Water Science in India
Hydrological Obscurantism

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The proposal for addressing the twin problems of floods and water scarcity by interlinking rivers is based on an outdated and dangerous idea of surplus river basins from which water can be drawn at will. Global experience shows how damaging such plans of large-scale water transfer are to the environment, economy and livelihoods of the people. Such plans have also proved a failure to either prevent floods or provide water on a sustainable basis. It is unfortunate that water policy in India remains a prisoner to such obsolete ideas.

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The world is passing through a period of rapidly escalating demand on water, whose availability is limited by the ecological processes of the global hydrological cycle. For centuries, guided by the singular perception of gaining access to ever-greater volumes of water, humanity has created numerous supply-side solutions by obstructing rivers and diverting their flows to areas away from the rivers or use them in periods when demands are far larger than the natural availability. This was the driving force behind the growth of traditional water engineering. With the availability of reinforced cement concrete (RCC) technology and large pumps, the degree of abstraction from natural sources became very large. Most of these engineering efforts were driven by the objective of expanding irrigation.

Water: Scarcities and Governance

India today has the largest irrigation network in the world. While safe drinking water for all has been at the top of the policy documents, about 300 million Indians do not have access to safe drinking water. It is feared that by 2050 India's water demand will surpass water availability. The River Interlinking Project (RIP) has been prescribed as the official solution to this water scarcity by connecting flood-prone "surplus" river basins with the "deficient" basins.

As interdisciplinary water science advanced globally in addressing the emerging challenges of water scarcity, the recent decades have witnessed fundamental changes in the perceptions of water governance. The traditional supply-side solutions are rapidly being replaced by ecologically informed holistic approaches that recognise the many diverse benefits of water systems beyond irrigation (Bjorklund et al 2009).

The central objective of water systems governance has changed from maximising the abstraction of water from the natural sources to ensuring that the ecological status of water systems are not degraded drastically by water abstractions. This is to ensure the long-term sustainability of water supplies while accepting limited degradation of the natural ecosystems. In this perspective, all negative externalities of water extraction projects are to be identified and valued to the extent possible, and compensations made for loss of ecosystems' functioning, productivity and related livelihoods. The water framework directive of the European Union is an important example of such science-based updating of the principles of water governance.

In India large-scale but reductionist engineering interventions have led to serious decline in the flows of rivers. Ecological degradations in downstream floodplains, estuaries and the coastal regions caused by lowering quantity as well as quality of water have been recorded extensively. The related ecosystem functions, services and productivity have got drastically damaged, causing loss of livelihoods and underdevelopment for a large population. While in modern water science basins are considered as the suitable ecological unit for holistic water governance, the method for benefit-cost assessment of water projects has remained traditional and partisan. Of particular significance in this regard is the unpublished note by Desai (1983) that had already suggested fundamental changes in the methodology of appraisal of large water projects to the Planning Commission. There seems to be little impact of that suggestion, in spite of its holism and comprehensiveness.

Questionable Water Science

In India, with its wide spatial and temporal variation in natural water availability, demand for regional transfer of water was common. The Periyar-Vaigai system, Indira Gandhi Canal or the Telugu Ganga are examples of such water transfer projects. In spite of very high level of investment in dams and transfer

projects, however, open assessments of their economic as well as hydrological performance are difficult to come by in the literature. The proposed RIP, described as the largest civil engineering project in the world, with all the gaps in information on whether the project will be economically viable and ecologically sustainable, exemplifies how governmental engineers in India have remained tied to a very traditional perception of water governance.

It is no surprise that the RIP finds its justification from the "Arthur Cotton Scheme" created as far back as in 1834 by the British engineer of that name. The proposal for transferring water of the Ganga to the Cauvery through a link canal by Rao (1975) was a reiteration of that idea. The science of water, and in particular of rivers, has progressed remarkably since the time of Cotton. Is it not important that the RIP, involving huge investments from the public, gets assessed with the recent-most interdisciplinary scientific knowledge and not that of the mid-19th century?

