Chapter–3: Water Resource Projects - The Managerial Enigma

❑ *"In the abundance of water, the fool is thirsty."*
(Bob Marley)

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WATER RESOURCE PROJECTS - THE MANAGERIAL ENIGMA

While throwing light on the corporate concept of stakeholders, the previous chapter has drawn parallel between business development and water resource development, and also delineated such aspects of water crisis as: scarcity mentality of development, competition turning into conflicts, overlooking of social and environmental costs, and inattention to issues of human values and empowerment. Even then, the problem faced here is unique and cannot be handled by application of standard theories and techniques; hence there is a need to create a framework within which the problem can be understood and made amenable to solution (see Thomas, 2003, P.88). With this view, the present chapter seeks to provide a fresh perspective of India's water crisis in the stakeholder framework by assimilating information germane to overall issues of water resource development. The chapter analyses India's demand-supply gap and the reasons thereof forming the core of water crisis, along with the challenges of bridging the gap. Most part of India's river resources are prone to interstate disputes; and since practically no solution is workable under this situation, the chapter delves into the concepts of water rights and unravels limitations of present mechanism for dispute resolutions. Despite the titanic task, rarely ever a water resource project reaches a deadlock on technical grounds. Instead, the factors impeding constructions or affecting operational performances of such projects primarily fall in the domain of management; and the chapter attempts to identify all such factors.

1 SITUATION OF WATER CRISIS IN INDIA

The recent time has seen a dramatic rise in water related crisis giving rise to issues of wide spread drought, depleting ground water levels, salinity ingress and increasing pollution of water bodies. These issues relate to demand and supply imbalance where demand of water at specific place and at specific point of time, is considerably in excess of available supply.

1.1 Water Supply and Water Demand Scenario

The annual precipitation of India is about 4000 km^3. A significant portion of rainfall returns back to the atmosphere by evaporation, a large portion seeps into the ground and the balance forms streams, rivers and other surface water bodies. Part of surface water may enter ground and add to ground water reserves while part of ground water may again return to streams and rivers. Since the river basin[1] forms the natural hydrologic unit, the surface water resource estimates are made basin-wise and the annual mean flow in a basin is reckoned as water resource of the basin. Such estimated annual measure of India's water resource is 1953 km^3 (Table 3.1), which includes groundwater resource of 432 km^3.

Table 3.1: Basin-wise Surface Water Resource Potential of India in km^3.

Sl. No.	River basin	Water resource per year	Utilisable flow excluding groundwater*
1	Indus	73.31	46.00
2	a) Ganga	525.02	250.00
	b) Brahmaputra, Barak and others	677.41	24.00
3	Godavari	110.54	76.30
4	Krishna	69.81	58.00
5	Cauvery	21.36	19.00
6	Pennar	6.32	8.86
7	East flowing rivers between Mahanadi and Pennar.	22.52	13.11
8	East flowing rivers between Pennar and Kanyakumari.	16.46	16.73
9	Mahanadi	66.88	49.99
10	Brahmani & Baitarani	28.48	18.30
11	Subernarekha	12.37	6.81
12	Mahi	11.02	3.10
13	Sabarmati	3.81	-
14	West flowing rivers of Kachchh, Saurashtra & Luni.	15.1	14.98
15	Narmada	45.64	34.50
16	Tapi	14.88	14.50
17	West flowing rivers from Tapi to Tadri	87.41	11.94
18	West flowing rivers from Tadri to Kanyakumari	113.53	24.27
19	Minor river basins draining into Bangladesh & Mynmar.	31.00	-
	Total	**1952.87**	**690.31**

*(Source: NCIWRD, 1999. Table 3.6, P.37; and *CWC, 1998[a])*

The annual availability of groundwater is determined by the annual recharge of aquifer by surface water. Thus availability of groundwater is intricately linked with the availability of surface water. It is estimated that against the total annual availability of 1953 km^3 of water resource in India, about 690 km^3 of surface water (Table 3.1) and 396 km^3 of ground water, totalling 1086 km^3, can be put to use (NCIWRD, 1999).

