National River Linking Project: Analyses of Hydrological, Social and Ecological Issues

Overview of the Workshop Proceedings

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Introduction

Coping with annual floods and droughts, both occurring at the same time in different parts, has been a major concern for India over the millennia. These concerns are more acute today as the growing population and the resultant increase in water demand place a heavy burden on the unevenly distributed water resources, and also cause huge economic losses to the financially vulnerable groups of the population. Additionally, there is a huge demand to enhance and diversify food production to meet the needs of a vast population with changing consumption patterns and higher disposable incomes. Designed to address these concerns, the National River Linking Project (NRLP) envisages transferring water from the potentially water surplus Himalayan rivers to the water-scarce river basins of western and peninsular India (NWDA 2006). The NRLP will build 30 river links and approximately 3,000 storages to connect 37 Himalayan and peninsular rivers to form a gigantic South Asian water grid. As Tushaar Shah et al. (Paper 1 in this volume) have pointed out, the NRLP concept perhaps originated at a time when there was stiff opposition to large dams. Environmentalists questioned the ecological cost of large dams, while the NGOs and civil society probed the social cost of people displacement. However, much of the discourse on the NRLP to date is filled with opinions and assertions, but many of the arguments for and against the project have little analytical rigor. The International Water Management Institute (IWMI) and the Challenge Program on Water and Food (CPWF) have designed a 3-year project titled 'Strategic Analysis of India's River Linking Project' to qualitatively improve the issues and direction of the present NRLP debate (IWMI 2005).

The primary focus of the IWMI-CPWF project is to provide the public and the water resource and policy-planners with a balanced analysis of the pros and cons of the NRLP components. The IWMI-CPWF study, 'The Strategic Analysis of India's River Linking Project', assesses India's water future from 2025 to 2050 and analyzes alternative options, including

the River Linking Project, and their adequacy to meet the demands of the proposed water future. The specific objectives of the project are to:

- Assess the most plausible scenario of water supply and demand given the present trends of the determinants of water demand;
- Analyze whether the NRLP concept can be an adequate, cost-effective and sustainable response in terms of the present socioeconomic, environmental and political trends, and if implemented, how best the negative social impacts can be mitigated; and
- Prepare a plan of institutional and policy interventions as a fallback strategy for the NRLP and identify the best strategies to implement alternative options.

Phase I of the project focused on analyzing India's water future scenarios from 2025 to 2050 and the related issues. Phase II, which is ongoing, analyses aspects of social cost: benefits associated with NRLP without attempting a full social cost-benefit analysis. Based on the findings of the earlier phases, Phase III will explore alternative strategies for ensuring India's future water security. Due to the paucity of information on many of the proposed links, Phase II's assessment is conducted in two tracks. Research in the first tack assesses how NRLP as a concept can be socially acceptable and to what extent NRLP can contribute to meeting the water demand scenarios of the nation. Studies in the second track analyze the social cost-effectiveness of the few proposed river links. Under this track, we have selected the proposed Polavaram-Vijayawada and Ken-Bethwa links of the NRLP, and the existing IGNP canal project for detailed analysis. The social cost-effectiveness analysis of the links includes assessing:

- Direct and indirect benefits of irrigation water transfers;
- Groundwater externalities of surface water transfers;
- Gender impacts and equity issues of new water transfers;
- Benefits of domestic and industrial water transfers;
- Environmental benefits and 'dis-benefits';
- Hydrological feasibility; and
- Resettlement and rehabilitation issues of large water transfers.

The studies conducted so far have generated a large number of outputs of relevance for policymakers and the public. The major objective of the national workshop was to share the results of various research activities conducted in Phases I and II of the project, and add value to the ongoing debate on this subject, which remains of great importance to India and the region.

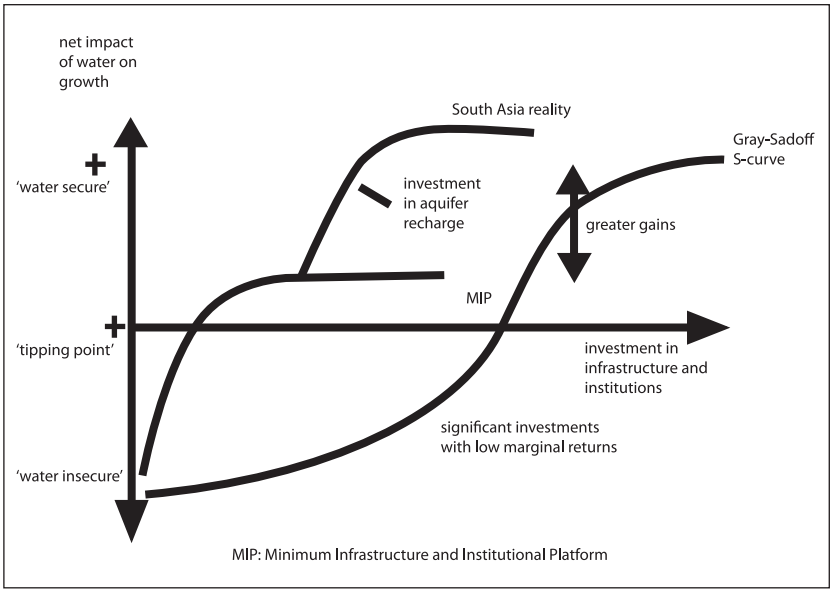
This paper presents an overview of the keynote speeches and presentations of the first national workshop. Sections one and two are a summary of the keynote speeches presented at the inaugural session. The issues related to hydrological feasibility of water transfers are discussed in section three, benefits and cost of irrigation water transfers in section four,

