussion on the global trends of water resources management in context to the development of big water projects, especially for the rise and fall in big water projects is also presented. Finally, a set of policy alternatives have been recommended that meet the goals of the ILR project while minimizing the social and environmental impacts identified in this paper.

These recommendations put forward the need for a fundamental change in thinking and attitude towards water resources management in India. The policy recommendations encompass both the science and politics of water resources management and planning. The recommendations present the need for a bottom-up, participatory, decentralized, and interdisciplinary approach to water management. Special emphasis is on understanding demands and justified water needs at the local level; priority to localized and traditional solutions; efficiency improvements in agricultural and irrigation systems; pricing of irrigation water use; education outreach; and an increased research focus on the different facets of Indian River systems.

Introduction

The global freshwater availability is finite. It has been estimated that people living in conditions of acute water shortage will increase from the present figure of 470 million to around 3 billion in 2025 (Vombatker 2004). In addition, spatial variations in the distribution of this prime natural resource have led to formation of "water surplus" and "water deficit" regions. Water scarcity leads to regional imbalances in terms of socio-economic development and such imbalances are detrimental to sustainable development and adversely affect human rights.

Regional water transfer (RWT) is an attempt to redistribute water across region(s) to ensure that sustainable water resource development is achieved in consonance with broader planning of socio-economic development (Gupta 2001). The regional transfer can be intra-basin, inter-basin, or both. RWT has a long history as a means of addressing water scarcity in one region by transporting additional supplies from water surplus areas. Water transfers can therefore promote the efficient allocation of water and has been attempted worldwide as a water management alternative in both developed and developing countries[1] (NRC 1992; Gupta 2001; NWDA year[2]; Liu and Zheng 2002). Although RWT can help to address the imbalances in water supply and demand, it has generated controversy and caution throughout the world. Environmental (rehabilitation of the ecosystem), social (rehabilitation and resettlement of the displaced people), legal (sharing of water), and ethical/spiritual (associate values, beliefs and cultural contexts) issues have been raised and debated in many RWT projects worldwide (Gupta 2001, Iyer 1998, Gichuki and McCornick 2008, Gupta and van der Zaag 2008, NRC 1992). These issues question the use of water transfer as a strategy for water resources planning and management.

[1] Several RWT projects have been designed and implemented in the arid and semi-arid west of USA, like Nevada's Carson-Truckee basin, the Colorado Front Range, northern New Mexico, Washington's Yakima River basin, central Arizona and the Central & Imperial valleys in California. Examples are also abundant in several other countries like South Africa (Tugeal/ Vaal transfer scheme between KwaZulu-Natal and the Free State), Kenya, Nairobi, erstwhile Soviet Union (around 37 inter-basin flow diversion systems), France (LRC Aqueduct- proposed water transfer from river Rhone in France to Catalonia region in Spain), Spain (Ebro-Tarragona and Tajo-Segura projects), Venezuela and China (Grand canal, under-construction Three Gorges project, South-to-North water transfer schemes).

[2] Available at NWDA website: Existing experiences, http://nwda.gov.in/index2.asp?slid=107&sublinkid=7&langid=1. Accessed November 2007.

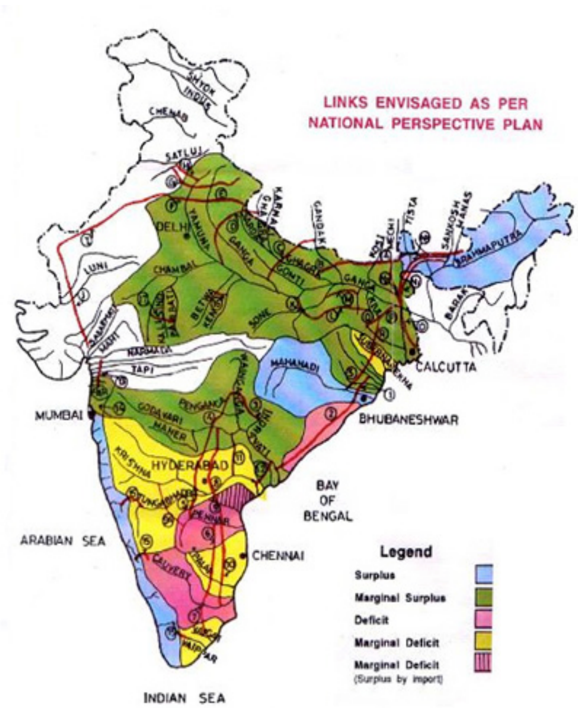


Figure 1: The Inter-Linking of Rivers, India

Source: Bandyopadhyay and Perveen (2004).

The Inter-Linking of Indian (ILR) Rivers Project

The proposed Inter-Linking of Rivers (ILR) project in India is an inter-basin water transfer project that envisions linking 37 rivers of 20 major basins through 30 links and canals (Figure 1). It aims to transfer water from surplus to water-deficit areas to rid the country of droughts and floods and to utilize waters that are going to waste into the sea (Gupta 2001). This project was formerly adopted by the Ministry of Water Resources (MOWR), Government of India (GOI) through a Supreme Court order in 2002. The proposed scheme has two components, a Himalayan component with 14 links and a Peninsular component with 16 links (Figure 2).

Before the need and justification of the ILR project is discussed, the sequence of events that led to the evolution of the project to its current status is briefly discussed in the next section to provide historical background information. Following this is a discussion of the debate surrounding the need for the project, which presents the various challenges and arguments questioning the feasibility and justification for the ILR project implementation. A discussion on the global debate on issues of water resources management and development follows, especially in context to the development of big water projects (like dams and diversions) that will help to contribute to the understanding of the debate and challenges associated with the ILR project. In conclusion, a list of recommendations and policy options for water resources management and planning in India are presented.

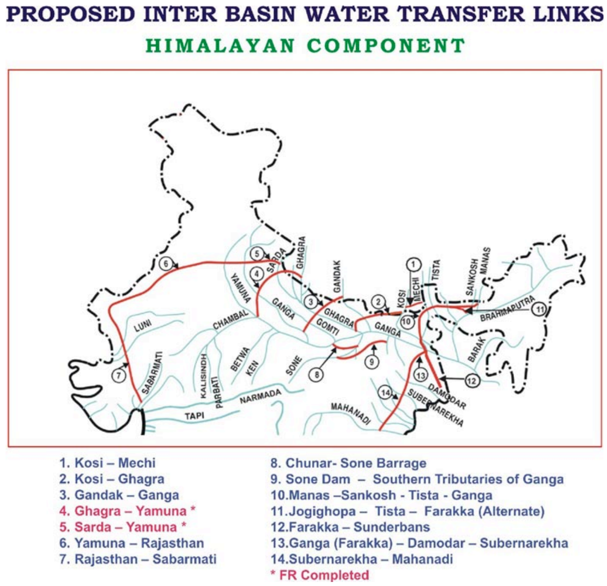
The ILR project: Resurrection of the dormant proposal post-independence

Under the British colonial power, the dominant ideology for water resources management in India was that of *hydraulic manipulation* of rivers (D'Souza 2003a, p.3786) through large scale perennial engineering solutions like dams and diversions for human improvement and welfare (Singh 1997, Shah 2009, D'Souza 2006). This ideology, which survived post independence, led to the active construction of several dam[3] and water transfer[4] projects in India (Shah 2009, p.14). In 1858, a grid of navigation and irrigation canals under "the Orissa Scheme" was proposed by Colonel Cotton[5] to divert the excess flood waters in eastern India as a flood control scheme with additional benefits like irrigation and navigation (D'Souza 2003a, D'Souza 2006). However, financial failures of the canal system and the success of railways as a viable mode of mass transport led to the abandonment of the scheme towards the end 19th century (D'Souza 2003b).

