Viability of Inter Linking of Rivers

AN EXAMINATION FROM A SYSTEMS APPROACH

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Interlinking of rivers (ILR) is not simply a scheme to connect rivers by canals. It is a complicated system to connect high-discharge, fast-flowing Himalayan-sourced rivers with the seasonal rivers of peninsular India, transferring large quantities of water between river basins. The main aim of the mega-project is to transfer surplus water from flood-prone river basins to deficit river basins to eliminate flood and drought at the same time. This aim has been frequently repeated by President Dr APJ Abdul Kalam in his doubtless well intentioned but untiring promotion of ILR.

ILR is estimated (in 2002) to cost at least Rs 560 000 crores, occupy around 600 000 ha of forest, agricultural and other land, displace several lakhs of people in many states, and is probably the biggest project of its kind in the world. The questions about the project from concerned and informed citizens have been stone-walled and opposition by potentially affected people, intellectuals, experts and activists has been steam-rolled, even ridiculed. All this, while the Government of India Ministry of Water Resources (MoWR) website created to provide information contains only the barest outlines and no details. Several feasibility studies have been conducted but the Feasibility Reports (FRs) were made available only after activists agitated the matter and after repeated orders of the Supreme Court. The ILR project seems to have even has the blessings of the Supreme Court, which directed in 2002 that the project be completed in 10 years.

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Any thinking person would wonder why there is so much calculated official opacity for a project of such enormous magnitude that promises such obvious benefits like solving flood and drought at the same time. Due to the lack of transparency on the part of government, there is growing, deep distrust regarding the ILR project. This has polarized opinions, namely, the government-corporate lobby – the "FOR" camp - earnestly selling the idea to a largely uninformed public with the carrot of solving all water problems for all time to come, and the "AGAINST" camp consisting of directly affected people who stand to lose land and livelihood due to displacement, and the activist-environmentalist lobby supporting affected people and demanding information but not getting it. Perhaps 90% of India's people are silent because they do not know about the project at all, while some others from the economically well-off classes are convinced by government propaganda that the project is beneficial to the nation. The FOR camp mainly holds that if detailed information is provided in the public domain, there will be opposition to the project that will delay its commencement and completion. But they fail to realize that suspicion and opposition are best overcome by giving information freely (to which, in any case, the public is entitled), and that information in driblets and commencement of projects by use of police force only leads to social tensions and time-cost overruns as has happened in innumerable projects in the past.

The FOR camp, mostly consisting of officials and engineers of MoWR, appears to view the mega-project as a problem in hydrology to the exclusion of social, environmental, economic and geo-political consequences. It is disturbing that some officials in government criticize the democratic dissent of opposition to ILR as being anti-development, even anti-national. However, Dr Kalam's criticism is milder, terming it as "being negative". Some in the AGAINST camp question the propriety of the President taking sides in a growing controversy.

ILR will have serious social ill-effects due to involuntary displacement of lakhs of project affected families (PAFs) from the forest, rural and urban land to be acquired for dams and canals, roads and bridges, and other connected structures. This assumes significance since governments have a miserable track record of rehabilitation over the past six decades due to overbearing and/or corrupt officials. Though the present article focuses on the systems view of ILR and its technical aspects, it does not in anyway dilute the seriousness of the social problems that will accrue from forcible displacement of populations.

Design of the project A project that involves people, especially very large numbers, cannot be successfully designed, leave alone executed and operated, unless it takes into account the benefits and costs to people. The benefit: cost (B:C) ratio is inherently an inaccurate parameter because of the impossibility of quantifying intangibles (like social and environmental costs) and for several other reasons, not the least important of which is the fact that those who bear the cost by displacement and consequent loss of land and livelihood are not those who benefit from the project. The inaccuracy of calculation and arbitrariness of the acceptable B:C ratio together go to make it a dehumanized parameter, which however appears to be acceptable to engineers, economists and bureaucrats.

The technical design of any system has to be based upon what are known as design assumptions. The successful functioning of the completed system is only as good as the design, which in turn depends upon the validity of the basic data which form the design assumptions. For example, consider construction of a dam across a river – it is a geo-technical system to impound a certain (designed) quantity of water. If the dam is designed to withstand an earthquake of a certain assumed intensity (called the "design earthquake"), and it is subjected to an earthquake of much higher intensity, it may collapse. If the actual earthquake is only slightly more than the design earthquake, the dam may not collapse but may develop defects that may or may not be repairable but will reduce the functional effectiveness and life of the dam. This indicates the importance of the initial assumptions in carrying out the design. Though some of the design assumptions of some of the individual dam-canals in the ILR project may be obtained from the FRs made public so far, the design assumptions for the ILR project as a whole have not been defined.

