PRIORITY OF INTERLINKING INDIAN RIVERS

BY

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ABSTRACT

National Water Development Agency (NWDA) has proposed a National Perspective Plan (NPP) of interlinking Indian rivers, comprising of 14 canal links in the Himalayan component and 16 canal links in the Peninsular component of the scheme. One group of people, mostly govt. officials, is in favor of immediate implementation of the scheme while the other group, comprising mostly of NGOs, are strongly opposing it. Different benefits of the scheme are pointed out. Various difficulties to be faced in the implementation of the national water grid as proposed by NWDA including the opposition viewpoints have been discussed .Other .alternatives to interlinking and the Recommendations of the National Commission on Integrated Water Resources Development (NCIWRD) are stated. Author's own views on the priority of interlinking Indian rivers are stated at the end.

INTRODUCTION

Concept of national water grid for effective management of flood and drought situations in India has been introduced by a number of eminent persons like sir Arthur Cotton, Dr. K.L. Rao, Captain M. N. Dastur and many others [1]. Lately, the National Water Development Agency (NWDA) under the Ministry of Water Resources, Govt. of India, [2] has proposed the National Perspective Plan consisting of 14 canal links under the Himalayan component and 16 canal links under the peninsular component for transfer of surplus water to the deficit areas.. Figure 1 illustrates the proposed link canals.. The National perspective plan, prepared by NWDA, is being hotly debated. all over the country. A group of people, mostly in the Govt. sector, are strongly advocating for immediate implementation of the project for our food security and other benefits. Another group of people [3], consisting mostly of NGOs, are strongly against the project as they are afraid that the project will bring disaster to the country. A Task force was appointed by the Vajpayi Govt. under the chairmanship of Sri Suresh Prabhu [4], after the Supreme Court order to implement the project in a period of 15 years by 2012. The present UPA Govt., however, wishes to hear the views of all the stakeholders. A standing committee under the chairmanship of sh. Sambasiva Rao, M.P., has been formed and the committee invited suggestions/opinions of public and experts in the subject. The committee is going to examine the representations and finally give its recommendation to the Govt. of India regarding implementation of the proposed scheme. Recommendation of the NCIWRD [5] and the author's own views regarding the priority of implementation of the proposed national water grid are stated at the end.

The estimated cost of the project is about 5.6 lack crores which is likely to increase manifold due to cost and time over run.. Before looking for a loan from the World Bank or the Asian Development Bank, it is necessary to consider whether we will be in a financial and physical position to repay the loan as we are already running in debt. India is having water-related conflicts among its states, e.g. Haryana and Punjab, and Karnataka and Tamil Nadu. Already Bihar, West Bengal, Maharashtra, Kerala, Assam, Punjab and Rajasthan have opposed this proposal. Bihar has always argued that its water needs have not been met with from the Ganga. North east states say that their surplus is due to lack of storage as there is hardly any investment there.

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Some experts have proposed other alternatives of solving the water and food problems in India. In their opinion, decentralized local rainwater harvesting, reviving and improving

traditional techniques can meet essential requirements more effectively and at a far lesser cost. There is much scope for increasing the efficiency of the irrigation systems in place by reducing losses and through better water management. Besides, the optimal use of existing projects, traditional water-harvesting projects and recharging groundwater may be useful as alternative sources. According to UNICEF and the WWF, if the precipitation within the watersheds or sub-basins is harvested and conserved properly, domestic water needs will not be a problem in most parts of the country... There is need for examining the pre-suppositions on which the interlinking project is based. Besides, all Indian states and neighbouring countries like Bangladesh, Nepal and Bhutan should also be brought into confidence. We should also consider the fate of interlinking of river systems in Australia, Russia and other countries where environment is affected with rivers turning saline, natural eco-system withering away, and water along the natural course of the river drying up. The side effects of this mammoth project on the environment and human beings can be avoided by proper scientific planning with the help of experts in all related areas prior to its implementation..

This project has been designed with the concept that it will improve the living status of people in India, with growth in our economy. The completion of this project will result in constant water supply for domestic use, agriculture and industries along with flood control, improvement in water flow, navigation, food security, etc. Construction of dams, canals, etc. and their maintenance will create opportunities for new jobs and will check the migration of people from villages to cities.