implications of improvements in rain-fed agriculture on NRLP water transfers in section five, contingencies for large inter-basin water transfers in section six, groundwater irrigation and future direction in India in section seven, issues of resettlement and rehabilitation in large water transfer projects in section eight, and transboundary issues of water transfers in section nine. We conclude this paper with an overview of the major issues raised in the discussions of the workshop.

Inaugural Session

The economic growth of a country is critically linked to water security, for which substantial investments are required. The Model by Grey and Sadoff 2005 (Presentation 1 of Tushaar Shah), which influenced the thinking of public investments in the past, suggests that poor countries require investments in water resources development that reach tipping point in order for these to yield positive returns. After a country reaches the tipping point the returns to investment increase, and after a country reaches a reasonable level of water security the returns to investment taper off.

Figure 1. Dominant view of public irrigation investments and returns (Grey-Sadoff model), and South Asia investment patterns.



Source: Tushaar Shah's presentation 1 (see annex)

Many poor countries will have to invest several times more than their Gross Domestic Product (GDP) value in order to reach the tipping point. However, due largely to low-cost private investment, in South Asia in general, and in India in particular, investments have already reached this tipping point. As a result additional public investment in canal irrigation in these

countries now yields little returns. For example, India invested close to Rs. 100,000 crore (US$24 billion in 2006 prices) in surface irrigation since the early 1990s, but it has hardly resulted in any addition to the net irrigated area. However, use of groundwater, which is primarily private due to the source of investments, dominates irrigation now and is expanding further. Countries such as India, require re-thinking in their public investment strategies to shift the returns to an upward direction. The present trends of development indicate that the major challenges for India in the future lie in managing the colossal groundwater economy.

Similar sentiments on the management of groundwater resources were echoed by Prof. M. S. Swaminathan in his inaugural address. Declining returns from past public investments in canal irrigation sector indeed raise many serious issues concerning 'India's Water Future'. Many a time, the performance of the irrigation sector in India tends to be measured by the quantum of total investment. However, even after huge investments many areas are still under agrarian distress. Irrigation is one of the important components of the relief packages to areas of agrarian distress. Yet, even after substantial investments, poor performance of the canal irrigation sector remains a grave concern. Statistics of irrigation potential are often overestimated for purposes of obtaining project approval, resulting in a substantial gap with the actual irrigated area. In this context, it is of concern how the 10 million ha of new irrigated lands can be created under the proposed Bharat Nirman Program, let alone the proposed 34 million ha under the NRLP. Although not much research has been conducted on these issues, a substantial part of this additional area could also come from groundwater irrigation. In such a scenario, rainwater harvesting and aquifer recharge become important and necessary. Given its contribution to irrigation and also to drinking and industrial water supplies, augmentation of supply and management of demand of groundwater are important.

Accoding to Prof. Swaminathan, given the importance of local level water harvesting and aquifer recharge, grassroots level institutions could play a major role in addressing problems related to water, for which these organizations should be empowered with better knowledge and technology, and sound financial and legal frameworks. Two recent initiatives of the Ministry of Water Resources can contribute immensely to improve rural livelihoods through local planning. The first initiative is the 'National Water Year Award'. Last year this was awarded to Hiware Bazar (Box 1), which is a classic case of how locally managed organizations can transform villages through better planning. Many National Water Awards, such as the one awarded to Hiware Bazar, could have significant uptake and impacts.

Box 1. Water Budgeting in Hiware Bazar

Hiware Bazar, a village in Ahmedngar district of Maharashtra, with slightly over 400 mm of rainfall, frequent droughts and degraded environments, is faced with an acute shortage of water. To regenerate its once rich natural resources base and to address current water scarcities, Hiware Bazar Panchayat has created a village level water budget. The village water budget first estimates water availability and then plans the allocation to different users. The local participatory democratic organization, called Gram Sabha, approves these plans, which then become law for the local people. These plans have helped Hiware Bazar recharge its wells, to increase from single to double cropping, to have stable production, and to increase income by 20 times over the last 10 years.