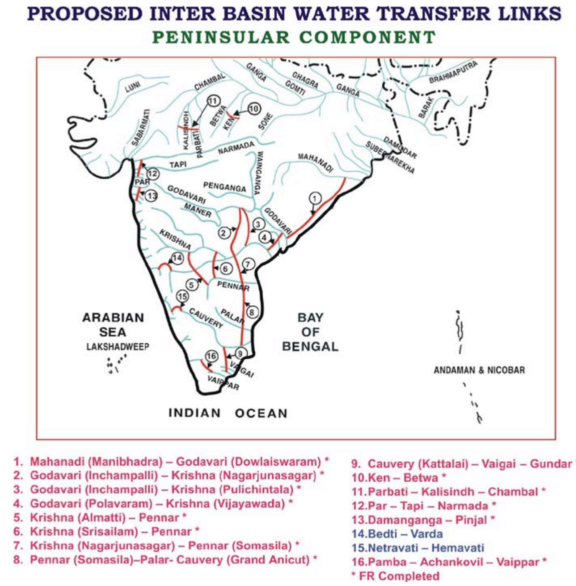
[3] According to the WCD (2000), India is among the top five dam building countries in the world. The WCD India Country review quotes that there are 4291 large dams in India according to the National Register for Large Dams, Centre Water Commission (CWC) (1994) (WCD 2000 p.370). The International Commission on Large Dams (ICOLD) World Register of Dams (1998), states that India has 4011 large dams.

[4] Several water transfer projects like the Periyar-Vaigai project (1895), Kurnool Cudappah Canal (1863), Indira Gandhi Nahar Project (1958) and Telugu Ganga Project (1977) were also undertaken (NCIWRD 1999, Rao 1975).

[5] Colonel Cotton was an hydraulic engineer under British India.



a) Himalayan Component



b) Peninsular Component

Figure 2: Links proposed under the ILR

Source: NWDA

The current ILR project draws upon the colonial legacy of hydraulic management and control and is an extension of the concept of water transfer on a larger scale. The project has been proposed time and again in different forms post-independence. A brief chronology of events that led to the current ILR scheme is presented in Table 1; the details of this table are discussed in greater detail below.

Table 1 Resurrection of the dormant proposal to the current project

Phase	Year	Event
Pre-Conceptualization "the ideas"	1858	Colonel Cotton proposes the Orissa Scheme
	1972	"Ganga-Cauvery link" by Dr. K.L. Rao Proposal rejected by NCIWRP for being technically unfeasible and economically prohibitive
	1977	"Garland Canal" by Captain Dinshaw Dastur
Conceptualization "turning the idea into a plan"	1980	National Perspective Plan (NPP) formulated by MOWR; (for water resource development through regional water transfer to minimize regional imbalances). NPP consists of two river development components- Himalayan and Peninsular. 42 water transfer links identified under the NPP
	1982	National Water Development Agency (NWDA) established to carry out detailed studies and develop feasibility reports of the links as proposed under the NPP. 30 links identified for preparation of feasibility reports (16 under Peninsular and 14 under Himalayan component).
	1987	National Water Policy (NWP)
	2002	National Water Policy revised "water should be made available to water-short areas by…..transfers from one river basin to another."
Pre-implementation "the plan into action"	2002	Task force for ILR established by Supreme Court order. Also a detailed timeline for ILR scheme established.
	2005	Memorandum of Understanding for the first link (Ken-Betwa) between the states of Madhya Pradesh and Uttar Pradesh, and preparation of the detailed project report (DPR) commissioned.
	2008	DPR for Ken- Betwa link completed. NWDA has completed the feasibility report for 14 Peninsular links and for 2 Himalayan links (Indian portion). Memorandum of Understanding for two more links (Par-Tapi- Narmada and Damanganga-Pinjal) signed between the states of Maharashtra and Gujarat and the detailed project reports and feasibility reports are to be prepared by December 2011.
	2009 2010 - 2011	DPR for Ken- Betwa completed. DPR for Par-Tapi- Narmada and Damanganga- Pinjal expected completion.

Source: Compiled from various sources (D'Souza 2003a, D'Souza 2003b, NCIWRD 1999, MOWR 1980, Rudra 2004, MOWR 2002 Iyer 2004, Rao 1975, Bandhyopadhyay and Perveen2003, Gopal Krishna 2004, SANDRP 2003, NWDA website, Press Information Bureau- Government of India[6])

[6] See Press Information Bureau, Government of India, "14 Water Resources Projects declared as National Projects" 23December 2008 Release ID: 46095 and "Review of inter-linking of Rivers" 25 November 2009 Release ID :54546 (Accessed April 2011).

In 1972, Dr. K.L. Rao put forward the “Ganga-Cauvery link” proposal that aimed to connect the surplus river basin in the country to the deficient ones through the creation of a “National Water Grid” (Rao 1975), while Captain Dinshaw Dastur in 1977 put forward the “Garland Canal” idea to feed the Himalayan waters to the peninsular parts of the country by means of pipelines (Bandyopadhyay and Perveen 2003). Both these schemes were found to be impractical (NCIWRD 1999), the former on the grounds of the very large financial and energy costs involved and the latter because it was technically unsound (MOWR, Iyer 2004; Goyal 2003).

Yet interest persisted, which gave impetus to the study of inter-basin transfer proposals. The current ILR program is based on the National Perspective Plan (NPP) (MOWR 1980) formulated by the MOWR to minimize regional water imbalances and to optimally utilize available water resources by transferring water from water surplus to water deficient regions by interlinking rivers. The main objective was transfer of water from Ganga-Brahmaputra basin to the river basins of western, central, and southern India (Rudra 2004). Around 42 water transfer links were initially proposed under this plan, 21 each under the Himalayan and Peninsular components (NCIWRD 1999).

The National Water Development Agency (NWDA) was established in 1982 to carry out detailed studies, survey, and to prepare feasibility reports of the links as proposed under the NPP. After carrying out detailed studies, the NWDA identified 30 links for the preparation of feasibility reports. The need for overall planning and coordination of policy programs for development and regulation of water resources in the country led to the formulation of a National Water Policy (NWP) in 1987. A revised NWP was released in April 2002 which mentioned use of non-conventional methods like inter-basin water transfers to increase the utilizable water resources in the country[7] and the need for a national perspective for transferring water from one river basin to another[8] (MOWR 2002). This policy proposed to divide the country into several water zones with a view of exporting water from "surplus" to "deficit" zones (Rudra 2004) for economic development and activities including agricultural, industrial, and urban development (MOWR 2002). The policy mentions that "water should be made available to water short areas by transfer from other areas including transfers from one river basin to another, based on a national perspective, after taking into account the requirements of the areas / basins" (MOWR 2002). The national perspective for water development formulated in 1980 by MOWR envisages use of water for agricultural production "for meeting the growing food requirements of the country" and economic development (p.1) as it's most beneficial use besides flood control, hydropower generation, and navigation as other benefits.

These developments culminated in the formulation of the current plan, the ILR project. It was formerly adopted by the MOWR, GOI through a Supreme Court order in 2002.[9] Following this, a resolution was passed by the MOWR in 2002[10] to set up a task force for the ILR to bring about

[7] National Water Policy 2002. Article 3.2 states that - "Non-conventional methods for utilization of water such as through inter-basin transfers, artificial recharge of ground water and desalination of brackish or sea water as well as traditional water conservation practices like rainwater harvesting, including roof-top rainwater harvesting, need to be practiced to further increase the utilizable water resources. Promotion of frontier research and development, in a focused manner, for these techniques is necessary" (MOWR 2002).

[8] National Water Policy 2002. Article 21.1 states that - "The water sharing / distribution amongst the states should be guided by a national perspective with due regard to water resources availability and needs within the river basin" (MOWR 2002).