However, several scientists and others are worried about river linking which would disturb the entire hydrological cycle by stopping the rivers from performing their normal ecological functions This project will change the composition of the sediment load, river morphology and the shape of the delta formed at the river mouth. Construction of dams and canals will get villages dislocated, flood towns and cut through millions of hectares of agricultural land. The large network of dams to bring an extra 35 Mha of land under irrigation canals will also alter natural drainage pattern such that occasional flooding and waterlogging is likely to inundate millions of hectares of agricultural land. Diversion of natural flood-water may reduce land fertility gradually and over the years the fertile land may change into desert, affecting agricultural production. Due to the high cost involved, there are talks about privatization of this project. But by allowing the private sector to invest in this project, the rights of the people for water resources may be affected.

.Some experts have proposed other alternatives of solving the water and food problems in India. Decentralized local rainwater harvesting, reviving and improving traditional techniques can meet essential requirements more effectively and at a far lesser cost. There is much scope for increasing the efficiency of the existing irrigation systems by reducing losses and through better water management .Besides, the optimal use of existing projects, traditional water-harvesting projects and recharging groundwater may be useful as alternative sources. According to UNICEF and the WWF, if the precipitation within the watersheds or sub-basins is harvested and conserved properly, domestic water needs will not be a problem in most parts of the country. The most important points to be considered.are the cost, in comparison to other alternative methods. to control water and food scarcity and the impact on our economy and the environment. The project should be undertaken with full recognition of the serious ecological damages that may be caused by interlinking rivers and that the benefits should far outweigh these costs. Interlinking of rivers should be subjected to a more comprehensive and realistic assessment.

OBJECTIVE OF TRANSFER OF WATER FROM SURPLUS TO SCARCE BASINS

History shows that the economic prosperity of a country and its cultural wealth are closely related with water resources development. India is blessed with ample water resources, but its enormous

population growth has resulted in poor per capita availability. It may be interesting to know the per capita water availability of India vis-à-vis other countries in the World as indicated in table-1.

Table-1: Per Capita Availability Of Fresh Water Per Year (Cum / Per Person)