The second initiative is the 5,000 small experiments conducted by 61 agricultural institutions at 1-2 ha level, for improving water productivity. It is imperative to examine how these unique experiments, and also experiences such as Hiware Bazar, can be out-scaled to other areas or regions and up-scaled to bigger area or community units to achieve larger results, like more crop per land where land is scarce, more crop per drop in water-scarce situations, and more crop per drop of diesel in the context of the emerging energy crisis.

According to Prof. M. S. Swaminathan, three important requirements need recognition in the future: 1) Water literacy - education and awareness of the efficient use of scarce water supply, especially given the wastage of water by the affluent ; 2). Social mobilization, where democratic grassroots level organizations that are empowered with knowledge, technology and financially and legally, can play a major role in water management, especially rain water harvesting and managing groundwater in a scientific way; 3) Regulation, which can be used as an instrument in reducing over-exploitation of the resources. These initiatives are important in the context of integrated water resources management at the basin level meeting India's future water demand.

What then is the role of large water transfers such as the National River Linking Project in meeting the future water demand? In his inaugural address, Mr. Suresh Prabhu cited two extreme opinions in the present discourse on NRLP. Both proponents and opponents think that the country will be doomed depending on whether NRLP is not implemented or implemented. In many instances independent analyses of large water transfers are lacking. In this respect, the analysis of IWMI is timely and could contribute to a proper evaluation of the NRLP process. Mr. Prabhu, however, emphasized that it is important to accept that India is having serious problems relating to water. These problems will only be aggravated by an increasing population, especially by an increasing young population. The acceptance of existing and also of impending problems relating to water could help people to think through and analyze the process, and arrive at a logical conclusion. Such an analysis needs a holistic approach.

Every human intervention has ecological consequences. Therefore, analysis of water developmental projects should not only assess direct benefits such as hydropower generation, irrigation, groundwater recharge, transportation, employment generation etc., but also assess ecological cost, social and political cost, and the impact of international implications. Such a holistic analysis should also include:

- Investigating the potential for up-scaling of micro level water management, such as the case in Hiware Bazar, and their implications;
- Conducting scientific analysis of groundwater availability, use, management and of future potential;
- Assessing reasons for the gap between irrigation potential that is created and utilized, and the potential for increasing the efficiency of existing irrigation systems; and
- Exploring suitable/ optimum cropping patterns for different regions of the country.

Furthermore, such an analysis should also consider projects that are already undertaken by different ministries. While the Power Ministry initiates various projects to harness the 150,000 MW potential, the Water Resources Ministry is undertaking projects to increase the irrigated

potential. In addition, the Forest Ministry conducts forestation activities and the Rural and Urban Development Ministries augment the water supply to meet domestic drinking and municipal and industrial demands. A holistic analysis in the water sector should consider all these factors and results and indicate further requirements for meeting India's water and hydro-power futures. Only a comprehensive analysis of these complex interacting problems can provide scientific solutions and provide the options that India requires to face the serious challenges in the water sector. Such solutions will not only help the national and state governments, but also cities, communities, households and farmers to make proper decisions on water development and management.

India's Water Future: Scenarios and Issues

Increasing demand for water at global, regional, national and local levels has received significant attention in recent studies. The 'water future' assessments of the recently concluded Comprehensive Assessment of Water Management in Agriculture highlighted many issues of global and regional importance (Paper 2 by Upali A. Amerasinghe et al)). Growing population, increasing income and urbanization, and associated changes in consumption patterns, especially with increasing income in developing countries, are changing the pace of water demand patterns. Along with changing patterns of food consumption and production, the increasing water demand in domestic and industrial sectors is changing the pattern of water use in developing countries.

India is no exception to these changing patterns in the drivers of water supply and demand (Paper 2 by Upali A. Amerasinghe et al.). While demand for cereals in India has been decreasing since the early 1990s, the demand for non-grain crops and animal products has been increasing. As a response to the changing patterns of internal demand and also to the increasing export opportunities under global agricultural trade, cropping patterns in both irrigated and rain-fed areas are diversifying. Groundwater has been the major source of water supply for irrigation in the last two decades. Business-as-usual trends indicate that groundwater will continue to be the major source of water supply for irrigation, and the share of water withdrawals for domestic and industrial sectors will increase much faster than that for irrigation. However, the business-as-usual water use patterns will increase unsustainable water-use patterns, which will lead to water crises in many river basins in the country. Both, supply augmentation through groundwater recharge and irrigation demand management are two areas of immediate importance.