The ILR system has three major flaws, and while it is true that every system has drawbacks, the ILR system is different on account of scale. One, the system envisages mass transfer of water during flood in the monsoon season of July-September, when the water in rivers carries a large load of sand and silt. Any mass transfer of water will inevitably involve transfer of substantial volumes of sediment along with the water. This will clog canals in a very short time, reducing the flow in the canal and making it inefficient, necessitating heavy recurring expenditure to dredge the canals. Two, rivers like Ganga and Brahmaputra shift their courses by upto one or two kilometers over a period of a few years and could leave the canal head works dry or with reduced capacity for off-take of water. This necessitates expensive "river training" maintenance works to be constructed almost every year so as to maintain supply to the canal.

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In the prevailing situation of social and political unrest, deliberate interference with any link canal or canal head works by one or more of several methods of sabotage to cause system failure, cannot be ruled out.

PROPOSED INTER BASIN WATER TRANSFER LINKS

HIMALAYAN COMPONENT

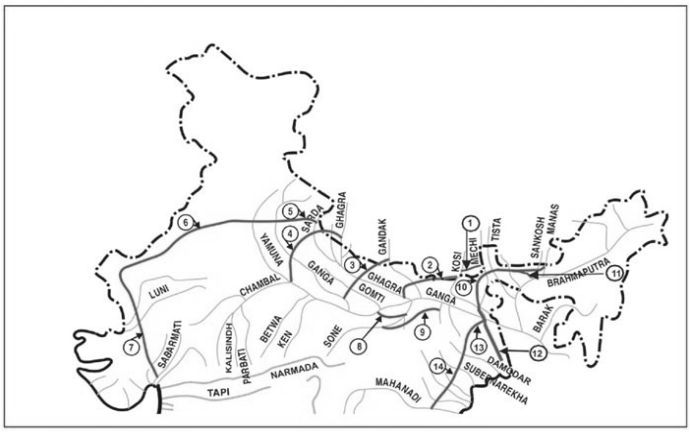


FIGURE – 1 THE HIMALAYAN SUB-SYSTEM

For example, a $3.6 billion 540 km long 24 m top width, 5 m deep canal from Lake Havasu to Tucson in USA, is fenced on both sides for its entire length, there is 24x7 land and air patrolling, and electronic alarms at all key structures along the length. If similar security is to be provided for the ILR system of about 14,000 km length, the cost of security will add to the cost of water, possibly making it uneconomical.

The recurring heavy cost of security, maintenance and water losses needs to be considered in computing the economic viability of the ILR. There is no evidence that this has been taken into consideration.

The ILR project The National Water Development Agency (NWDA) of MoWR has published a map indicating the link canals, 14 in the Himalayan region and 16 in the Peninsular region, as shown in Figures 1 and 2 respectively. For water to be transferred from a river, it is necessary to construct a dam (or a barrage, if the river is broad and sloping gently, like the lower reaches of Ganga or Brahmaputra) to feed water into a canal. The ILR project may involve construction of about 150 large dams, but MoWR has not stated how many dams would be involved, though it proposes 30 large canals.

An important consideration is the fact that out of 1,300 irrigation projects taken up for implementation since 1951, only about 900 have been completed, while 400 are incomplete, and on-going major and minor irrigation projects are languishing in various stages for want of

funds to the extent of Rs.80,000 crores. The questions here, that MoWR is not about to answer, are:

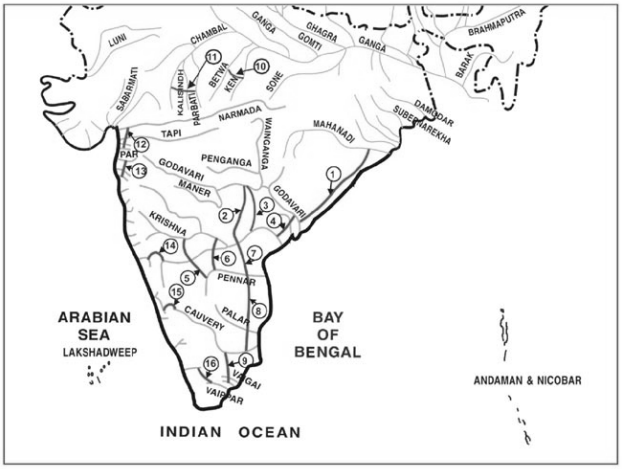
(a) Are the incomplete projects being abandoned or being integrated into the ILR system?