Numerous scientific publications and books written by independent water experts have questioned the justifiability of the RIP and its declared benefits (see for example, Iyer 2003; Alagh et al 2006; Bandyopadhyay 2007; Mirza et al 2008). Not only that the scientific base of the RIP needs to be updated, the assurance that investments in water projects can generate good and overall economic returns also need to be established. For this open economic review of large projects will be essential. It is very important for correct decision-making that the proponents of the RIP professionally engaged with these publications in open platforms.

Wishful Ideas

Due to the domination of the monsoon on the climate of India, during the summer months of July-August-September precipitation is quite high, while in the rest of the year it is quite limited. Further, the directions of the monsoon currents cause the high precipitation to be in the eastern and north-eastern parts of the country as well as the western aspect of the Western Ghats. Thus, the Himalayan rivers and the west flowing rivers of the Western Ghats carry large flows during these months. In the perception of the proponents of the RIP, there is an apparent "paradox" that some parts of the country face "floods" and have "surplus" water while the other parts are "deficient".

On the unscientific assumption that water flows in rivers going out to the seas are a waste, Prabhu (2003), who headed the task force for interlinking of rivers, claimed that "the (interlinking) project is all about rationalisation of water that is lost to the sea". Like in other parts of the world, such traditional and simplistic perceptions of water systems governance are also accepted by the unsuspecting professional community without much scrutiny. For example, Bery (2008) takes recourse to this categorisation of rivers as "surplus" and "deficient", though there is hardly any basis in modern water science that can divide rivers in these groups. Bery (2008) has observed

> …the interlinking of rivers programme is aimed at linking different surplus rivers of (the) country with the deficient rivers, so that the excess water from the surplus region could be diverted to (the) deficient region. This would help in increasing irrigation intensity in the country, increasing water availability for drinking and industrial purposes.

The fixation for such supply-side solutions in place of "soft" demand-side options has consequently led to several plans for grand inter-regional water transfers in many parts of the world (Biswas 1979). In a country where politicians of all colours are keen to extend free water supply for irrigation, there are very few to point out that this is a subsidy to an irrigation system whose efficiency is only 35%. With the recent conceptualisation of environmental flows, it is common knowledge that every drop in the flow of a river is accepted as contributors to ecosystem functioning and creation of related services. Nevertheless, such a partisan unscientific approach of "surplus" or "deficient" river basins makes it easy for parties wanting free access to greater supplies of water by diverting natural flows without paying any compensation for the in-stream uses of water and loss of productivity that such diversion projects result in.

Sustaining Water Supply

It is indeed necessary to divert part of natural flows for supply of water for irrigation, domestic uses and industrial demands. In a world where water availability is limited by the hydrological cycle, how does a country plan its supplies? The age of supply-side affluence and inefficient use of water has obviously ended. More than half of all accessible global freshwater run-off is currently withdrawn for various human uses. While the case of the ecological disaster from such transfers from the tributaries of the Aral Sea is globally known, smaller "Aral Seas" are already present in large numbers in many parts of India, damaging the various ecosystem functions and services provided by the natural flows.

The Nile in Egypt, the Ganges in south Asia, the Amu Darya and Syr Darya in central Asia, the Huang He in China and the Colorado river in North America are among the major watercourses that have been dammed and diverted – to the extent that for parts of the year, little or none of their freshwater reaches the sea (Postel 2001). In recent years China has taken serious steps to revitalise the mother river, Huang He. River science now provides clear methods for the identification and assessment of negative externalities of such transfers and possible damages to the ecosystem functions and services.