Water supply and demand scenarios of the Godavari (Polavram)-Krishna (Vijayawada) link canal under the NRLP water transfers are the focus of Paper 3 by Luna Bharati et al. This study addressed the implications of alternative cropping patterns on the water demand in the command area and outside. Proposed water transfers and use would affect the downstream water users in the Godavari delta reservoir, and will not be able to meet the environmental water demand in the Krishna Basins. The study suggests that water resource development in the region should take into consideration the monthly variations in planning of water resource development.

The discussion of this session highlighted that developing countries need to seriously consider and prioritize their investments in development , utilization and management of water resources, study the scaling implications and institutional requirements for wider dissemination of micro-level successes in water resources management, consider the environment and the project-affected people as important stakeholders in the planning, and identify potential interventions required to be adopted and take suitable action to increase the productivity of water by following environmentally-benign technologies.

Hydrological Feasibility of Large Water Transfers

The main objective of this session was to discuss issues relating to the hydrological feasibility of large water transfers, such as NRLP, in India. Anil Mohile's (Presentation 3) keynote address noted the rationale for the planned water transfers in the NRLP project given the situation in the 1970s and 1980s; changes of key parameters in recent years, and the feasibility of proposed links under the changing socioeconomic scenarios. National food security, agriculture dominated economy, lack of electric power in rural areas, imbalance in international trade and strong regional and national view points were among the key drivers that justified the NRLP concept. But many of these key drivers and also agricultural water use practices have changed or are in the process of changing. Agriculture no longer dominates the economy, and agricultural demography is also fast changing. Groundwater is a major source for meeting agricultural water need, and the agriculture sector does not necessarily have priority over other economic sectors and the environment in water use. However, water scarcities are increasing in many regions and concerns do still exist as to the inequitable distribution of water in different regions and as to national food security. In light of these concerns many of the proposed links would generate significant benefits and attract medium to low inter-state and international concerns for implementation.

Paper 4 by Vladmir Smakhtin et al. analyzed the hydrological feasibility of proposed water transfers through the links in the NRLP that flow into and out of the Krishna River Basin. This study suggests that the use of annual flow data, as indicated in the feasibility reports, may show that more water is perceived to be available for transfers at the respective site. If the environmental water demand, such as that which is critically required for the delta areas of the Krishna Basin, is also taken into account, the perceived water surpluses may further be reduced. The study suggests that intra-annual variability of water availability and environmental water requirements need be to taken into account in assessing the hydrological feasibility of large water transfers.

Shah and Kumar (Paper 5) discussed the issues and controversies associated with the feasibility assessment of small and large dams. According to this analysis, the present criteria of classifying large dams according to the height of the dam, is not appropriate. The existing criterion often overestimates the social and environmental cost, which often leads to substantial interest and debate. It also leads to a significant underestimation of the indirect social and economic benefits that large dams generate. This paper argues that the new classification criteria could better assess the benefit and cost of large dams.

Cost and Benefits of Irrigation Water Transfers

The economic cost and benefits of past irrigation investments and also of the proposed water transfers were the focus of this session. The study by Inocencio and McCornick (Paper 6), which is based on a global data set of 314 water development projects, included 37 projects from India that showed that although the economic performance of surface irrigation projects is increasing globally, it has been declining in India in recent years. However, large projects with many small schemes, projects with diversified cropping patterns, and projects that are farmer-managed and others managed by water user associations tend to have a higher economic performance. The finding of this study is indeed revealing in the light of the huge investments made and the decline in the canal irrigated areas in recent years.

Anik Bhaduri et al. (Paper 7) and Upali A. Amarasinghe et al. (Paper 8) estimate the economic benefits of the proposed water transfers in the Godavari (Polavaram)-Krishna (Vijayavada) and the Ken-Bethwa links of the NRLP. A major part of the proposed command area in both locations is already irrigated.

The study by Anik Bhaduri et al. (Paper 7) shows groundwater irrigates more than 90% of the command area of the Godawari-Krishna Link at present. Thus, the additional net value added as economic benefits per additional cubic meter of proposed water transfer, is estimated to be low. However, a substantial part of the command area has declining watertables due to overabstraction of groundwater, and is presently a constraint for further diversification and economic growth in the command area. The proposed water transfers will assist more diversification to high-value annual crops and recharge the depleting groundwater tables in the command area.

The study by Upali A. Amarasinghe et al. (Paper 8) noted the importance of local level hydro-meteorological conditions and patterns of crop production in the planning of local level water transfers. Monsoons provide much of the rainfall in the Ken-Betwa link command area, thus, hardly any area is irrigated during the kharif season. However, a substantial part of the irrigation transfers is proposed for the kharif season. Moreover, rice is a major part of the proposed cropping pattern, whereas rice cultivation in this area, even under irrigation conditions, has decreased significantly in recent years. The study shows that the direct and indirect benefits per every cubic meter of water consumed or delivered is rather low even under the most optimistic scenarios of cropping patterns. The results of this study once again reaffirm the importance of giving due consideration to interests conducive to local conditions.