USSR	USA	Australia	China	India	Ethiopia
19500	9900	5000	2420	2214	250

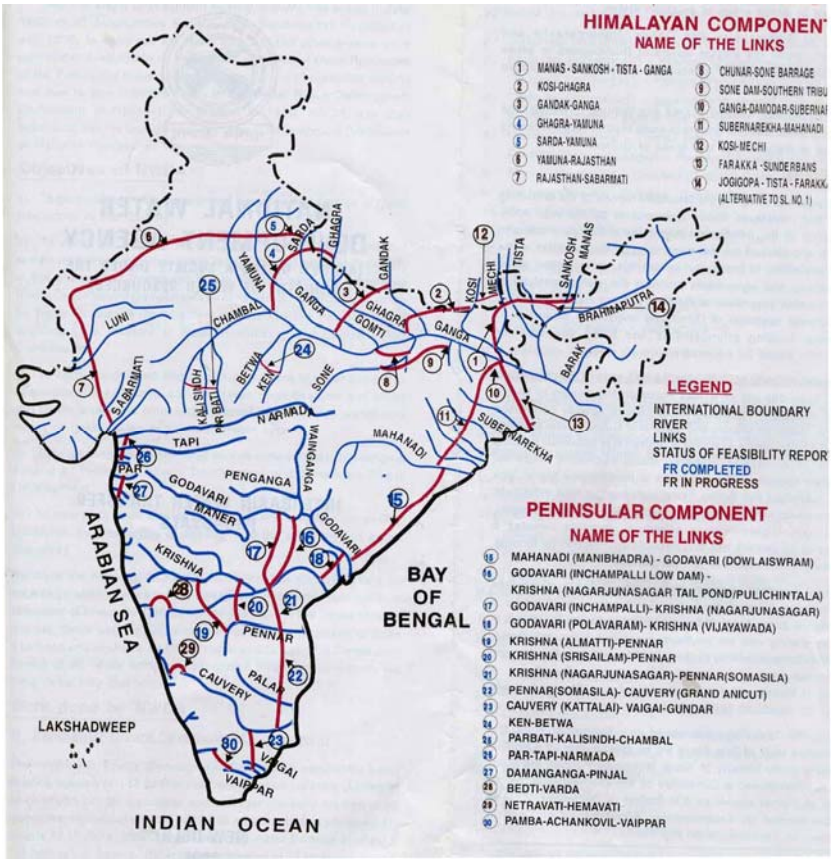

Fig.1 Himalayan and Peninsular components of Interlinks (in red)

Areas with availability less than 1000 cu. m. per capita per year is designated as scarcity areas. Although, the average figure (2,214 from table-2) for India, as a whole, shows it is not deficit, but when we look at the spatial distribution of water from basin to basin, it is noticed that there is a great deal of non-uniformity principally due to extreme non-uniform rainfall distribution in our country. Table-2 gives the list of surplus and scarce basins in India. One of the fundamental objectives of the proposed river link is to bring equity in water availability by transferring water from surplus basins to the scarce basins. The scarce basins are often subjected to droughts and the surplus basins are frequently devastated by floods. The flood and the drought occur almost simultaneously leading to loss of human life and animals, damage to crops and properties, disruption of communication and so many other miseries. Annual average flood damage has increased from Rs. 52 Crores in 1952 to Rs. 5,846 Crore in 1998. Flood prone area in India is about 40 mha out of which 7.5 mha gets flood affected almost every year. Droughts, on the other hand, result in loss of soil moisture leading to loss of crops and the people are deprived of even the basic need of drinking water. The flood-drought-flood syndrome in India, occurring almost regularly, is causing disaster to the nation. The primary objective of inter-linking the rivers is to transfer water from the surplus basins to the deficit/scarce basins for optimal use of national water resources and its equitable distribution amongst the states. By 2025 our total demand of water of 1050 Km^3 (Food – 770, Domestic Water Supply - 52, Industrial Use – 120, Power – 71, Miscellaneous e.g. Salinity, Pollution Control, Navigation, Recreation etc. – 37) is going to be more or less equal to utilizable water resources of the country estimated as 1100 Km^3 (690 Km^3 from surface water and about 432 Km^3 from ground water) [6]. Acute scarcity of water supply will arise after 2025 unless we control the growth of population.

Table 2: **Surplus and Scarce Basins in India**

Surplus Basins		Scarce Basins	
Name of Basins	**Per Capita Availability in Cum. Per Year**	**Name of Basins**	**Per Capita Availability in Cum. Per Year**
Brahmaputra Basin	18,417	East flowing Rivers between Mahanadi and Pennar	919
Barak Basin	7,646	Cauvery	666
West flowing Rivers between Tadri and Kanyakumari	3,538	Pennar	648
West flowing Rivers between Tapi and Tadri	3,194	West flowing River Basin of Kutch and Saurashtra including Luni	631
Narmada	2,855		
Brahmani-Baitarni	2,696		
Mahanadi	2,546	East flowing River Basins between Pennar and Kanyakumari	383
Godavari	2,026		
Indus	1,757		
Ganga	1,473		

BENEFITS OF THE PROPOSED NATIONAL WATER GRID

Those who strongly advocate implementation of the national water grid linking Indian rivers cite the following benefits which the project is likely to bring about for an all round development of the country.

Food Security

The projected population of India is expected to stabilize at about 1600 million by the year 2050 from the present population of about 1050 million. The food requirement for this increased population will rise from 205 million tons at present to 460 million tons in 2050. The proposed grid is going to increase irrigated area from the present 113 million hectare to 148 million hectare by 2050 ensuring our food security.

