River linking

India is bestowed with envious water wealth, the average annual precipitation being nearly 60% more than 70 cm, which is the global average. About 4000 km^3 comes from monsoon rains and winter snowfalls. Nearly half of this amount either flows through the rivers or percolates into the ground and gets evaporated. However, estimated utilizable water is 1122 km^3, out of which contentious surface utilizable water[1] is 690 km^3.

The concept of linking of the water-surplus rivers, e.g. perennial rivers of the Himalayas on the one hand, and Mahanadi and Godavari of the peninsular region on the other, with other water-starved rivers south of the Ganga plain is being taken seriously now throughout the nation though the concept is old[2]. The general tenor of debate is against this[3–11], with full or partial support from academicians[11–13]. The linking of rivers into a network or grid is an ambitious programme. Such programmes have been adopted from time to time in our country and elsewhere[4], but on a small scale. One potent example in our country is the Beas–Sutlej link that is working quite satisfactorily, with anticipated benefits. However, the present strategy in question has attracted attention because it envisages linking of 30 rivers of 20 major basins through networking of existing rivers and canals; construction of new canals of 1000 km length and 400 storage dams/reservoirs at an exorbitant projected cost that might scale up to Rs 10 lakh crores by the time the project gets completed.

Alarming decline in per capita availability of water for the unabatedly rising population without any sign of stabilization in near future, coupled with change in food preferences and rise in living standard, etc. have accelerated water demand in a nearly static, time-specific and (un) dependable input scenario. These factors are responsible for various stresses and litigations within or beyond the frontiers of the nation.

If this endeavour is implemented, it would not only provide jobs to lakhs of people but would also boost the economy. As water starts flowing into the new modified regime, problems of drinking water and irrigation of dry land will relegate along with rise in groundwater level, reduction in severity of floods, and generation of approximately 34000 MW hydropower. This might be a fulcrum for 2020, the proposed deadline for crossing the 'Lakshman rekha' from a developing to a developed nation.

There is a lot of rhetoric against the linking of rivers and the widely criticized/debated issues are as follows[3–11]: inadequate understanding of riverine processes, inadequate evaluation of water resources (such as run-off or stream-flow data and assessment of available surplus water), secrecy in data maintenance by government(s), high evaporation loss ~ 30%, ecological disasters, change in natural equilibrium, land degradation due to seepage of water and loss of scarce land, uprooting of population, limited possibility of flood reduction (if water is flowing 5–16 m above danger level), lack of indigenous competence and poor record of implementation in small ventures like the 306 km long Satluj–Yamuna link canal or Telugu–Ganga project, high projected cost of construction and maintenance with highlighted financial constraints, free distribution of water to farmers (because of political compulsions), involvement and likely control of MNCs on water resources, inadequate study of the project and no heed towards alternative possibilities (like rain and rooftop water-harvesting, conventional water-conservation techniques like ponds, bunds, etc.), reuse and recycle of waste water, irrigation return flow and artificial groundwater recharge[12,13], deliberate overexploitation of groundwater for dynamic recharge, etc. regulated and judicious use of water, questionable quality of construction, interstate as well as international disputes, and scarcity of power for lifting of water in certain segments of the proposed scheme.

The above-mentioned aspects are mostly based on our casual approach to the problems, may be social, economic, political or ecological. In some cases they are self-contradictory. In general, negative thinking and poor level of confidence in our own ability also inculcate such approaches.

Behind the genesis of the major lifelines of the nation, e.g. the Ganges or any other major river, lies a natural linking of hundreds to thousands of streams and rivulets, since the geological past. A major river crosses highly diverse geological, geographical, climatic and ecological environments without any adverse consequence. For example, the nearly 2900 km long river Indus begins its journey from the cold desert of Tibet and ends its journey in the hot desert of Thar (close to the Arabian Sea) and on its fluvial course passes through various climatic, ecological, geological and geographical zones without any ecological disasters. Favourable and unfavourable conditions, in most of the cases, are created by nature herself. Geomorphologically, due to the phenomenon of river capture or piracy, a weak river is left high and dry because of diversion of its waters into a powerful river having strong incision capacity or rivers change their affiliation from one basin to another, e.g. Yamuna (its disaffiliation from the Indus system) or they disappear from the scene (like the river Saraswati) or there is an annual change in their course.

Had there been a major fault between the plains of north India and the deeps of peninsular India, along with necessary topographical corrections, as in the case of the rift-controlled, relatively straight, 4160 km long Nile river, Ganga would have linked herself naturally with Kaveri. In the light of the ever-happening natural processes, one should not be unduly critical of the schemes initiated by the Government in the wider interest of the society. Perceptions like 'mixing of water from diverse ecological and environmental settings and pollution levels are likely to invite ecological disasters'[12], do not fit well in nature-governed confluences, viz. of the Himalayan Yamuna with the peninsular Chambal.