Studies indicate that at least four important factors have contributed to recent global changes in the professional view of large investments in water transfer projects, like the RIP. First, feasibility of huge investments in engineering interventions for "controlling" monsoon "floods" has not been established. In the absence of open availability of hydrological data on the Himalayan rivers, the claim for flood control can only be a wish. In an assessment of the RIP, Gourdji et al (2005) of the University of Michigan have cited the impacts of investments for flood control in the Mississippi river by pointing out that

> a great deal of flood damage has occurred in the Mississippi River basin despite the vast sums of money that have been invested to stop it. In fact, even with the huge federal and private expenditures, floods and the losses they cause continue. For example,

current flooding of the Mississippi River at St Louis tends to be 2.7 metres higher than historic floods. Furthermore, in St Louis over the last six decades a major flood, which is one at least 3.7 metres above flood stage, has occurred on average once every six years.

Second, for simple political reasons, there was strong opposition to the transfer from the basins from which water is taken out. Third, the economic feasibility of such large transfers was not established in a convincing manner.

Fourth and the most important reason was the cumulative environmental impacts, that got little attention in the initial feasibility reports. The cumulative damages in the ecosystemic productivity started to increase with time. In short, the decade of 1970s was also the time when, "New approaches to complex river development were according greater recognition to its environmental limits and consequences" (White 1977). In many countries and regions, which are keen on ensuring long-term sustainable availability of water and not on immediate maximisation of its supplies to specific regions, a fundamental change in policy has taken place, in which ecosystem functions and services of water systems have received high priority. The case of India is different, as is clearly seen from the conceptual framework with which the draft national water policy (2012) has been written. Large number of independent water professionals of India have come out in scientific criticism of that draft (see for example, Iyer 2012; Bandyopadhyay 2012, *Times of India* 2012).

As a result of the new vision for rivers, in North America itself, implementation of some large projects perceived on the older framework has been abandoned or modified. The original proposal for the Texas Water System made in 1968, consisting of a large diversion from the water-rich Mississippi river into the drier state of Texas, is a clear indication of this new trend. The earlier plan for the Texas Water System has been modified so much that it now serves as a negative example of inter-basin transfers. The overwhelming attention was focused on narrow aspects of engineering while scant perfunctory attention was accorded to the associated ecological-economic aspects (Greer 1983).

Fallacy of 'Surplus' or 'Deficient' Basins

The single hydrological idea on which the RIP bases itself exclusively is the categorisation of river basins as "surplus" and "deficient". There is, however, no accepted mechanism for arriving at such a qualification in modern water science. An unpublished document (Mohile 1998) has provided the conceptual basis for the world's largest civil engineering project, ignoring all other uses of river waters and related economies, especially of the in-stream uses.

By contrast, in modern water science, the movement of all drops of water flowing in a river has important ecological roles to play, albeit in small magnitudes. Diversions and extractions of water from natural flows are surely needed but their social, economic and ecological downstream impacts need to be part of the project assessment. A lot of scientific literature is available on the ecological integrity of rivers and ecosystem functions and services cannot be set aside by partisan policy, overt or covert.

Our water establishment needs to get away from the traditional and unsubstantiated perceptions of unilaterally declaring river basins as "surplus" and "deficient". Inadequate knowledge of project proponents should not be the basis of depriving the negatively affected parts of the basin facilitating a de facto act of water acquisition. Water is renewed at the highest microlevels and the demand for nationalisation of rivers to facilitate regional transfers will be counterproductive.

Consideration of ecological and economic implications of the RIP would promote its full costing and will ensure that water is used efficiently. The real paradox in India is the coexistence of scarcity and inefficient use of water. In extending hydro-luxury to some, hydrological obscurantism cannot rob some others of their resource bases and livelihoods. Water scarcity in drier parts of the country needs to be ameliorated. This has to base itself on a region-specific assessment of water availability and use and should contribute overall economic benefits to the country. Gains for some and loss for others or the undemocratic transfer of water, depriving millions of their livelihoods and right to life, cannot be a sustainable plan for addressing the water problems of the country.

Hydrological obscurantism has to make way for modern holistic water science which will give a new foundation to water governance replacing the subjective and meaningless concepts of "surplus" and "deficient" basins. Only through such a transformation can India develop an assured and sustainable water future.

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