Hydropower Development

At the present, the share of hydropower is only about 25% of the total power generation since our hydro-power development is only about 22,000 MW out of the potential of about 84,000 MW. Only 2% of the potential of north-east has been developed so far, although 45% of total hydro-power potential of the country lies there. The proposed grid, especially the Himalayan component, is going to provide 34,000 MW of additional hydropower for peaking purpose and for increasing the desired share of hydro to about 40%Water Supply for Drinking and Industry. The proposed grid envisages supply of clean drinking water and water for industrial use amounting to 90 and 64.8 billion cum. respectively with a view to meet the demand by 2050. This will remove the current hardship, especially for the rural women who have to walk long distances daily to collect water for drinking and other domestic uses. No industrial growth is feasible without guaranteed water supply.

Navigation for inland water transport

Currently, the national waterways run only for about 120 days or so in a year due to inadequate depth, which is less than the required minimum depth of about 2m. The proposed grid is going to ease pressure on railways and roads by introducing inland navigation – through National Waterways (no I, II, & III) by guaranteeing a minimum 2 m depth of water on all the 365 days in a year.

Flood and Drought Protection

As already pointed out, while one part of the country is devastated by recurring floods, the other part is suffering from drought due to acute shortage of water. The main challenge is how can the water causing devastation and running waste into the sea (especially from Brahmaputra, Ganga and Mahanadi Basins) can be diverted for productive use in the drought prone areas in the South and the West, so that the country gets rid of the current flood-drought-flood syndrome.

Employment Opportunities in Rural Areas

People in the rural areas are now compelled to migrate to cities in search of jobs, causing rapid deterioration of our national economy. Villages are getting poorer and cities are getting congested – resulting in unprecedented pollution of air, water and soil in the cities. Only way to reverse this unhealthy trend is to create more job opportunities in rural areas through agricultural and agro-industry based projects. As the proposed grid and the storages are going to be mostly in rural areas, it is going to create large employment opportunities for the rural youths.

Dry Weather Flow Augmentation

Transfer of surplus water stored in reservoirs during monsoon and releasing it during dry season will ensure a minimum amount of dry weather flow in the rivers which will help in pollution control, navigation, fisheries, growth of forests, protection of wild life etc. Any water body either in storages or in flowing links will be very attractive and offer recreational opportunities for both rural and urban people.

DIFFICULTIES IN IMPLEMENTING THE PROPOSED SCHEME

There are several issues and challenges involved in the scheme [7]. The several difficulties that the Govt. is facing in the implementation of the proposed scheme may be summarized as follows:

Opposition to Interlink Mostly by NGOs

A group of people, especially the NGOs, the Socio-Economic and the environmental group [8] are strongly against the inter-link. They apprehend that such a massive inter- basin transfer of water will result in environmental degradation, climatic changes, loss of aquatic eco-system, loss of land, forests, fisheries and the livelihood of the poor people who thrive on them, massive displacement of people, evaporation losses, water logging and salinity and possible change in the climate [9] due to submergence of vast areas of land in reservoirs and the huge network of unlined open canals. The massive investment (Rs.5.6 lakh crores) required for the implementation of the project, which is likely to further increase manifold [10] due to cost and time overrun (as illustrated in table-3), is going to deprive other important projects for our socio-economic development due to diversion or inadequacy of funds. They also complain about inadequate information and transparency about the scheme, lack of data regarding cost of other alternatives to inter-link e.g. what will be the cost of transporting surplus foods (by increasing productivity of irrigated land. from the current figure of 2 T/ha to 4 T/ha or more) from water surplus areas to drought prone areas as an alternative to long distance water transfer for irrigation. As only a small part of floodwater (approximately 3 % only) will be stored and transferred, there will be hardly any flood relief. Droughts may not occur concurrently with flood and it may not be feasible to remove drought in all the distant areas ,especially those lying in higher altitude due to excessive cost of pumping.

Change in Constitution

Water is a state subject under entry 17 of state list- II subject to entry 56 of central list- I at present. Even if the project is found to be techno-economically feasible, implementation of the same will be a Herculean task. It needs constitutional amendment. Most of the donor states, even though surplus, will be reluctant to part with its resources free of cost and shall try to project their future demands stating that their surpluses are owing to insufficient storage due to lack of investment in their states. To provide incentive, water has to be considered as a trading commodity like electricity and other raw materials and the beneficiary states will have to be asked for paying the price of water possessed legally by the surplus states. Is it desirable to bring water from state subject to central subject and finally privatise it as is being done in the case of public sector undertakings now-a days ?