(b) If Rs 80,000 crores are not available to complete the projects in progress, what is the justification or financial-economic wisdom in incurring a fresh expenditure of Rs 5 60 000 crores?

Relieving drought or flood? Ganga in the Himalayan sub-system (Figure 1) has been identified as a "surplus basin". Considering that in many parts of the Ganga basin (especially in Bihar, from where a canal is to divert water southwards to Subarnarekha) flood and drought occur simultaneously a mere couple of kms apart, the logic of assuming Ganga as a surplus basin is questionable. Even so, the claim of relieving flood by diverting water needs to be examined.

It does not call for great intelligence to understand that ILR cannot relieve flood in Ganga and Brahmaputra, and the most generous interpretation that can be given to pro-ILR propaganda is that the proponents are misinformed.

PROPOSED INTER BASIN WATER TRANSFER LINKS
PENINSULAR COMPONENT



1. Mahanadi (Manibhadra) – Godavari (Dowlaiswaram) *
2. Godavari (Inchampalli) – Krishna (Nagarjunasagar) *
3. Godavari (Inchampalli) – Krishna (Pulichintala) *
4. Godavari (Polavaram) – Krishna (Vijayawada) *
5. Krishna (Almatti) – Pennar *
6. Krishna (Srisailam) – Pennar *
7. Krishna (Nagarjunasagar) – Pennar (Somasila) *
8. Pennar (Somasila)–Palar- Cauvery (Grand Anicut) *
9. Cauvery (Kattalai) – Vaigai – Gundar *
10. Ken – Betwa *
11. Parbati – Kalisindh – Chambal *
12. Par – Tapi – Narmada *
13. Damanganga – Pinjal *
14. Bedti – Varda
15. Netravati – Hemavati
16. Pamba – Achankovil – Vaippar *

* FR Completed

FIGURE – 2 THE PENINSULAR SUB-SYSTEM

Average Ganga floods carry 50,000 cubic meters per second (cumecs) during the 4 monsoon months, while for technical reasons a 100-m wide 10-m deep canal can divert at most 2,000 cumecs to provide 4% relief, that too only downstream of the off-take point. Likewise, Brahmaputra floods carry over 60,000 cumecs and a similar canal can provide at best 3% relief. However, for the balance 8 non-monsoon months every year, average Ganga flows are 5,280 cumecs, and diversion of 2,000 cumecs will deny Bihar 38% of Ganga water when it is needed most, even if the demand of lower riparian Bangladesh are not counted at the moment. Thus, clearly, the claim of relieving flood in Ganga or Brahmaputra by canals cannot make economic sense. The diversion of 38% of Ganga water in the dry season can only lead to the most serious socio-economic consequences. The alternative of using the canal for the 4 monsoon months (to divert a mere 4%) and keeping it idle for 8 months would, of course, be economic nonsense. Perhaps that is the reason that the Himalayan part of ILR has been considered "not feasible" by MoWR, as brought out below.

It may be seen from the map showing the Peninsular sub-system (Figure 2), that some canals draw water from rivers that are not flood-prone. For example, Links Nos. 2 & 3 start on upper Godavari in areas that are actually drought-prone, and draw water for release into upper Krishna, while Link No. 4 takes water from lower Godavari to release it into lower Krishna. Also Link Nos. 5 & 6 draw water from upper Krishna and deliver water to upper Pennar. Notwithstanding that those areas of Krishna, Pennar and Palar are water-deficit according to MoWR, Link No.8 takes water from Pennar to Cauvery. All these links do not serve the main purpose of ILR, namely, relieving flood and drought. They are merely links that complicate management and interfere with the existing stable *ayacut* system.

Systems view of ILR Mr. Suresh Prabhu in his capacity as Chairman of ILR Task Force (TF) had compared the proposed network of canals to the road, rail and electric power network in India, unmindful of the fact that water in canals flows only in one direction. However, in a sense, Mr.Prabhu is correct if we substitute the word "system" for "network".