[9] Relevant excerpts from the Supreme Court Order 31 October 2002; "Pursuant to the notice issued by this Court to all the States and the Union Territories in relation to the inter-linking of the rivers, an affidavit has been filed by the Union of India and also by the State of Tamil Nadu. No other State or Union Territory has filed any affidavit and the presumption, therefore, clearly is that they do not oppose the prayer made in this writ petition and *it must be regarded that there is a consensus amongst all of them that there should be inter-linking of rivers in India*". For more details refer to Gopal Krishna 2004, pp.444-445.

[10] MOWR, GOI Order Number NO.2/21/2002-BM. This order highlights the milestone dates and the timetable for ILR scheme. It states that the detailed project reports should be completed by December 2006 and the implementation of the project within ten years (December 2016) (SANDRP 2003).

speedy consensus among the states for the sharing and transfer of water, the preparation of Detailed Project Reports (DPR), and their implementation (SANDRP 2003). The current ILR plan has 30 of the original 42 identified links,[11] with 14 under the Himalayan and 16 under the Peninsular component (Figure 2).

Of the planned 30 links, the feasibility reports for 16 links have been completed[12] (NCIWRD 1999). According to the timeline laid out by the task force, the projected time for the ILR scheme was ten years (by the year 2016) with the actual on-ground construction targeted to begin in the year 2006, after the preparation of DPRs of all the 30 links by 31st December 2006 (SANDRP 2003). However, the Memorandum of Understanding (MOU) for the first link, the Ken-Betwa link, between the states of Uttar Pradesh and Madhya Pradesh, was signed in August 2005 and the DPR for this link was completed in December 2008 (NWDA). The MOUs for two more links (Par-Tapi-Narmada and Damanganga-Pinjal) were signed between the states of Maharashtra and Gujarat towards the end of the year in 2008 and the DPRs along with the feasibility report for both were expected to be completed by December 2011.[13] At present however, no link under the ILR project is under actual implementation.[14] The estimated cost for the project is in the range of US$ 112[15] to US$ 200[16] billion (Vombatkere 2004, Bandyopadhyay and Perveen 2003).

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[11] NWDA reduced the number of links envisaged in the NPP at the pre-feasibility stage because they were not considered feasible (NCIWRD 1999, p.182).

[12] The studies (14 for the Peninsular and 2 for the Indian portion of the Himalayan component) are available at NWDA- NWDA Studies, http://nwda.gov.in/index1.asp?linkid=9&langid=1. Accessed April 2011.

[13] See Press Information Bureau, Government of India, "14 Water Resources Projects declared as National Projects" 23December 2008 Release ID: 46095 and "Review of inter-linking of Rivers" 25 November 2009 Release ID: 54546. Accessed April 2011.

[14] See Press Information Bureau, Government of India, "Economic Impact of Interlinking of Rivers" 8 September 2011 Release ID: 75847). Accessed January 2012.

[15] This US$112 billion is equivalent to nearly one-fourth of India's GDP and was 250% of the entire 2002 tax revenues. As mentioned in: *Interlinking of India's rivers- a reality check* (by Rivers for Life, an independent research action group) (Available at http://www.scribd.com/doc/59031052/Interlinking-Rivers). Accessed August 2007.

Keeping the historical evolution of the ILR project in picture, we now move on to the justifications and challenges associated with the implementation of the ILR project in India. The following section discusses the need and rationale for the adoption of the ILR project in India as a solution to water problems in India. We then discuss the various issues that question the rationale, viability, and the decision-making process for the implementation of the ILR project for water resources management, planning, and development in India.

ILR as critical solution to water problems in India

Water availability and precipitation patterns in India - In the global picture, India has been identified as a country where water scarcity is expected to grow considerably in the coming decades due to rapid growth in the demand of freshwater driven by growth in population and economic development (Bandhyopadhyay and Perveen 2003). Water scarcity leads to regional imbalances in terms of socio-economic development and such imbalances are detrimental to sustainable development and adversely affect human rights (Gupta 2001, p.144). Gupta (2001, p.133) claims that in more than 25% of villages in the state of Gujarat, India the non-availability of clean drinking poses serious threats to the health of the people. Although India receives about 4000 km^3 of water as precipitation annually (NCIWRD 1999), this gross annual precipitation level hides the significant variations of the precipitation patterns across India. Precipitation regimes in India are characterized by wide spatial variations from east to west (Figure 3) and acute temporal variation through the concentration of heavy precipitation during the 2.5 months of monsoon period spread over July, August, and September (Bandhyopadhyay and Perveen 2004). The distribution of precipitation in India, which is governed by the Southwest monsoons,

[16] According to Bandyopadhyay and Perveen (2003) this estimate includes only the construction cost. If social, environmental and operational costs are added to the figure would be in the order the annual country income.

results in substantial rainfall in the northeastern part of the country in comparison to the northwestern, western, and the southern parts. A large part of the total precipitation is received by the Ganga-Brahmaputra-Meghna basin in the northeastern Himalayan region. The variability is also exemplified by a comparison of the numbers of rainy days in different parts of India. For example the state of Rajasthan in the northwestern boundary of India has just 5 rainy days in comparison to about 150 days in some areas in the northeastern India (NCIWRD 1999).

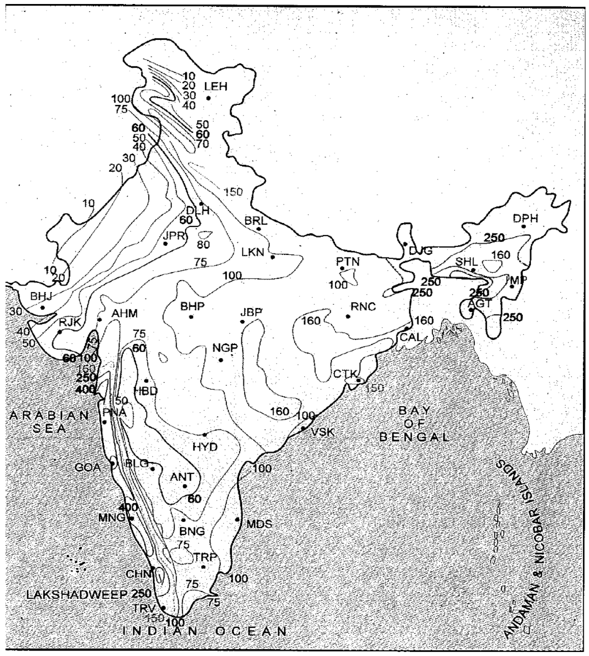

Figure 3: Spatial variation in precipitation pattern over the country (Normal annual rainfall {cm} isohyets[17])

(NCIWRD 1990)

Flood and drought control – The above mentioned spatial and temporal variations of precipitation patterns have led to the development of projects in India that aim to extend the spatial availability of water by diversion of rivers through regional water transfer (Gupta 2001). Several schemes involving water transfer already exist in India.[18] The proposed ILR project is an

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[17] A line on a map connecting points having the same amount of rainfall in a given period.

[18] Refer to the earlier section "ILR project: resurrection of the dormant proposal post-independence for examples.

extension of the same idea at a grander scale, and is borne out of the desire by the political leadership to bring a permanent solution to the negative impacts of droughts, water shortages, and floods in the country (IWRS 1996). One-sixth of India is declared as drought prone while at the same time, one-eighth of India's territory is susceptible to flooding (Gupta 2001, MOWR). As a result, while 270 million people struggle for their livelihood in a parched condition, about 60 million people are liable to annual flooding (Rudra 2004). In 2004, 8.031 million hectares were affected by floods as assessed by Rashtriya Barh Ayog.[19] The flood damages in the country are also steadily rising and have gone up to US$ 5.85 billion in 1998 from US$ 0.52 billion in 1953.[20]

Water for irrigation and food security - Additionally with an increasing population, demands made by agricultural needs are ever increasing in India. Irrigation is a dominant demand sector in India with nearly an 83% share in total national water use compared to the world average of 69% (Rudra 2004). However, to feed the estimated 1.5 to 1.8 billion people in 2050 with 450 million tons of food grains, India needs to increase its irrigation potential to 160 million hectares. Hence, strategies like inter-basin water transfer are in demand.[21]

Domestic water needs - The per capita availability of utilizable water has been reduced progressively from 3450 cubic meters to 1250 cubic meters from 1951 to 2000 owing to the increasing population. In the next 50 years, it is likely to come down to 760 cubic meters (for a projected population of 1.6 billion) (Gupta 2001, p.128). With irrigation accounting for a

[19] Rashtriya Barh Ayog (National Flood Commission), Flood affected areas, MOWR, India (available at- (http://wrmin.nic.in/index2.asp?sublinkid=352&langid=1&slid=353) (Accessed November 2007). In its 1980 report, it had officially assessed that nearly 40 million hectares of land as liable to annual flooding.