Interstate Dispute

In almost all the projects executed in the country so far, water of a river basin has been shared only by

Table-2 Cost & Time Overruns in typical Indian Water Sector

Project	Budget Year	Budget (Rpx106)	Increase on Original Budget	Comments
Indra Sagar	1984-85	13928.5		Estimated cost for earliest time of completion.
	1988-89	21676.7	56%	
	1993-94	34967.9	151%	
	2004-05	75000.0	438%	
Onkareshwar	1984-85	5780.00		
	1988-89	19092.50	230%	
	1993-94	40000.00	592%	Ditto
	2004-05			
Maheshwar	1985-86	2412.70		
	1993-94	8240.00	242%	
	2004-05	23000.00	853%	Ditto
Sardar Sarowar	1984-85	42400.00		
	1986-87	64066.40	51%	
	1992-93	131806.20	211%	
	2004-05	275000.00	549%	Ditto

Source "Between the Extremes: The Dam Dilemma": GG Puri

the riparian/basin states. The proposed scheme envisages transfer of water from surplus basins to drought prone basins irrespective of whether they are riparian/cobasin or not . Recently, the country has witnessed bitter quarrel and animosity amongst the states of Karnataka and TamilNadu over the sharing of water from rivers Kaveri and Krishna, even though both the states are riparian states. One can well imagine the degree of complexity and the dispute that will arise over sharing of water from the proposed scheme where a large numbers of states are involved, resulting in tension and rivalry amongst the people of different states. Who is going to control and operate this mega project?

Resistance of People in the East and North-East

Most of the surplus water lies in the east and North-East states where people are economically backward mainly due to lack of investment. People may resist inter- basin transfer of their water resources free of cost to the beneficiary states unless the Govt. of India bring their economic condition at par with other developed states of the country. Equity in economic development is no less important than equity in water distribution for a healthy and prosperous nation. There is a massive unemployment and unrest amongst the unemployed youths in these states. Unless the Govt. addresses these problems first by taking up those components of the project e.g.inbasin development of water for hydro-power, irrigation, flood control, inland waterways, communication and development of other infra-structures for these states, it may be almost impossible for the project authorities to implement the proposed national water grid, however well planned it may be.

Poor Performance of Many Exiting Projects

It is extremely important to evaluate and improve the performance of the existing river valley projects and address the genuine problems being faced by the people especially those who are affected and who oppose river valley projects for fear not unfounded. Performances of many of the projects are not satisfactory [11]. About 70% of irrigation water is wasted due to improper maintenance, lack of proper co-ordination between users and controlling authorities, mismanagement of water at farm level, wrong and unrevised pricing policy etc. Almost one third of the irrigated land is subjected to water logging and salt problems. Farmers of Punjab state are not allowing completion of Sutlej-Yamuna river link while half of the project is already completed by the Haryana Govt. long back and the entire investment is lying idle. The Punjab farmers are resisting mainly due to their fear of water

logging and salinity experienced by them from Bhakra- Nangal scheme. Not a single drop of water has flown in the Telegi- Ganga link project so far inspite of massive investment for this link since upper riparian states are objecting. Teesta barrage irrigation project in the northern part of West Bengal is half completed even after 30 years from its inception due to lack of funds. One of the DVC main canals which was designed for inland navigation has not carried a single vessel so far inspite of large investments and wastage of prime agricultural lands which had to be occupied for the construction of the wide canal. The state of Kosi canals and the problems being faced in river training after construction of Kosi barrage [12]) and Farakka barrage [13] are well known. These are only a few examples to illustrate the utter mismanagements in water sector. Many such projects which were earlier considered to be national assets have now become national liabilities. Unless and until we can correct the situation and improve the performance of these existing projects, it will be very difficult to earn people's confidence and convince the people for implementing a massive programme like national water grid ,however justified it may be.