The success of the ILR scheme is based on functioning of a system of canals, in which northern river basins supply water to river basins that are more to the south by link canals forming a "chain of supply". The Peninsular sub-system depends upon the Himalayan sub-system for Brahmaputra water to be transferred to Ganga, and Ganga water to Subarnarekha, and so on southwards to Mahanadi, Godavari, Krishna and Pennar to finally deliver water to Cauvery in Tamil Nadu. Apart from providing water for the Peninsular sub-system, the Himalayan sub-system also supplies water to Rajasthan and Gujarat through a series of links to transfer water from Kosi to Ghaghara, Gandak to upstream Ganga (across Ghagahara & Gomti), upstream Ghaghara to Jamuna (across Ganga), and from Sharada to Sabarmati (across Ganga, Jamuna and Luni). These links may be seen in Figure 1. Barring Brahmaputra,

which only gives water but receives none, the functioning of both sub-systems is dependent upon chain-supply of water, each river basin donating water in exchange for water received from a river basin to its north. The concept of donating water in exchange of water received, being the basic assumption for the ILR system to function, as mentioned in the FRs.

Here we come up against an anomalous situation. Page 9 of Volume I of the Report of the National Commission for Water Resource Development states, "The Himalayan river linking data is not freely available, but on the basis of public information, it appears that the Himalayan river linking component is not feasible for the period of review up to 2050". From a system viewpoint therefore, this statement of a national document raises the following important question: If the Himalayan sub-system is not feasible, then what is the source of water to feed Subarnarekha basin and onward to the river basins to its south (Mahanadi, Godavari, and so on) for each basin to supply water to the next basin?

the ILR system is delicate, failure-prone and subject to many if's and but's, mainly because it is too complicated to be practical, and the risk of system failure is high. Thus, from a system standpoint, the entire ILR scheme is unworkable.

According to the "exchange concept", if a (recipient) river basin does not receive water from another (donor) river basin for any reason whatever, it will not be in a position to feed water (as a donor) into the next link canal in the system. For water to reach Cauvery, all the links have to function as a system, conveying water from North to South. But even neglecting the absence of water supplied from the unfeasible Himalayan sub-system, let us discuss the Peninsular sub-system. The then Chairman of the ILR TF Suresh Prabhu assured that links not found feasible will not be constructed. It is of course known that engineers are not above manipulating FRs and B:C ratios to establish feasibility and obtain sanction for a project. But there are other causes for any particular link canal not functioning adequately or not at all, such as siltation of canals, canal breaching, political agitations not permitting release of water, etc.

According to ILR TF, there are pumped lifts within three link canals requiring 4,000 MW of dedicated electric power, planned as follows: Ganga-Subarnarekha 60-m, Subarnarekha-Mahanadi 48-m, and Godavari-Krishna 116-m. If any of the pumped lifts between Ganga and Krishna fail to function for any reason whatever (equipment failure, power failure, etc.), the recipient basin will not only not receive water, but there will be severe flooding at the pump input point besides disrupting systemic water flow.

In the Peninsular sub-system, supply to Cauvery is predicated on the reliable and continuous operation of the chain of links to its north, that is, Subarnarekha-Mahanadi-Godavari-Krishna-Pennar. Suppose, for example, that Krishna-Pennar links Nos. 5 and 6 fail to operate for some reason or are not found feasible and therefore not constructed. In such circumstances, Cauvery at the tail end cannot receive the quantity of water that it is supposed to receive, because farmers of the Pennar basin will certainly interfere with release of water southward since it will directly and immediately reduce water availability to them.

Therefore, even putting aside the argument that canals cannot relieve flood in Ganga or Brahmaputra as already demonstrated above, with the Himalayan links not being feasible, there is no reason to take up the Peninsular links because water from Brahmaputra or Ganga will not reach Mahanadi, and the system of water supply to Cauvery will necessarily fail. The ILR system flow plan - if indeed MoWR engineers have prepared one - indicating the design flow quantities has not been made public by ILR TF or MoWR. The FRs consider each link separately and there is no evidence that NWDA or ILR TF have considered all of them together to take a systems view of ILR. In sum, the ILR system is delicate, failure-prone and subject to many if's and but's, mainly because it is too complicated to be practical, and the risk of system failure is high. Thus, from a system standpoint, the entire ILR scheme is unworkable.