Amrita Sharma et al. (Paper 9), while analyzing the impact of irrigation water transfers on gender and equity', made a deliberate deviation, looking at different types of impact on irrigation within the command areas of a canal project. The benefits of irrigation are utilized differently across different communities, depending many a times on the social, political and financial capital of different communities. The existing inefficiency in water supply management and poor supervision from the irrigation authorities and WUAs have made the head-tail divide much sharper. The rapid land transactions altered significantly the social geography of the area during the initial period of the study. While some communities with more social and financial capital are able to move up the economic order, many other landless people could not get adequate benefits. Thus, with the prevailing poverty situation, irrigation interventions have made little dents on unequal gender relationships. There is a little change

in women's access to and control over key primary assets and with little impact on their personal lives and decision-making capacity.

Future of Rain-fed Agriculture – Implication for NRLP Water Transfers

Rain-fed agriculture covers 60% of the present crop area in India but contributes to only one-third of the crop production. Improving productivity could significantly increase crop production from the existing rain-fed areas and in turn reduce requirements for large scale intra- and inter basin water transfers for irrigation. Dr. J. S. Samra, Chairman of Rain-fed Agriculture Authority of India explained its role in improving agricultural productivity under rain-fed conditions (Presentation 4). The importance of supplemental irrigation in critical periods of water stress for higher crop yields, opportunities of runoff water harvesting and recycling of water for supplemental irrigation on crop yields are vital areas of research and development for the Indian rain-fed agriculture.

Bharat R. Sharma et al. (Paper 10) showed that the productivity of rain-fed areas is indeed hampered due to mid-season and terminal droughts. Supplemental irrigation in these critical periods can significantly increase yields of many rain-fed crops. In large parts of rain-fed areas, water availability is not a constraint for supplemental irrigation. This analysis shows that 28 M ha of rain-fed lands, which can benefit from supplemental irrigation, generate about 114 billion cubic meters of runoff annually. Only a fraction of this runoff can provide critical supplemental irrigation to 25 million ha of crop lands during normal monsoon and 20 million ha during the drought seasons. Provision of this harvested water through one supplemental irrigation during the later stages of crop growth has the potential to enhance rain-fed production by more than 50 %.This analysis shows water harvesting for supplemental irrigation in rain-fed lands is indeed economically viable and socially equitable, and could have little negative impact in the downstream. Potential benefits are much higher for oilseeds, pulses and rain-fed rice areas as compared to coarse cereal areas.

Contingencies that Could Justify Large-scale Water Transfers

It is argued that uncertainties associated with international trade and the requirements for national food self-sufficiency, increasing use of biofuel and the associated increase in irrigation water demand, essential requirement of reliable water supply for crop diversification in high-value crops, the energy crisis and its impacts on smallholder farmers using groundwater, depleting groundwater tables in basins that are reaching closure, constraints for large-scale groundwater recharge in hard rock regions and increasing demand and willingness to pay from domestic and industrial users in exchange for reliable surface water supply, are several contingencies that could justify large-scale water transfers between basins. This session focuses on a few of the aforementioned important issues.

Prof. Y.K. Alagh (Presentation 5) discussed how international trade can be used to avert large- scale water transfers between basins. Although internal demand is a major driver of crop diversification in India, international trade can increase this process. This kind of impetus

on crop diversification will also increase pressure on water and land availability. However, the trading trends between agricultural agroclimatic regions were the ones which often encouraged the implementation of sustainable land and water management policies. There can be considerable synergy between trade, diversification and sustainable development. However, the present agricultural policies of India are not conducive to a trading environment, which is dominated by the WTO and also confounded by highly distorted global agricultural markets.

A major part of the present agricultural exports includes horticulture, dairy products and spices, most of them grown on drylands. However, the present crop diversification that is followed in many irrigated lands ignores these opportunities. The main crop diversification now includes switching to high-value cereal crops and following it up with non-cereal food or non-food crops. However, fodder or tree crops or horticulture in some areas, while improving trading opportunities, will decrease pressure on the demand for water.