Poor Economic Return & Faulty Pricing Policy

Unlike other commodities, water for irrigation is currently distributed almost free of cost. The present irrigation water rates are extremely poor and the realization of even those low rates is still poorer. Whereas during the British days, 87% of the maintenance cost used to be realised from water users, today the revenue receipt has come down so low that only 15% of maintenance cost can be met. [14]. As a result, there is hardly any maintenance of the irrigation projects after their execution. There is tremendous wastage of water due to losses in conveyance and operation as well as in the farms since farmers get it almost free of cost. Presently, the overall irrigation efficiency of most of the surface irrigation schemes, which consume about 80% of our total water supply, is about 30% only. Should we build such things which we can not maintain? The savings of water due to even a marginal improvement in irrigation efficiency and use of return flow through scientific management of irrigation water may be sufficient to irrigate the additional areas for increased food production. It will be wise to charge the beneficiary states for the water they will receive and pay a part of the revenue to the donor states as a price of the water they legally posses. The present practice of distributing irrigation water almost free of cost must be abandoned and the water rates so fixed that the revenue realized could pay for at least the annual maintenance and overhead costs if not the annual depreciation, interest on borrowed capital and the amount to be paid to the donor states.

ALTERNATIVES OF INTERLINKINKIG RIVERS

Food Transport

A large amount of water is consumed for agricultural production and will continue to be so. Therefore, import of food virtually amounts to conserving/having water. This is commonly known as virtual water. About 80% of 170 km^3 of water proposed to be transferred from surplus to scarce basins are for food production through assured irrigation. Instead of transferring such large volume of water through thousands of kilometers of unlined open canals, it may be feasible to transport food from surplus to deficit regions. The present productivity of unirrigated and irrigated areas in India are of the order of 1 and 2 tons per hectare respectively compared to the productivity of 5 to 8 tons per hectares in developed countries like Japan, Taiwan, Israel etc. With the development of agronomic science, bio-technology, improved irrigation and agricultural practices, it is feasible to increase productivity of our land per unit of area, unit of time and unit of water. Water used for additional food to be transported is termed as virtual water.

Increasing Irrigation Efficiency

In our country, lands are partitioned with partitioning of family. This hereditary convention has resulted in very small size of scattered lands where proper land leveling, land sizing, introduction of improved irrigation and agronomic practices are not possible. A single measure like land consolidation in Punjab and Haryana has resulted in 2 to 3 folds increase in agricultural productivity. Poor farmers with small and scattered lands can never undertake improved management of land and water. .As a result, there is a colossal loss of water in

most of the irrigated commands in our country. If the current irrigation efficiency of about 30% can be increased to 50% with adequate investment and proper management of water, the surplus water will be sufficient for irrigating additional land of 35 Mha for which transfer of water through link canals is envisaged. A large amount of irrigation water is at present wasted, especially in mega projects, due to lack of proper co-ordination between users of water and the controlling authorities, surface flooding, evaporation and percolation losses.

Changes in Food Habit/Choice of Appropriate Crops

There is a growing tendency to produce rice and sugarcane in irrigated commands all over the year. Rice and sugarcane consume large quantity of water compared to wheat, ragi and similar cereals. Rice should be cultivated only in the humid areas with plenty of rainfall, like Assam, West-Bengal, Orissa, AP,UP, Bihar etc .where average annual rainfall varies from 1000 mm to 1500 mm or more. Cultivation of rice in arid areas like Rajasthan, Gujrat etc. should be discouraged as its consumptive need is 3 to 4 times higher than that of wheat, ragi and similar cereals. Appropriate choice of crops and change in food habit in arid areas will result in substantial savings of water which can be utilized for additional areas proposed to be irrigated through water transfer by the link canals.

Control of population

Our population will grow in between 1600 and 1800 million at low and high level forecasts respectively by 2050 and then stabilize. If the population cannot be contained, as has been seen in the past, the requirement of water may go up well above the estimated utilizable water resource of 1122 km3/yr (SW 690 + GW 432). Therefore, it is necessary that a significant national effort be devoted to limit the population growth in our country through improved education and health for which adequateinvestment is essential.