[20] See NWDA website: Inter basin water transfer- the Need. Available at: http://nwda.gov.in/index2.asp?slid=3&sublinkid=3&langid=1. Assessed August 2007.

[21] India's maximum irrigation potential that could be created through conventional sources has been assessed to be about 140 million ha. For attaining a potential of 160 million ha, other strategies shall have to be evolved (Refer to NWDA: Inter basin water transfer- the need). The NPP would give additional benefits of 25 million ha of irrigation from surface waters, 10 million ha by increased use of ground water, totaling to 35million ha (Refer to NWDA: Benefits of NPP), Available at: http://nwda.gov.in) (Accessed November 2007).

dominant share in total national water use, only about 4% is attributed to the domestic sector. Thus, at the household level, the per-capita availability has also been reducing progressively and more than 25% of villages suffer from drinking water problems (Gupta 2001, p.128). The National Water Policy lists drinking water supply as the first priority among the overall water allocation priorities in planning and operation of systems (MOWR 2002). The proposed ILR scheme will help to provide additional waters to meet the domestic water needs.

Therefore, given the variability in the endowment of water in India, the proposition of ILR scheme seems plausible as a solution for India's water problems and needs mentioned above. ILR is being viewed as a win-win solution by the government because it will put to use "the water otherwise going waste in the surplus river basins" (NCIWRD 1999) and will "bring about rationalization of water that is lost to the sea" (Rudra 2004). It will also provide additional benefits of 35 million hectares of irrigation water and generate 34 million KW of power.[22] However, several questions arise related to the viability of the completion of the project and to its very rationale on the basis of technical, social, economic, political, and environmental criteria (Iyer 2004; Bandyopadhyay and Perveen 2003, 2004). The following section presents a discussion on the many questions related to the scientific, environmental, social, economic, and political dimensions of the ILR project.

The Debate- Is ILR a remedy for water problems in India?

The myth of "surplus" and "deficit" water - The proposal for interlinking rivers is critically dependent on the identification of some river basins as "surplus" ones, from which water may be

[22] See NWDA: NPP- Benefits of NPP (Available at http://nwda.gov.in/index2.asp?slid=7&sublinkid=13&langid=1. Assessed November 2007.

transferred to the "deficit" river basins. A traditional engineering approach has been used for determining whether a river basin has any “surplus” water in the Report of the Working Group (RWG) on Inter-basin transfer of water of the MOWR.[23] Indirect ecosystem services provided by water such as rain-fed plant production, transport of pollutants, nutrient recycling, wetlands habitat etc. have been neglected (Falkenmark and Folke 2002) in these calculations. Similarly, projected “deficit” areas due to bad water management and unsustainable demands cannot be categorized as water scarce regions (Bandyopadhyay 1989; Iyer 2006, p.55-56). In such cases, the deficit will likely disappear with better water management. “Careful, economical and sustainable intra-basin management should come first and bringing water from elsewhere should be the last resource” (Iyer 2007, p.49).

Flood control and “drought-proofing”? - A significant moderation in floods can be brought about by a massive diversion of flood-water, which may not be feasible[24] (Rudra 2004, p.63) or, if technically feasible, will have severe ecological and river regime impacts downstream of the diversion point, both on the diversion route and on the recipient areas. However, if only small fractions of flood flows are diverted, there will be negligible flood moderation in some cases (Iyer 2006). Even if all the river linking proposals are implemented, it has been found that the

[23] This is based on an unpublished paper by Mohile, A. D. 1998. “India's Water and its Plausible Balance in Distant Future”. Unpublished paper as cited in NCIWRD 1999: 29. In this traditional engineering approach, a simple exercise in arithmetic hydrology has been employed taking just the visible and flowing water into consideration. This is because the reductionist engineering does not “recognise and assess the diverse ecosystem services performed by water in all parts of the river basin, from the moment it gets precipitated to the moment it is drained out into the sea. The arithmetical hydrology of reductionist water resource engineering sees water purely from the point of storage, transfer and allocation for supplies. It is, thus, unable to recognize that in all river basins, from a holistic perspective, one does not see any 'surplus' water, because every drop performs some ecological service all the time” (Bandhyppadhyay and Perveen 2003, p:8) .

[24] The excavation of a canal having a discharging capacity of more than 1400 cumecs is hardly possible on technical grounds. The peak discharge of the river Ganga at Farakka and river Brahamaputra at Pandu were measured to be 75900 cumecs (in September 1998) and 72726 cumecs (in August 1962) respectively. Hence withdrawals of about 1400 cumecs would not moderate the floods in the lower reach.

contribution made to the mitigation of the flood problem will not be substantial[25] (Iyer 2007, p.50). The project will merely provide additional water to areas already served by rivers and is therefore not a feasible answer to the drought-prone areas of the country (Iyer 2006). Also, the introduction of irrigated agriculture in arid or drought-prone areas in the country is potentially an unwise move that can lead to increased incidents of conditions of water logging and salinity.

Irrigation water and food security - A greater availability of water does not necessarily translate to higher agricultural production. Although the irrigated area in India has expanded from 19.5 million hectares to 95 million hectares during the past five decades (Rudra 2004, p.58), the yield of cereals per hectare (agricultural productivity) in India is much lower than other countries in the world (Bandyopadhyay and Perveen 2004). China with much less arable land has yielded levels almost double of that of India (Bandhyopadhyay 2009; Rudra 2004, p.58). Swaminathan (1999, p.73) has pointed out that China produces 13% more food grains per capita than India. In fact, the Food and Agriculture Organization (FAO) data indicates that cereal yield for India in 1995 was 2135 kg per ha while that for China was 4664 kg per ha (see Figure 4) (CWC 1998: 223-24).

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[25] Bharat Shah, Professor Emeritus at Water resources training centre at the IIT, Rourkee, and Member of the NCIWRD (1996-99), has observed categorically that "any water resources engineer will immediately discard the idea of inter-linking of rivers as a flood control measure" (Iyer 2007, p.50 and Singh 2003, p.11).