Objections by States the Govt of Andhra Pradesh has raised the following objections with regard to the Peninsular sub-system: (1) Nagarjunasagar *ayacut*, now getting dependable Krishna waters by gravity has to depend upon Godavari water pumped from Inchampalli Project nearly 300-km away, (2) Srisailam and Nagarjunasagar Power Stations may have to be shutdown, (3) Proposed Inchampalli and Polavaram Power Stations may not materialize due to lack of flows, (4) Dependable flows will be diverted and instead Andhra Pradesh will be made dependent on flood flows, and (5) Andhra Pradesh reiterated a number of times that there is no balance water (out of dependable yield) in Godavari, after meeting the requirements of basins States. Thus, in the balance, it would appear that Andhra Pradesh stands to lose by becoming a part of the ILR system. ("Comments of various State Governments on Inter Basin Water Transfer Proposals of National Water Development Agency" on NWDA website)

The Government of Orissa has questioned NWDA's assumption that Mahanadi (at Manibhadra) has surplus flow that can be transferred to Godavari, and has objected to the submergence of productive lands by the proposed Polavaram dam on Godavari. There are also various objections by state governments of Chhatisgarh,

Maharashtra and Madhya Pradesh. Even Gujarat, one of the most vocal of ILR proponents that is to receive water from Sharada in the Ganga basin, objects to parting with water from Damanganga for supplying Mumbai with water (Link No.13, Figure 2). Gujarat argues that transfer to surplus Pinjal basin in Maharashtra is against the national policy since it "diverts water from surplus basin to surplus basin" while "(emphasizing) diversion of water from surplus to deficit basin". Whether the argument is valid or not, the truth is that Gujarat does not want to part with water.

Kerala, despite its high annual rainfall, suffers from serious water shortage in the non-monsoon months, and as far as ILR is concerned, is always only a donor state. It has passed a resolution in the Legislative Assembly that it opposes ILR. Tamil Nadu, which is always a recipient and has always been in favour of ILR, has objected to a dam proposed on Pennar by (upstream) Andhra Pradesh, on the grounds that it will deplete flow in Tamil Nadu – a simple case of wanting more! Thus it is clear that no state would like to spare water even though every state is keen to receive water - such attitude is also present at intra-state levels. In this general ambience of water demand, cobbling together inter-State consensus regarding water sharing can only be a pipe dream. Orders by the Supreme Court regarding water sharing are impractical since they can never be truly accepted at the farmers' level. If a Chief Minister is forced to share (release) water even when his own state is running short, he will have to face the political consequences of such action, as erstwhile Karnataka CM Mr SM Krishna did in the elections ensuing release of water to Tamil Nadu in the Cauvery water dispute with Tamil Nadu in 2003.

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Given the above few examples of objections from states regarding ILR, it passes understanding how a water-sharing dispute between states of different river basins may be resolved by a fiat of the Supreme Court, and what will be its local and national political cost.

Local farmers' perceptions of water needs cannot be countered by calculations in an engineer's office, nor by an agreement or MoU signed between Chief Ministers. It is common knowledge that politicians and bureaucrats can be induced to agree to almost anything (in this case, sparing "surplus" water) by application of political pressures, or offer of benefits, or threats of exposing past indiscretions, etc. But finally, the will of the people must supervene. ILR cannot function as a system.

Risk and consequences of system failure Any system can fail. The failure can be minor and dealt with easily, or major with serious consequences. When a system fails there is some loss to people, immediate and/or distant in both time and space. It is axiomatic that the consequences of system failure become more serious as the system gets more complex. An airline operator takes insurance against system failure (like say the crash of a passenger aircraft) to enable payment of compensation to survivors and next-of-kin, but strict inspections for airworthiness and safety procedures, etc., are a part of the insurer's conditions. In this straightforward example, the passengers were in the ill-fated aircraft by choice and the compensation is paid to the victims of the failure. However, the ILR system is not only entirely different in nature but is on a gargantuan scale compared to an aircraft.