RainwaterHarvesting,GroundwaterRecharge,Recycling irrigaton,Industrial and Municipal water/Development of Surface and Gorund water Resources

It has been shown that conservation of water through rainwater harvesting and artificial groundwater recharge can generate about 125 km^3/yr of additional water. Similarly, recycling of municipal and industrial waste water can regenerate another ~ 177 km^3/yr water. Both these measures provide water at local scale, where people live and engage in productive activities. However, it is only the former, namely rainwater harvesting and artificial groundwater recharge, where people and communities can directly participate due to the low level of technologies involved. The gestation period for such projects can be a few months to a few years and because of the distributed nature of this activity. It is only through the involvement of people and communities that sustainable works can be carried out. The gestation period for such activities is more as the required technology becomes more advanced and the capital intensive. A good part of south India is covered by hard rocks which, on the face of it, appears to be unsuitable for groundwater storage and development. In most places, however, hard rock is weathered and decomposed and can hold an appreciable quantity of groundwater as is evidenced by the innumerable open wells across the region Catching rainwater where it falls and storing it in tanks and wells helps in recharging the ground water resources. There is still untapped potential of almost 550 km3/yr comprising groundwater and conventional run-of-the-river schemes. Inter-basin transfer of water as proposed by NWDA can generate another ~ 173 km3/yr of water. But due to the complex political, technological and financial requirements, both intra- and inter-basin projects can only be undertaken by the State and National government agencies. The gestation period in these projects can be a couple of years to even 30 years or more. .

Another area of immediate emphasis has to be the recycling and reuse of water, because it not only generates water for subsequent use but also prevents pollution and ecological hazards. The impact of conservation, recycle and reuse is largely local but widespread and is the only way to drought proof the country.

Water conservation in Village Tanks

Our forefathers had a clear conception of the characteristics of the Indian monsoon rainfall and in their wisdom they constructed numerous water-harvesting structures in different states of India. Large numbers of tanks were constructed by erecting bunds across the courses of rivulets to collect rainwater. These tanks not only provide water for irrigation, but allow it to seep and recharge groundwater for subsequent use by farmers in non-rainy months through large diameter open wells sunk in lower sections of the valley. Such works were undertaken not by state agencies, but by local leadership. In recent years there is a tendency to discredit ancient practices in favor of grandiose schemes of constructing major dams and interlinking of rivers involving thousands of crores of rupees, uprooting in the process large sections of the population. In this connection it is worthwhile to recapitulate the words of Bankim Chandra Chattopadhyay, the greatest nationalist and novelist which Bengal has produced: He said

'Do not lose your reverence for the past; it is on the past that you must plant your foot firmly if you wish to mount high in the future. You are not a race of savages who have no past to remember. You cannot annihilate in a day a past national existence which has survived the annihilation of hundreds of empires, of hundred systems of religion. . I have to make my warning emphatic because the general tendency is to decry your past history, to call for its virtual erasure from your memory and lead you in the opposite direction'.

Tanks are an essential part of our village life and have a major role to play in conserving water resources. They have, however, been sadly neglected and their utility has been completely lost. First priority should, therefore, be given to desilting of existing tanks to make them functional. Every drop of rainwater should be harvested and used conjunctively with groundwater wherever possible.

PRIORITY OF INTER- LINKING OF RIVERS FOR WATER TRANSFER

To meet the growing requirements of water for various uses and to be counted as a developed nation, it is imperative not only to develop the new water sources but to conserve, recycle and reuse water wherever possible. For the food security of our growing population, various options have been considered in quantitative terms as possible sources to augment the anticipated deficit. These include: (i) conservation of water through rainwater harvesting and groundwater recharge, (ii) recycling and reuse of municipal and industrial wastewater,(iii) utilizing increased return flow from irrigation and other supplies, (iv)) virtual water and (v) intra and inter basin transfer of surplus water. The planning for both intra- and interbasin transfer of water has to clearly begin now because of the long gestation period involved. It is also important to note that only through projects of this nature can we generate the power required for groundwater pumping, provide water for inland navigation and meet ecological requirements. Every developed society has to provide for such requirements. Therefore, it is clear that India as a nation has to now initiate action on all fronts for developing its water resources. The priority of action, however, must be for increasing productivity of land, choice of proper crops as per prevailing climatic conditions, increase in irrigation efficiency of existing projects through improved water management, rainwater harvesting and groundwater recharge, recycling and reuse of wastewater, preservation of water in tanks to be followed by intra basin and inter basin transfers..