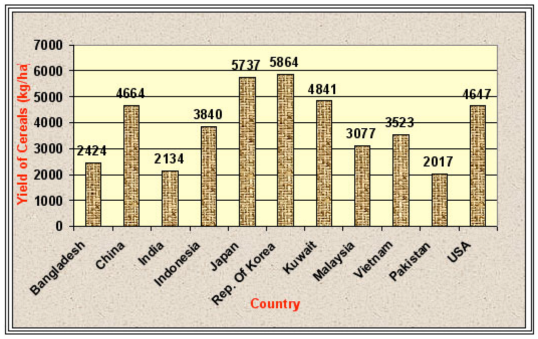

Figure 4: Country-wise yield of cereals (in kg/ha)
Source: Water and Related Statistics, CWC 1998 (Bandhyopadhyay 2009)

Rise in the social and environmental movements - India has had a rich history of water development projects with nearly 4291 large dams (WCD 2000). However, with the rise in the social and environmental movements in the 1970s the yesteryear harbingers of progress are now being viewed as "temples of doom spelling disaster for man and nature" (Thukral 1992, p.7) due to the growing awareness of the disparity between the losers and the beneficiaries. The rise in such national and even related transnational movements have led to delays, substantial modifications, or even termination of several projects in India like the Narmada Valley Development Project,[26] Silent Valley project,[27] and Bodhghat project[28] to name a few (Khagram 2004, p.42-48). The Narmada project has been dragging on for over 50 years and has undergone considerable modifications since its inception in the year 1945-46 (Kalpavriksha 1988) due to

[26] The project involved construction of 30 big dams and hundreds of small dams along the river Narmada. Of these Sardar Sarovar Project (SSP) is the largest and was the focal point of the struggle of Narmada Bachao Andolan's (NBA) (Save Narmada Movement). The opposition to the project initiated in 1980s with issues of resettlement and rehabilitation of project affected people. In 1987, similar resettlement packages were announced for all project affected people like the landed and landless oustees and the tribals. A second campaign began in 1990s based on environmental concerns. This campaign led to withdrawal of World Bank's financial support to the project in 1993 and a stop in construction 1995. However, in 2000 the Supreme Court again allowed construction (Khagram 2005, p.65- 138; Kalpavriksha 1988; Sathe 2000; Dabholkar 1993, Roy 1999; Dreze, Samson and Singh 1997).

[27] The project involved setting up of hydropower dam in 1973 in the Silent Valley in the Western Ghats. A grassroots mobilization based on concern for ecological impacts led to cancellation in 1983 and conversion of the area into a National Park (Khagram 2005, p.42-49)

[28] The project involved a series of hydro-projects on Godavari and Indravati rivers around 1956. The non-governmental stakeholders were able to compel the government to halt the projects in 1995 based on a environmental and human rights campaign (Khagram 2005, p.49-50)

the subsequent struggles of stakeholders not included in the decision-making process (Khagram 2004, p.65-101). The costs of delay in project implementation have been colossal (Patel 1994). The ILR scheme, which is a more elaborate water transfer scheme across the whole nation therefore, can face similar but greater delays in implementation and completion.

Social and environmental implications - The ILR project is potentially fraught with serious environmental consequences given the fact that it will necessarily involve dams, reservoirs, canal systems, diversion of waters, etc. The adverse ecological impacts of dams and diversions have been documented worldwide and research indicates that they fragment rivers and modify watershed area. They also affect the downstream aquatic ecosystems, floodplain ecosystem, and fisheries by fundamentally altering the natural flow (hydrologic) regimes of rivers, trapping sediments and nutrients in impoundments, reducing in nutrient content in downstream flows, and blocking migration of aquatic organisms (WCD 2000 p.73-95). Other impacts can be submergence of forest habitats and movement routes of wildlife, loss of bio-diversity (flora and fauna), the deterioration of soil fertility, alterations in geomorphic features leading to loss of aquatic and riparian habitats, implications for estuarine processes, changes in saline circulation and salinity gradients, altered energy flows, changes in water quality, introduction of invasive species, and subsequent establishment and spread of disease vectors (Meador 1992; Davies, Thoms and Meador 1992, Poff et al. 1997 pp.773, 776, Baxter 1977 p.274, Aleem 1972, McCully 2001, Biswas and Biswas 1976, Ligon et al. 1995, Iyer 2006).

Also, on the basis of feasibility reports and the DPR put up in the public domain by MOWR, critical reviews by Alagh et al. (2006) have established the need for a more comprehensive environmental impact study of the project. Thakkar and Chaturvedi (2006) who conducted an analysis on the Ken-Betwa link claim that the basic environmental impacts of the link are not even known (p.151).

In addition to the environmental consequences, the debate about the social impacts of dams, in particular, is both complex and fiercely argued. The debate involves several discrete dimensions (Adams 2000, p.1): (i) The nature and scale of *negative* impacts (people displaced, the extent of disruption to the lives and livelihoods of people downstream), and the *benefits* claimed for dams (the economic and social benefits of electricity generation, water supply, flood control or irrigation); (ii) Whether the positive economic benefits of dams (flood control, electricity and irrigation water) outweigh the costs (disrupted downstream economies, resettlement); and (iii) Distribution and equity regarding the positive and negative impacts between people (between displaced and electricity consumers).

This debate is particularly relevant for the ILR scheme given the distributional effects of irrigation dams in India. Duflo and Pande (2005) noticed a remarkable unequal sharing of costs and benefits from these constructions. Agricultural productivity in the area where a dam is built does not increase but poverty does, whereas in the downstream areas due to increased irrigation benefits the agricultural production increases and poverty declines. Overall, dams were found to be a "marginally cost-effective investment with significant distributional implications and have, in aggregate, increased poverty" (Duflo and Pande 2005, p.1). The ILR scheme will result in submergence of forest and agricultural land along with the displacement of a large number of people (Vombatkere 2004, Iyer 2004). Conflict over resettlement and rehabilitation of the affected people, and social and environmental impacts among various stakeholders may occur and lead to unnecessary delays as mentioned earlier for several water projects in India.

Institutional arrangements and the "history" of water disputes - Other potential burdens will involve interstate and international issues (Prasad 2004; Iyer 2004; Siwakoti 2004; Anwar 2004). In India, water falls under the jurisdiction of at least six federal level ministries and various agencies at the state level. The MOWR is responsible for the development, conservation, and management of water as a national resource; however, the state has the primary responsibility for use and control of this resource (Narain 2000). This fragmentation hampers effective formulation and implementation of policies (Ananda et al. 2006) due to lack of responsibility and accountability. For the ILR project, a problem could arise if individual states refuse to become an integral part of the project. As mentioned above, the delay in implementation of Narmada Valley Project in 1945-46 was due to a dispute among the three states over the lack of agreement over the sharing of waters, the height of Sardar Sarovar dam, and sharing the responsibility for land availability for resettlement (Khagram 2004).

Furthermore, India is known for major water-related conflicts—example include the Cauvery river dispute involving the States of Karnataka and Tamil Nadu over water use sharing, and the Krishna river dispute involving the States of Karnataka and Andhra Pradesh. The possibility of a water basin being shared by more than one state or across national boundaries is usual. Also India is susceptible to the existence of divergent perspectives and priorities among the states or nations (like Nepal, Bangladesh, and China) in dealing with shared water resources. The proposed ILR scheme will, therefore, potentially increase administrative and political conflict within the country, which will potentially delay its completion with the possibility of complications within international agreements.

Exorbitant cost - The estimated US$ 112 billion cost of the project is for the first ten years. This figure is equivalent to nearly one-fourth of India's annual GDP and was 250% of the entire 2002 tax revenues. In an event of delay, this cost will increase. The MOWR has already claimed that the project is feasible in 35 years and that the costs may rise to US$ 200 billion (Vombatkere 2004). Cost overruns between 50 to 893% have been reported from some of the earlier large water development projects in India (Sharma 2003). Moreover, completion of existing irrigation projects in the country requires over US$ 800 billion by conservative estimates, with many projects languishing due to lack of funds. Resources are even lacking for maintenance of existing irrigation capacities (Thakkar 2004). External lending could worsen the current external debt situation, so the government has categorically negated external funding for the project and has given a call to industry to support this endeavor, which may open gates for private sector investment for managing India's water resources leading to the further potential loss of traditional rights of people over water resources (Vombatkere 2004).