We do not have adequate data related to flow of water. Data regarding water level and flow of water are required to be procured and made available to the public, when required. It is a different aspect that the Central Water Commission withholds such data.

Questions are raised about the safety of major man-made mammoth constructions like dams, tunnels, etc. but only when they are in the construction stage. Once they come up and start bearing fruits, we forget our prejudices because they successfully stand the test of time, as we have excellent records of safe constructions in such cases.

For any development activity or for even employment of traditional technologies in newer areas, new chunks of land are needed. This loss of land would be compensated by rise in productivity in yet under-utilized areas owing to inadequate availability of water. The projected cost of the scheme would be spread over at least two decades. Therefore, burden on the exchequer would not be unmanageable.

Alternatives to linking of rivers, namely rain and rooftop water-harvesting[14–16], conventional water-conservation techniques, reuse and recycle of waste-water, irrigation return flow and artificial groundwater recharge, dynamic recharge by over-exploitation of groundwater, etc. have been examined quantitatively[1], all these approaches have been discouraged not only on technical and economic viability grounds but also because of pollution threats to subsurface aquifers. Fall in per capita availability of water from 5500 m^3 at the time of independence to less 1800 m^3 at present and 1140 m^3/yr by 2050, calls for its regulated use. Merely enactment of laws would not suffice. The need of the hour is to spread proper awareness in the masses through sustained campaign and the will to implement proper water pricing policies for different sets of users. One finds an opt-quoted statement: 'Israel with less than 200 mm of annual rainfall, has made a success of its agriculture only through adoption of such practices'[15] (i.e. rain and roof-water harvesting, sprinkler and drip irrigation). But similar approaches are unlikely to succeed in India, still dominated by above 65% rural population.

Where nature is not favourably disposed to use, we have made many successful attempts at alternatives by digging canals hundreds of kilometres in length and reaping the benefits of such endeavours since time immemorial. Using favourable topography and availability of water, many rivers have been stretched through canals over the length and breadth of the nation. But for this, we would not have dreamt of the Green Revolution and moved ahead in solving the drinking-water problem in many parts of the country. We do not raise questions regarding these endeavours, because we are availing benefits.

Generous compensation packages should be given to the displaced lot and their rehabilitation be preferably done at the place(s) of their choice or in nearby regions. Water-related national and international disputes, a time-consuming activity, are usually amicably sorted out either through mutual discussions or through judiciary. Corruption is often cited for perpetuating the status quo in the present setup[4]. Yet the progressive initiatives must not be muffled on this ground.

This conservational and mass-utility approach of linking the 'lifelines of a nation' may bear fruit if the government(s) at the helm of affairs act(s) positively, not politically. The concerned States will have to be taken into confidence. To make the two ends meet is an arduous and challenging task. It is a great responsibility of academia to present the linking scheme in right earnest and remove misgivings generated by vested interests.

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Manganese nodules as a possible source of precious metals

In the earth system, the precious metals include silver (Ag), gold (Au) and Platinum Group Elements (PGE) consisting of platinum (Pt), palladium (Pd), rhodium (Rh), iridium (Ir), ruthenium (Ru) and osmium (Os). There are no comprehensive data on PGE in sedimentary environments.

Marine geochemistry of Pt and Ir shows that both the elements are relatively enriched in manganese nodules with concentrations of up to 900 ppb and 7 ppb respectively (compared with ~ 3 ppb Pt and 0.2 ppb Ir in pelagic clays)[1]. Pt and Ir are incorporated into hydrogenous Fe–Mn oxyhydroxide minerals, and these phases might control the distribution of Pt and Ir in manganese nodules as well as in sediments. It is also observed that Ir and Pt enrichments in oceanic sediments are accompanied by enhanced Fe, Mn, Cu and Ni concentrations[2].

Compared to Pt concentration in the earth's upper continental crust (5 ppb), the oceanic manganese nodules contain, on an average, 100 times more Pt[3]. It is observed that relative to sea water, the manganese encrustations and nodules contain, on an average, approximately 2.10^6 times more Pt[3]. Also, while the Pt/Pd ratio in sea water is about 4.5, that of extraterrestrial iron meteorites varies between 2 and 10 and that of manganese nodules varies between 23 and 42. Enrichment of PGE, especially of Pt and Ir, in oceanic sediments therefore serves as excellent fingerprints of inputs from