The National Commission on Integrated Water Resources Development (NCIWRD) has projected the improved irrigation efficiencies of the surface and groundwater irrigation system for the future. The Commission also assessed the return flow from the various uses, which would flow into the hydrologic system and thus make it available for reuse. The Commission recognized that inter-basin transfer of water is an outstandingly large complex program of water management. Studies have to be done with the help of computer simulation models and systems analysis.

CONCLUSIONS

Under the above circumstances, it will be perhaps wise not to hurry for interlinking of the rivers in the first phase of the water resources development project but to keep it as a long-term goal. The immediate need is to examine the feasibility of the river links and other alternatives to interlinks with more data and sound economic analysis of cost - benefit of different alternatives to achieve the same objectives. A master plan should be prepared for the integrated development of the country's total water resources - both surface and sub-surface. A strategy should be adopted for implementing the different components of the master plan (including river-linking) in a phased manner, keeping in view the immediate needs of the people and the country's economic conditions, especially of those in the east and the north-east where most of the surplus waters are available. The problems of the donor states are to be addressed first and topmost priority should be given for their economic upliftment to bring their economic conditions at par with rest of the country. Those components of the master plan related to in-basin development of water resources and other infrastructures should be taken up in the first phase of development before the execution of long distance interlinks for inter-basin transfer of surplus water from the the east and north east to the drought prone areas in the south and west in the last phase of execution of the master plan

REFERENCES

1. IWRS, Interbasin transfer of water for national development- problems and Prospects, theme paper pub. on water resources day by IWRS, New Delhi, 1996.
2. IWRS, Water Vision 2050, Theme paper pub. on water resources day by IWRS, New Delhi, March 22nd, 1999
3. lyer, Ramaswamy,R.,River link to disaster, pub. in the daily news paper The Statesman, April 5th, 2003.
4. Task Force for inter-linking of rivers, Agenda for the meeting of IITs and IISC under the chairmanship of Suresh Prabhu, chairman, task force, August, 2003.
5. Bharat Singh, Inter basin water transfer- review of need and problems, Theme paper pub in the proc. of All India seminar on Water and Environment-Issues and Challenges, org. by IWRS and WRDTC, Roorkee, Oct. 2002
6. Iyer, S. S., Water resources of India, J. of IWRS, April, 1989.
7. Mazumder,S.K., Interlinking Indian Rivers-Issues and Challenges, Proc., National Conf. On Hydraulic and Water Resources Engg., HYDRO-2003, org. by ISH and CW&PRS ,Pune.
8. NWDA, Water for life, 11th National Water Convention, New Delhi, May 11th, 2005.
9. Desai, V.R.,Ghosh, S.N.and Patro, J., National Water Grid-its Objectives and Challenges, ISH J. of Hyd. Engg., Vol. 11, No.1, March, 2005
10. Khitolya, A.K., Goyal, A.K. and Dhruv Kumar, Environmental and other Aspects of Interlinking Rivers, Proc. Recent Advances in Water Resources Development and Management org. by Deptt. Of Water Resources Development and Management (WRDM earlier known as WRDTC), IIT, Roorkee, 23-25 Nov. 2005.
11. Mazumder, S.K., Performance of surface irrigation schemes in India, keynote speech pub. in the proc. of all India seminar on water and environment-issues and challenges, org by IWRS and WRDTC, IIT (Roorkee), Oct. 2002.
12. Chitale, S.V., Future of Kosi river and Kosi project, J. of Instn. of Engrs(I), vol.81, Dec.,1999.
13. Mazumder, S.K., Training river Ganga near Farakka barrage, Proc. of national conf. On hydraulics and water resources HYDRO-2001, org. by ISH and CW&PRS, Pune, Dec.2001
14. Mohile, A.D., River valley development- a comprehensive approach, proc. of Int. conf. On hydro-power and river valley development
15. Water for India in 2050: first-order assessmentof available options

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