The 'process' of decision-making - Although the NWDA has been working on the project for the last two decades, the ILR scheme was not mentioned in the Ninth Plan (1997-2002), had a cautionary mention in the 1999 Report of NCIWRD, and was silenced in the Tenth Plan (2002-2007), thus clearly demonstrating lack of serious intention for its implementation (Iyer 2004 p.11-12). Even though the project formed a key place in the electoral platform of the National

Democratic Alliance (NDA),[29] led by the BJP (Bharatiya Janata Party, a key political party in India) in 1998/99, the project still could not take off. In 2002, following a Public Interest Litigation, the Supreme Court directed the implementation of the project within ten years (by 2016) (Shukla and Asthana 2005, Iyer 2004). This politically lucrative opportunity was aptly used by the ruling party, the BJP, to its advantage in context of the coming elections by announcing the launch of the mega-project for bringing water to needy areas and the common man. Even in the absence of an open public debate, the Prime Minister's announcement of the task force for ILR's execution garnered support from the Opposition leader, since water is a sensitive political issue and failure to do so would have appeared negative (Shukla and Asthana 2005, p.19). This is also in contrast to the NWP (2002) which states that "management of the water resources for diverse uses should incorporate a participatory approach; by involving not only the various governmental agencies but also the users and other stakeholders, in an effective and decisive manner, in various aspects of planning, design, development and management of the water resources schemes" (MOWR 2002).

At the bureaucratic level, the project provides the MOWR with a frontier position in the national political arena. The project serves the aspirations of the bureaucrats and technocrats who form the rank and file of the Indian government. The proposed ILR scheme offers the promise of prominence to professionals and administrators in the MOWR to be linked with the greatest engineering "*magnum opus*" of the contemporary times (Shukla and Asthana 2005, p.19). This

[29] NDA or National Democratic Alliance, a coalition of political parties in India led by Bharatiya Janata Party, BJP. It had thirteen constituent parties at the time of its formation in 1998. This NDA government was keen on the implementation of mega projects like national highway plan. The ILR project was also supported by the United Progressive Alliance (UPA) when it came into power in 2004 after winning the next elections. The UPA coalition government was guided by their National Common Minimum Program (NCMP 2004) (document outlining the minimum objectives of the UPA coalition government) which talked about "a comprehensive assessment of the feasibility of linking the rivers of the country starting with the south-bound rivers"

hype and value associated with the project also had an element of nationalistic sentiment (Iyer 2004).

These arguments and debates, therefore, question the viability of the project. There appears to be great inconsistency in the declared claims of the project and their feasibility. What is also contestable is the manner of the process of decision-making for the project which effectively by-passed conventional democratic and administrative procedures. The lack of transparency and accountability in the process and non-involvement of the civil society actors (grassroots groups, NGOs, independent scientists/ engineers, social scientists, etc.) have raised questions about the legitimacy of the project and its implementation. There is a clear need for re-examination of the assumptions or claims on which the project is being implemented in a public domain. Last, but not least, unless the proposed ILR scheme is discussed in detail with all the stakeholders, the wisdom of going ahead with it will remain questionable. These issues are key especially given the current global debate on water resources development which is questioning the need for big water projects (like large dams and diversion projects) as preferred alternatives (WCD 2000, Khagram 2004, McCully 2001, Scudder 2005). This discourse prioritizes socially equitable and environmentally sustainable development of water resources, and advocates informed participation of all stakeholders concerned (WCD 2000).

Global trend on water resources development: the rise and fall of big water projects

Water resources development in the latter part of 19th century and the 20th century has manifested itself primarily through supply-side solutions like dams and diversions (water transfers) (WCD 2000, Khagram 2004). Consequently, the large dams "emerged as one of the most significant and visible tools for the management of water resources" (WCD 2000, p.xxix), and many water transfer or diversion schemes also gained importance in the 20th century with increases in population, economic activities, and human settlement in water scarce regions (Gichuki and McCornick 2008). Thousands of dams were constructed for most of the 20th century to aid man in harnessing water for food production, irrigation, energy, flood control, domestic use, industrial uses, and other uses like recreation, inland-navigation, fisheries, and tourism (WCD 2000, p.11-14, Altinbilek 2002, McCully 2001, p.11-12). Similarly, water transfer schemes have also supported socio-economic development by facilitating water allocation from surplus to scarce regions and reducing regional inequity (Gichuki and McCornick 2008).

The rise and spread of large dam building has been a predominantly 20th century phenomenon.[30] The decades between 1930s and 1970s saw the construction of large dams as "synonymous with development and economic progress" and they were "viewed as symbols of modernization and humanity's ability to harness nature" (WCD 2000 p.xxix). The era also contributed to the formation of the international big dam regime (establishment of International Commission on Large Dams [ICOLD][31]) and proliferation of "*hydraulic bureaucracies*" like national agencies and river valley organizations across the world (Molle et al. 2009, Khagram 2004, p.6). The end of World War II was marked by economic growth, decolonization, and state building and

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[30] The numbers of dams has increased from about 600 big dams in 1900 to nearly 5,000 in 1949 and to about 45,000 by the year 2000 (WCD 2000). A similar trend has also been noted for inter-basin water transfer, which increased from a paltry 22 km3 per year in 1900 to about 364 km3/year in 1986, and is estimated to increase to 760-1240 km3/year by 2020 (Shiklomanov 1999).

[31] ICOLD was established in 1929 and comprised of engineers, builders and bureaucrats to collect and coordinate knowledge about big dam building

witnessed a phenomenal rate of dam building. The World Bank supported construction of big dams across the third world, which also contributed to their spread, growth and legitimacy.

The pace of dam building, which was at its peak until about mid-1970s, at nearly 1,000 dams per year, fell to under 200 by the turn of the 21st century (Khagram 2004, p.8-9, WCD 2000, p.9). This decline can be attributed to many factors. With time, as the experience and information on the performance and consequences of dams beyond their immediate benefits became available, serious public concerns over their impacts on rivers, riverine ecosystems, people, and even economic performance emerged (WCD 2000, p.15-17; Khagram 2004, p. 7-10, 178-183; McCully 2001). The initial criticisms against big dams emerged in North America and Western Europe with conservationists trying to preserve the natural environment and growing loss of free flowing rivers (McCully 2001, Khagram 2004). By the mid-1960s many researchers also started criticizing the undesirable and unnecessary environmental and social impacts caused by big dams (Scudder 2005, p.6-7).[32]

These anti-dam environmentalist movements, in conjunction with saturation of technically attractive sites for dam building in North America and Western Europe, led to the decline in the pace of dam building by 1970s. However, an increasing demand and support (national and among development aid and credit agencies) for big dams drove the proponents to developing countries. Approximately, two-thirds of the big dams built in 1980s were in developing nations. Many of these countries had centralized authoritarian regime political systems, which favored big dam building and were supported by transnational allies (Khagram 2004, p.10, 178-184).

[32] Refer to the earlier section on "social and environmental implications" for details on ecological consequences of dams and diversion projects.

However, the rise of environmental and social movements in 1970s and 1980s[33] expanded the initial anti-dam campaigns and led to the emergence of transnational networks (such as the International Rivers Network) that encompassed directly affected people, grassroots groups, and domestic non-governmental organizations[34] (Khagram 2004). There was integration of social impacts[35] caused by these big dam projects into the anti-dam movement (WCD 2000, p.98). These networks led a more vigorous and coordinated opposition to dams worldwide.