The ILR Project is an extremely complex system of dams, canals, appurtenant structures and ancillary projects like power generation, bridges, buildings and roads. The risk of failure of each sub-system like a dam is the equivalent of many passenger aircraft. Physical failure of even a part of a sub-system has long range (in time and space) physical, social, environmental, economic and political consequences. Contemplating the effects of systemic failure of the ILR Project is unpleasant. Suppose for a moment that the completed ILR Project does not function because of an erroneous basic assumption such as "water is surplus in the Ganga basin in Bihar". In such a failure situation, all the money spent would be a colossal waste, all the people who were displaced would have been displaced in vain, the national debt would not be repaid because benefits would not accrue from the project, India's economic standing and credit in the international arena would be lost, etc. This is the reason for people asking to know what are the basic assumptions on which the ILR Project is based, and also questioning the assumptions that have been put out, such as declaring a river basin as surplus, simultaneously relieving flood and drought, generation of 30,000 MW of net electric power, etc. The risk that there may be flaws in basic assumptions is too great to be left unquestioned. Hence the basic assumptions and the performance criteria of the completed ILR Project need to be spelt out, and discussed transparently at district, state & national level.

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India has about 4,500 large dams and it is pertinent to mention here that to date, no transparent review of the completed dam projects, each one a system in itself, has been done to verify if it has met the technical and economic performance criteria that were stipulated at the time the projects were designed and sanctioned. This opaque technical-cum-administrative track record, combined with the unwholesome track record of rehabilitation of about 50 million displaced families since 1947 naturally causes any informed and socially sensitive citizen to question the basis and demand a risk assessment of the ILR Project. The risk of failure of the ILR system is of such magnitude and type that no nation, leave alone a poor, developing one like India, can afford to take. The social risk already taken by displacing about 50 million people (since 1950) is manifesting itself in the display of heightened social tensions in both rural and urban contexts in the past several years.

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Conclusion The economic feasibility of a project can be determined only when there are comparisons of expected cost of the product with present cost, considering affordability and present availability. The cost of water based on alternative scheme(s) of watershed management needs to be compared, but even without doing so, determination of economic feasibility of the ILR project as a whole has not been carried out. The best planning can go awry if the end product is not economical. Privatization in India's electric power sector has demonstrated this adequately by producing power at unaffordable cost, leading to breakdown of agreements, expensive litigation and continuing shortage of the product.

Rather, a perverse, inverted planning method has been followed by which ILR has been assumed as the solution and then a network of canals has been prepared without consideration of the performance of the project as a system.

May be that India possesses the technical and management resources necessary to construct all the dams and link canals planned in the ILR project, and that financial resources can perhaps also be found. However, the matter at issue is not whether ILR can be constructed, but whether it should be constructed and whether, if constructed, it can perform what it is designed to perform. The accepted planning method in which alternatives (such as watershed management in the instant case) are considered and evaluated and the best alternative, or the best combination of available alternatives, are evaluated environmentally, technically and economically, has not been followed in the ILR project. Rather, a perverse, inverted planning method has been followed by which ILR has been assumed as the solution and then a network of canals has been prepared without consideration of the performance of the project as a system. The ILR project scheme has been prepared by engineers and uncritically approved by bureaucrats and the judiciary, and by politicians who, along with the bureaucrats and engineers, have seen opportunity in the mega-project. It is significant that ILR is strongly supported by the industrial-corporate lobby (CII, FICCI, etc) that influences decision-making at the highest levels.

The ILR project is a system of dams and canals that is meant to operate by each river basin supplying water to another river basin in exchange of water received from another "surplus" river basin. The concept of "surplus" water is one on which different states have different perceptions, and the quantification of "surplus" is even more contentious. Thus the design basis of the ILR project is itself delightfully vague, while the functioning of the system of canals cannot be ensured especially since the "source" of "surplus" water, namely Brahmaputra and Ganga are in the Himalayan region where, by admission of the Govt of India appointed National Commission, ILR is not feasible. Entering into this Rs 560 000 crores ($112 billion) project which looks like a colossal system design failure that cannot perform, can only end in social, environmental, economic and political ruin for India.

As a final perspective, with the IPCC Report on global warming that threatens reduced rainfall in peninsular India and speeding up of recession of Himalayan glaciers that feed Ganga and Brahmaputra, all calculations of river flow (and consequent "surpluses") are certain to go haywire, making the ILR system even more, not less, unviable. India can be saved from very serious water shortages and consequent widespread unrest if and only if

(1) Immediate investment is made in local watershed management and rainwater harvesting,

(2) The ILR project is shelved permanently as being misconceived and unworkable, and

(3) The apparently limitless greed of industrial and commercial corporations and individuals in power is curbed by democratic process.

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