More than 15 million smallholder groundwater irrigators in India, of which many are water buyers, are under siege from an energy squeeze. Deteriorating farm power supply, increasing difficulty in acquiring new electricity connections and an eight-fold increase in prices of diesel, contribute to this squeeze. Surface irrigation is an alternative to this crisis, but that may require large water transfers. Tushaar Shah (in Paper 11) discussed the trends of recent energy prices, the energy crisis in agriculture and of the coping strategies adopted by small landholder irrigators in India. Increases in diesel prices and pump irrigation charges by six to eight fold in the last four decades have far exceeded the increases in prices for food crops. In the 1990s, selling one kg of wheat was sufficient for purchasing one liter of diesel. Today, it costs three to four times more than that amount to purchase a liter of diesel. The demand for groundwater irrigation is highly elastic to the irrigation cost. Energy squeeze is a major cause of severe agrarian distress, especially among the landless smallholder water buyers. Coping strategies to minimize the impact of the energy squeeze at present include diesel saving crop substitution or return to rain-fed farming; energy substitution of PDS kerosene to diesel and/or using low-cost Chinese diesel/kerosene pumps; adopting energy-saving irrigation practices or shifting to high-value and high-risk crops; and as a last option, an exit from unviable farming. Promoting fuel-efficient Chinese diesel/kerosene pumps, subsidizing diesel or providing rations for kerosene, increasing power supply or providing a separate electricity supply for agriculture, and targeting electric supply to poor or cooperative electric tubewells could ease the present agrarian distress.

Surface irrigation is a major source for recharging groundwater and that in turn mitigates problems relating to the downward trend in the groundwater tables of water-scarce regions. However, positive and negative externalities of groundwater recharge in surface irrigation systems are often underestimated. The study of the Godavari (Polavaram)-Krishna (Vijayawada) Link of the NRLP by Bharat R. Sharma et al. (Paper 12) discussed the externalities of additional water transfers. The study also projects that surface irrigation in the Godavari-Krishna Link command would raise the groundwater level on average by 2 meters, and improve the groundwater profile from over-exploited to semi-critical blocks in the Krishna Basin. However, at the same time 16% of the command area could also be at risk of waterlogging. In addition, the study suggests that conjunctive water use with the existing infrastructure and with appropriate cropping patterns could mitigate waterlogging and, thus increase the economic benefits.

Rainwater harvesting and artificial groundwater recharge are proposed as possible alternatives for large surface water transfers. Dinesh Kumar et al. (Paper 13), however, highlighted the limited opportunities that exist for rainwater harvesting and artificial recharge in the many arid regions of India. Low quantity and highly variable rainfall, fewer rainy days, high evaporation and hard rock geology in many water-scarce areas are the major limitations in the supply side. Due to high demand, many river basins in water-scarce areas are facing closure now. As regards these basins, the economic value of water is high in water-scarce areas vis-à-vis water surplus upstream catchments. Therefore, attempts to change hydrological impacts upstream could have severe economic impacts in the downstream regions. The study also noted the high unit cost of water harvesting associated with many known techniques. A better understanding of surface and groundwater and upstream and downstream interactions of water supply in a basin, basin-wide water accounts, and of the cost of various techniques for different environments, are necessary for designing cost-effective programs of water harvesting.

Groundwater Irrigation – Future Directions for India

Groundwater was the major driver of irrigation expansion in the past, and is the source for more than 60 % of the total irrigated area at present. This trend seemed to continue unabated albeit at a slower rate of growth. Mr. Jha, Chairman of the Central Ground Water Board, shared the vision of future direction and policy issues (Presentation 6). Due to an unprecedented increase in groundwater abstraction, the depth of groundwater in many regions is at a threateningly low level. About 30 % of the 5,723 assessment units are either over exploited or at critical to semi-critical levels. This includes much of the breadbasket of India—especially in the states of Punjab and Haryana. The present rate of abstraction of groundwater could even impact the food, health and environmental security of these regions, in particular, and the whole nation, in general. It is imperative that many effective policy measures are implemented quickly to avoid a widespread crisis. These policy options include: regulatory mechanisms for curtailing groundwater exploitation in the over-exploited areas; demand management strategies for reducing abstraction, which includes pricing, spreading micro-irrigation techniques, providing a reliable electricity supply etc.; supply augment measures through artificial recharge; plan for ownership and allocation of groundwater among different sectors; and judicious planning of groundwater abstraction in under-exploited areas in the flood-plain aquifers, alluvial plains in eastern and north- eastern India, and in the coastal areas.

In spite of the limitation illustrated by Dinesh Kumar et al. (Paper 13), artificial recharge movement has a long history in India and is argued to have a significant potential for restoring depleted resources and thereby improving groundwater irrigation. R. Sakthivadivel (Paper 14), speaking on “Decentralized Artificial Recharge Movements in India: Potential and Issues”, showed the extent of artificial recharge movement in the country and the techniques of recharge, national status on artificial recharge technology, economic and environmental impacts, and cost of artificial recharge. This paper argues that a substantial part of the future water demand can be met from artificial and wastewater recharge. Sustainable groundwater recharge programs are necessary to reap the full benefits of artificial and

wastewater recharge. Thus, groundwater recharge programs should be participatory where communities are involved in the planning and management of groundwater resources. The paper also suggested a systematic research program for identifying potential areas for artificial groundwater recharge and their benefit and cost.