These transnational alliances and networks had an alternative vision for development that advanced a bottom-up and participatory processes approach directed towards socially just and ecologically sustainable outcomes (Khagram 2004, p.4). They questioned and criticized the traditional economic cost-benefit analysis model and framework for water resources planning and decision-making. These alliances advocated a bottom-up approach for natural resources management along with social and environmental costs (Khagram 2004, p. 4). As a result of their actions, the dam related planning and policy process started including environmental assessments. By the late 1980s environmentalists and sociologists were involved and by mid-1990s the affected people and NGOS became involved in the process (Goodland 2000, p.77). The last couple of decades also have seen an emergence of collaborative approaches[36] in water resources management, which represents a significant shift from a top-down central agency

[33] This was primarily fueled by 1972 United Nations Conference on Human Environment (which led to formation of environmental agencies and ministries across many countries) and the 1976 United Nations Declaration of Human Rights (Khagram 2004, p.16-17).
[34] For a detailed discussion refer to Chapter 6 in Khagram (2004).
[35] Such as impacts of forced displacement on people and their livelihoods, downstream communities, gender and rights of indigenous peoples (WCD 2000)
[36] The key characteristics of a collaborative approach is the realization by the central agency that the top-down, traditional, technocratic strategies and practices with a single minded focus on implementing the agency's mandate needs to be replaced by more collaborative and consensus based approaches; involvement of a variety of actors; integration of local knowledge with scientific knowledge; and finally that the decision-making should not be left up to bureaucratic experts and officials (Sabatier et al. 2005, pp.43-51).

dominated approach to a much more collaborative bottom-up strategy involving negotiations among a variety of governmental and non-governmental stakeholders (Sabatier et al. 2005, p.viii). This changing trend indicates a dissatisfaction and skepticism towards a centralized resources planning approach under experts who lack local knowledge and legitimacy to address needs of local or diverse stakeholders given the fact that they are removed from local problems, conditions, and controversies (Sabatier et al. 2005, p. 3-5).

Additionally, there was mounting evidence that showed that dams were not fulfilling the promises made by them (McCully 2001, p.133-157). Moreover, the ever-increasing protests against the big dams was causing time and cost overruns (Khagram 2004, p.9-10). Also, despite an estimate of more than US $2 trillion spent on the big dams and river valley projects over the last century, approximately one billion people currently do not have an adequate supply of water (Khagram 2004). Serageldin (1996) states it is estimated that about three billion people across 52 countries will be plagued by water stress or acute shortages by the year 2025.

These debates on environmental, social, and economic impacts of big dams which questioned the efficacy of benefits achieved by big dam construction led to the establishment of World Commission on Dams (WCD) in 1998[37] to initiate a dialogue on the future of large dams around

[37] The WCD was set up 1998 from an IUCN-World Bank workshop (April 1997) between dam opponents and proponents. WCD was set up as an independent commission and represented regional diversity, varying backgrounds, expertise, interests and views. The WCD included representatives from 68 institutions in 36 countries. For details on members refer to WCD (2000, p.xix-xxi). Membership to WCD did not however imply endorsement to the Commission's report and findings. No- strings funding was received from about 53 contributors including governments, international agencies, private firms and NGOs. The WCD framework was received by mixed reactions across the world. The proponents of dam building felt critical about the report and claimed that the guidelines would restrict construction of future dams. Several UN agencies, European governments and NGOS recognized the achievements of the report and endorsed it (Scudder 2005, p.10-13). MOWR, India comprehensively rejected the finding of the report claiming that "guidelines for development now suggested by WCD in their Final report are wholly incompatible with our development imperatives" and that "

the world (Scudder 2005, p.6-10, Khagram 2004, p.198-205). The idea was to review all big dams built around the world for their effectiveness, assess alternatives for water and energy development, and finally to generate internationally acceptable guidelines for future dam planning and construction (WCD 2000, p.28). The WCD (2000) advocated that any dam project should be "economically viable, socially equitable and environmentally just" (p.2) and is based on the core principles of "equity, efficiency, participatory decision making, sustainability and accountability" (p.202). The WCD proposed a new framework for water resources decision making that would enable a needs and an options assessment to validate and identify a preferred alternative for water resources development, ensure public acceptance by accounting for the concerns of all stakeholders along with their informed participation, and finally ensure compliance (on social, environmental, technical and governance measures) and adaptability in changing contexts (based on monitoring and evaluation programs) (WCD 2000, p. 195-275).

Recommendations and Policy implications

The global trends in water resources management and planning question the large centralized water development schemes (dams and diversions) and reflect a changing pattern of increased participation, transparency, and integration of social and environmental concerns into water resources management and development schemes. The debates associated with the ILR project reflect a digression from this global trend and reveal the complexity and challenges of the water resources management and planning in India. This reflects a need for a fundamental change in both the science and politics of water resources planning and development in the country. There is a need to develop an alternative paradigm, which accommodates the concerns and issues of

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India proposes to continue with its programme of dam construction to create another 200 Billion Cu. Metres of storage in the next 25 years or so to ensure continued self-sufficiency in food grain production and to meet the energy and drinking water needs of a growing population" (UNEP DAMS).

various/diverse actors and stakeholders, and is both scientifically recognized and socially acceptable. It is the hope that such a paradigm (and the associated planning process) will enlighten the decision-makers and facilitate informed decision-making, and assist in producing policy outcomes that are viable, balanced, and enable desired change to achieve the objective of sustainable water resources use, management, and planning in the country.

This new paradigm encompasses suggestions that include increased water use efficiency; increased and diversified stakeholder participation; reassessment of justified demands at watershed levels and their prioritization; importance to decentralized and traditional water systems; improved maintenance of existing water infrastructure; education outreach on water use efficiency; improved discipline diversity amongst water institutions; and increased alliances between and across governmental and non-governmental stakeholders at local, regional, and national levels. The following are recommendations for a new paradigm for water resources management and planning in India:

1. Comprehensive reassessment of demand projections of water requirements for all sectors in different regions, with special focus on the irrigation sector which primarily drives the water policy in the country. The current water resources management is being driven by highly inflated water demand estimates and/or cropping pattern preferences and lacks practicality (Amarasinghe et al. 2008).[38] This reassessment could be done by government departments in a collaborative effort with the non-governmental or academic research scientists to ensure

[38] Amarasinghe et al. (2008) have found a declining trend of food grain demand and their contribution to economy. So, if the target for self sufficiency of food grains especially surplus rice in India is reduced by 10-20 million tonnes (equivalent to only 3%-5% of total grain demand), it reduces about 3%-6% total irrigation demand. These saving can be used for other high value crop production, to reduce the production deficits of maize or in other sectors. Additionally, contribution of agriculture to GDP has decreased from 46% to 25% over the period of 1961-2000 and is declining at a rate of 2.9% annually in 1990s.

consensus.[39] Moreover this reassessment should encompass the following two steps: (i) reassessment at different watershed levels and aggregated at the next level to reflect the demands for different states. This will enable more accurate demand projections and can help determine the need or necessity for major irrigation projects; and (ii) prioritization of justified needs for each watershed.

2. More efficient irrigation potential by decreasing the application and conveyance losses. The NCIWRD (1999) also indicates a need to increase the irrigation efficiency in India from the 33% to 60% by 2050. The two step strategy includes:

a. Increase in yield per hectare. Amarasinghe et al. (2008) claim that by increasing the food grain crop water productivity[40] in India by 1% per annum, the increased demands for grains in 2050 can be met at current water consumption rates while a 1.4% increase can account for all crop demands. Thakkar (2008) further claims that average food grain yields from irrigated areas in India can be increased from 2.4 tons per hectare to 4 tons per hectare.

b. Review and evaluate existing water infrastructure, their operational efficiencies, and their repair/maintenance costs to obtain the intended or projected outcomes (economic assessment) by MOWR. Thakkar (2008) mentions that the gap between the irrigation potential created and actual irrigation is around 10 million hectare. Bridging this gap would be a more cost effective solution with less social-ecological impacts than creating more projects to increase storage capacity. Therefore, such an evaluation holds the potential to provide solid evidence if efficiency improvements could bring equivalent benefits (in terms of increased irrigation

[39] This is sync with the national water policy (2002) that call for a participatory approach to water resources management in India involving non-governmental stakeholders into the decision-making process (MOWR 2002). Additionally, the collaborative approaches also mention involvement of a variety of actors and integration of local knowledge to replace a top-down, centralized technocratic practice of decision-making (Sabatier et al. 2005).

[40] Improving water productivity means obtaining more crops or income or livelihood and ecological benefits for every drop of water used or depleted. Crop water productivity of grains is the ratio of grain crop production to consumptive water use.

and financial costs than in creating new projects). It could also serve as a template to identify areas/projects that need to be targeted and prioritized for improvement and to compare new project construction if need be.