Tushaar Shah and Shilp Verma (Paper 15) discussed a possible demand side management strategy for groundwater overdraft. In 2002, IWMI, in its studies, argued that intelligent rationing of an electricity supply is the second best option to full metering. It suggested to separate the electricity supply given to tubewell farmers, provide electricity according to a pre-announced schedule, provide high-quality power supply during the peak irrigation demand periods of about 30 days and reduce the supply to 4-5 hours per day during the rest of the period, avoid metering cost for now, but gradually increase the flat tariff to meet the average cost, and enforce stringent controls on the new electricity connections and pump sizes. 'Jyotirgram Yojana', is the Government of Gujarat's response to management of groundwater over-abstraction, in which they separated the power supply to farm tubewell irrigators and the non-farm sector, and implemented all but one of the IWMI recommendations. Today, the non-farm sector in Gujarat receives 24 hours of power supply, and the tubewell irrigators receive 3-phase uninterrupted power supply for 8 hours per day. 'Jyotirgram Yojana' is a successful effort on demand management in Gujarat, and an improved version with modifications will offer a way to reverse rural de-electrification in eastern India at a moderate cost.

Rehabilitation and Resettlement Management in Large Dam Projects in India: The Lessons for India

Resettlement and rehabilitation (R&R) of involuntarily displaced populations continue to be a difficult problem, despite the vast national and international experiences in R&R, and the existence of several guidelines on resettlement management. Many attribute this to the limitations of policy guidelines and institutional limitations. This session, while acknowledging these limitations, deviated from a traditional analysis of issues relating to R & R. It discussed the long-term impacts of R&R by analyzing the new livelihood opportunities created by new water development projects and which displaced people benefited from these projects.

Ramaswamy Iyer, former Secretary to the Ministry of Water Resources of India, illustrated the changes that are under consideration in the new policy on R&R. According to his opinion emerging enlightenment was reversed by the pursuit of growth and development accompanied by impatience with other concerns. He regrets the loss of a sense of justice and compassion, and outlined an approach to a more humane and equitable policy on displacement and rehabilitation.

The study by Madar Samad and Zankhana Shah (Presentation 7) shows that enhanced livelihood opportunities in relocation sites can create longer-term benefits that compensate the short-term losses associated with such resettlement schemes. The study also tests the hypothesis that with proper risk management policies, the short-term negative impacts of the livelihood of displaced people can be fully averted in some cases and largely arrested or

to some extent mitigated in others. In these cases, livelihoods of resettled people are restored quickly to those levels at which they were before displacement. The study findings are based on field studies of the resettled population in Ujjani project in Maharashtra and Sardar-Sarovar project in Gujarat and Maharashtra. The hypotheses have been proven true for the 'oustees' in Gujarat, but their success in Maharashtra and Madhya Pradesh lagged in propensity. Although 'oustees' in Gujarat have encountered a period of initial stress and a decline in their standard of living, a majority of them have restored their livelihood to that of the pre-displaced level within 4-6 years. Unlike other states, Gujarat has a unique mechanism for acquiring agricultural land for replacement at market prices, and also has a special agency for implementation. In addition the state has well-developed special units for monitoring the resettlement and rehabilitation process. This study, although discourages forced displacement, adds a new dimension to the discourse on R & R of 'oustees' of major development projects. It reveals that not all is bad for R & R 'oustees', contrary to what is frequently highlighted in many large water transfer projects.

Transboundary Conflicts in Water Transfers

Water transfers in the Himalayan component of the NRLP are saddled with issues and conflicts relating to transboundary water diversions. However, many lessons can be learned from existing international agreements. Gichuki and McCornick (Paper 16) highlighted international experiences from agreements on using water in the Aral Sea basin among Central Asian republics, and water transfers between Tagus and Ebro basins in Spain. Much of the initial agreements of water sharing are no longer functional in these basins, and many conflicts have arisen recently. Many of these conflicts are due to the unforeseen circumstances at the time of formulating the initial agreements. Thus, a holistic analysis of the water supply, its use and the future demand for it in different countries in a river basin could reduce these conflicts to a minimal.

Can existing agreements also be modified to augment water supply by transferring more water between basins? A classic case is the agreement between India and Bangladesh on sharing the Ganga's water. Under NRLP, surplus water of the Brahmaputra River is expected to be transferred to the Ganga basin to facilitate further transfers to the peninsular basins. Anik Bhaduri and Edward Barbier. (Paper 17) suggest that existing agreements can be modified to augment water supply, which in turn will benefit both countries. However this depends on the political altruism of India to transfer water to a downstream country such as Bangladesh. In the absence of political altruism, and if India unilaterally diverts water to her peninsular basins, Bangladesh would incur huge environmental losses.