The prioritization for both infrastructure and agricultural yield improvement should be done in collusion with the reassessed demands projected. This will help to effectively address water scarcity issues and guiding future water policies.

3. Increased and prioritized implementation of decentralized and local (traditional) water systems in the overall planning scheme. This will help the storage of water closer to the area where the water scarcity problem and demand is and reduce conveyance losses, which are a part of the high irrigation inefficiency in India. Vaidyanathan (2004) and NCIWRD (1999) both report that conveyance losses significantly contribute to the overall low irrigation efficiency of 33% in India. Several successful pilot case studies exist for decentralized traditional systems (Vombatkere 2004, Velasquez et al. 2005, Agarwal and Narain 1997, Singh and Tata 2002, Romesh D'Monte 2005, Kashwan 2006). Moreover, India has a rich and exhaustive history of traditional knowledge and systems of water harvesting and management (Agarwal and Narain 1997). The governmental agencies should consider partnerships (public-private partnership) with NGOs who are known for their work in decentralized local solutions.

4. Establish education outreach campaigns to (i) educate and provide information to the farmers on efficient irrigation methods; (ii) improve techniques related to agricultural yields; (iii) diversify crops for maximum output; (iv) increase availability of options related to water augmentation for the given local conditions; and (v) foster awareness regarding the scarcity of

the resource.[41] This could be done through the various regional and/or national NGOs who are working on water resources.

5. Introduce a system for pricing agricultural and irrigation water use to promote efficient utilization of water and maintain the existing water infrastructure through revenue generation by Government oversight. This can be based upon the already existing valuations and analysis done on the economics of irrigation in India. Bandhyopadhyay (2009) supports quantification of the economic contributions from irrigation and their subsequent utilization in public policy. The latter, however, has been lacking in India. The peer-reviewed system with participation from concerned stakeholders[42] could ensure a workable solution. The political representation should also be included within these negotiations given the nature and dynamics of the issue in India.

6. Place priority on the operationalization and implementation of groundwater recharge programs in India to deal with water scarcity issues. Given the vast network of decentralized structure like ponds, tanks, and wells throughout India, which are already contributing to the irrigation potential of the country (Thakkar 2008, Amarasinghe et al 2008),[43] such interventions could have a powerful impact. Moreover, the conveyance and application losses in the use of groundwater for irrigation are much less than the surface systems (Vaidyanathan 2004).[44] Amarasinghe et al. (2008) also claim that from an overall economic perspective,

[41] Such a campaign should also be targeted towards urban areas to promote resource conservation and promote overall efficiency and economy in water consumption.

[42] This may include (like farmer associations, water user associations, related industry associations, agricultural and ecological economists from research centers/ academia in the country)

[43] Thakkar (2008) has stated that over 90% of the additional irrigation in the last decade has come from groundwater in India, while about two-thirds of India irrigated food grains output comes form groundwater. Amarasinghe et al 2008 have shown that India already withdraws around 60% of sustainable groundwater supply which will increase to about 72% in 2050, and the majority of groundwater is abstracted for agriculture. Also in 2050, 8 river basins in India will withdraw more than 75% of their available groundwater supply.

[44] High technical efficiencies of about 70-80% can be achieved though groundwater irrigation systems.

groundwater development is a cheaper option mainly because most good sites for large dams in India have already been developed.[45]

7. Improve partnerships between MOWR and the *panchayats*[46] at the village and district level to strengthen the implementation of decentralized plans like the one mentioned above. This will improve the over all transparency and accountability of the process.

8. Expand water resource agencies and personnel within the government beyond the civil engineering expertise. The need for the multi-disciplinarily approach to water development is paramount. Bandhyopadhyay et al. (2002) has pointed out that the technical aspects of dam building or other systems used for enhancing built storage capacities for water, should be a collaborative effort of scientists and engineers of all disciplines to result in a more systematic and comprehensive understanding of the role of these structures/mechanisms in development. The requirements for recruitment in the national water agencies should include experts and practitioners from other disciplines that encompass the various dimensions of water resources development like environmental engineers, geologists, seismologists, ecologists, social scientists, foresters, agricultural scientists, conservationists, economists, and policy analysts. These experts can be hired on a permanent basis within the agencies or collaboration should be placed with related Ministries, other already established agencies, or by developing public partnerships with specialized NGOs. This will improve coordination across these agencies and

[45] At present, the development of one hectare of surface irrigated area costs more than three times the sot required for developing one hectare of groundwater irrigated area.

[46] Panchayats form the basic unit of the Panchayat Raj system of decentralized governance in India, where the Panchayats act as the basic units of administration, empowering people at the village level. It has 3 levels: village (*gram*), block (*tehsil* or *taluka*) and district (*zilla*). It was adopted by state governments during the 1950s and 60s as laws were passed to establish Panchayats in various states. It also found backing in the Indian Constitution, with the 73rd amendment in 1992 to accommodate the idea. The Amendment Act of 1992 contains provision for devolution of powers and responsibilities to the panchayats to both for preparation of plans for economic development and social justice and for implementation in relation to twenty-nine subjects listed in the eleventh schedule of the constitution

departments; and at the same time improve transparency of the process due to non-governmental partnerships.

9. MOWR should serve as the driving force for planning and developing policies, priorities, and plans for the water resources in the country in close collaboration with its counterparts at the state levels and other government agencies who also have a stake in water resources. This will ensure the establishment of clear priorities and policies, mutually beneficial projects, and will avoid working on conflicting or divergent allocations for the same water resource.
10. Increase and improve alliances between non-governmental stakeholders with strategic allies in the already existing governance structure who can champion their concerns, needs, and causes. This will enable them to have a foothold at different venues and platforms within the institutional structure and setup to affect desirable policy change.
11. Strengthen alliances/coalitions between various non-governmental stakeholder groups at regional, national, international, or transnational levels. This will increase their voice across different regions where different coalition partners may have more face-value and thereby bring about a more sustained grassroots mobilization for the issue. The transnational alliances can help them to raise the awareness for the issue worldwide and may result in an international pressure for policy change. Such transnational forces aided the NBA (Narmada Bachao Andolan) campaign to integrate social and environmental concerns during the construction of the Narmada valley development plan (Khagram 2004).

Conclusions and Relevance

The current conventional paradigm and strategies for water resources management need to be challenged and questioned in India. This is evident given the challenges associated with the existing solutions like centralized water transfer and the ILR project being adopted within the country, both of which are a deviation from the global trends of increased participation, decentralization, transparency, and integration of social and environmental concerns into water resources management and planning. The future solutions for water problems need to span across regions, discipline, and stakeholders and ought to be viewed within an intergenerational framework (Figuères et al. 2003, p.2). There is also a need for a paradigm shift in water management which enables not only integration but also brings with it opportunities for innovations and new approaches (Figuères et al. 2003, p.228-236). [47] In this paper we have discussed and examined some alternative policy solutions and approaches that can represent a paradigm shift for water resources management in India and other similar developing country scenarios. Also, we present and examine several strategies that can be utilized by different stakeholders, especially the non-governmental, which will enable them to integrate their concerns and issues into the water resources planning and decision-making process by forming alliances within the governance structure. It is hoped that the new paradigm presented can answer concerns raised and help to facilitate an informed decision-making process in India and other South Asian countries that face similar water resources management and planning process issues to achieve sustainable water resources development.

[47] The approaches include planning and decision-making by taking into account the global and regional perspective as units of account rather than the nation; increased importance to secondary sources of water through increases in rainwater harvesting, effluent reuse and desalination to broaden the resource base; effective governance of groundwater resources; and capacity building of current water managers (decision-makers) to enable a holistic and multidisciplinary understanding of problems and varied stakeholder views (Figuères et al. 2003, p: 228-236).

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