This research is still at an early stage and more work is required for quantifying the water transfers that entail a win-win situation for both countries, under many forms of possible contingencies. However, the study by Bhaduri et al. shows how two countries can transfer water between basins and benefit both if the up-stream country has political altruism to transfer water to the down-stream country or have sound legalistic insurance mechanism in place to safeguard the downstream country in the event of a negation in altruism.

Conclusions

It is indeed important to acknowledge, as many participants of the workshop agreed, that if business-as-usual trends continue, India will face a severe water crisis. Inter-basin water transfers could certainly be a solution for water-scarce regions in peninsular India. However, the research conducted under this project, although raised many important issues, did not provide precise estimates of the quantity and the locations that can benefit from these water transfers. The discussion on the need for expanding surface irrigation was always overshadowed by the poor returns to investments in this sector. The colossal investments in the canal irrigation sector in the recent decades had hardly any impact on increasing the surface irrigated area and promoting diversified agriculture. It is indeed intriguing why such stagnation or in some areas declining trends of surface irrigated area continue. Most likely poor management of the created infrastructure, inefficient water institutions at various levels and economically unviable political policies in the water sector are the factors that lead to such a situation. In order to know the need for further surface water transfers, it is imperative to accurately assess the reasons for such underperformance in the canal irrigation sector, and the potential of other supply augmentation and demand management strategies in the existing irrigation infrastructure. There are no disagreements that groundwater, as in the past, will play a major role in shaping India's Water Future. In fact, much of the proposed irrigated area, as in the Godavari-Krishna and Ken-Betwa, under the NRLP is already irrigated through groundwater. Many argued that harnessing the excess runoff through water harvesting and artificial groundwater recharge can provide supplemental irrigation for the rain-fed areas as well as sustain the groundwater irrigation in others. But, equally strong arguments are made that the potential for artificial recharge, especially in the water-scarce arid regions of India, is low due to vagaries of rainfall. And water harvesting, artificial recharge and upstream development in water-scarce basins can have a significant negative economic impact on downstream users. However, it is not clear where exactly and in what magnitude these negative impacts occur in India. This requires a thorough investigation. Studies also show micro irrigation, resource conservation technologies and other water saving technologies can contribute substantially to demand management and productivity enhancement as well.

Change in consumption patterns and fast economic growth in large parts of the country require a shift in cropping patterns with much greater attention to diversified agriculture and animal/ fisheries based products. All this requires precise and reliable water supplies, especially for the smallholder farmers, located closer to the cities and towns. Supplies from groundwater and treated wastewaters have the potential to meet these fast growing demands. Additionally, the domestic and industrial water demands are expected to grow substantially resulting in high opportunity costs to meet the additional investment requirements. Future large, water transfer projects must make an adequate allocation to meet these demands. In fact, the Godavari-Krishna Link's left bank canal has been designed mostly to meet the growing domestic and industrial demands of Vishakhapatnam city.

Productivity enhancement is also mentioned as a critical tool for reducing further irrigation expansion. Estimates show only less than half of the water withdrawals are depleted beneficially at present. It is also true that although irrigation was a major determinant of productivity growth in India, the growth of yield has begun to decline in recent times. Therefore, it is important to

identify locations of low productivity and high potential areas and where interventions for increasing the water productivity are required. Rain-fed agriculture shall continue to play an important role in meeting the existing and future food demands, especially relating to oilseeds, pulses, rain-fed rice and coarse cereals. Presently, in addition to the levels of productivity being low, the vulnerability of the farmers dependent on it is quite high. Improving productivity in rain-fed agriculture, with a small quantity of supplemental irrigation, is shown to have significant potential.

Assessment of available water surplus in river basins should also receive significant attention. Future water requirements of different water users within the basin, whether for irrigation, domestic or industrial uses and most importantly for the downstream riverine environment should be assessed before deciding the surplus. Presently, in the entire discourse on water resources development, environment is a silent stakeholder. Equally important is to consider water availability at shorter time periods, at least monthly for evaluating the water availability. In the absence of such an analysis, more water is perceived to be available for transfers at different locations.

When water is proposed to be transferred across the basins, on most occasions the interests of donor and the recipient regions (states/ countries) are at conflict and need to be resolved through innovative win-win solutions. In the absence of mature and experienced river basin organizations and well-established sharing mechanisms, the issues involved are sure to become more complex than the hydraulic structures and, have the potential to become the first stumbling block in the process of water transfer. The associated and equally important issue is the properly designed, disseminated and implemented rehabilitation and relief package for the project affected people. As the land is becoming scarce and valuable and civil society organizations more vocal and effective, the acquisitions must be handled with great sensitivity, tact and empathy.

References

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