The distribution of fresh water resources in India is uneven over space and time; its availability largely dictated by precipitation[2], which varies from place to place and from time to time. About 64% of the geographical area of the country accounts for less than 29% of total water resource of the country. The low precipitation coupled with high evaporation makes the water a highly scarce commodity in some parts of the country. Over 80% of the country's annual rainfall is recorded in the summer monsoon, which lasts for 100 to 120 days in a year. With as much as 50% of the annual precipitation taking place in a short period of about 15 days and less than 100 hours all together, about 40 million hectares of Indian land, i.e. 12.16%, is flood prone, though whole of it is not affected each year (CWC, 2001; and NCIWRD, 1999). Against the backdrop of a short and limited water supply scenario, the demand scenario of the country has been high, and on the rise continuously. The Union Ministry of Water Resources (2002) has estimated the annual per capita availability of water as 1829 cubic metre in year 2001, with projected decline to about 1557 cubic metre by year 2015. They have also projected that 47% of the geographical area and 55% of the population in the country will be under scarcity conditions by the year 2050. The Report of NCIWRD (1999) estimates that India's population by 2050 will be between 1346 to 1581 million and the water requirements for irrigation alone - so as to maintain food self-sufficiency[3] - will be in the range of 628 km^3 to 807 km^3 (table 3.2).

Table 3.2: India's Projected Water Requirement for Irrigation in Year 2050

Sl. No.	Particulars	Unit	Year 2050	
			Low demand	**High demand**
1	Projected population	million	1346	1581
2	Foodgrain Demand	million tonnes	420	494
3	Net Cultivable Area	million hectares	145	145
4	Cropping Intensity	%	150	160
5	% Irrigated to gross cropped area	%	52	63
6	Total Cropped Area	million hectares	218	232
7	Total Irrigated Cropped Area	million hectares	113	146
8	Total unirrigated Cropped Area	million hectares	105	86
9	Foodcrop area as % of irrigated area	%	70	70
10	Foodcrop area as %of unirrigated area	%	66	66
11	Foodcrop area - irrigated	million hectares	79.2	102.3
12	Foodcrop area - unirrigated	million hectares	69.3	56.7
13	Average yield – irrigated foodcrop	Tonnes/hectares	4	4
14	Average yield – unirrigated foodcrop	tonnes/hectares	1.5	1.5
15	Foodgrain prod. from irrigated area	million tonnes	317	409
16	Foodgrain prod. from unirrigated area	million tonnes	105	85
17	Total surrogate food production	million tonnes	422	494
18	Assumed % of potential from surface water to total irrigation	%	54.3	54.3
19	Irrigated area from surface water	million hectares	61.4	75.9
20	Irrigated area from ground water	million hectares	51.7	70.3
21	Assumed "Delta" for surfacewater	metre	0.61	0.61
22	Assumed "Delta" for groundwater	metre	0.49	0.49
23	Surface water required for irrigation	Km^3	375	463
24	Ground water required for irrigation	Km^3	253	344
25	**Total water required for irrigation**	Km^3	**628**	**807**

(Source: NCIWRD, 1999. Table 3.25, P.59)

The water demand for domestic use has been estimated to be in the range of 90 km^3 to 111 km^3 (table 3.3). Accounting for industrial, power and other miscellaneous requirements, the total water requirement for the year 2050 has been estimated to fall between 973 km^3 to 1180 km^3.

Table 3.3: Projected Water Requirement (in Km^3) for Domestic and Municipal Use

S. No.	Particulars	Year 2050	
		Low demand	**High demand**
1	Surface water	48	65
2	Ground water	42	46
3	**Total requirement for domestic and municipal use**	**90**	**111**

(Source: NCIWRD, 1999. Table 3.27, P.61)

Even if country's total utilisable potential of 1086 km^3 is fully tapped, the demand projection ranging from 973 km^3 to 1180 km^3 can only be narrowly met. The demand estimate for year 2050 also shows a phenomenal increase of 76% to 114% (depending on low or high population growth scenario) over the water utilisation level of 552 km^3 in 1990. This increase in projected demand is significantly higher than the projected increase of 60% to 87% in population (under low or high growth scenario) during the years 1990 to 2050. The population density[4] of India is far from uniform and hence demand pattern of water is uneven over space besides being uneven over time due to climatic variations. However, variation in water demand pattern over space and time is not exactly in tandem with the variation in its supply pattern.

1.2 Demand - Supply Gap and Reasons for Present Conditions

The situation of demand and supply gap in usable water is of grave concern owing to the creation of 'haves' and 'have-nots' in terms of their access to quality water. Apart from drawing geographical demarcations, the water crisis has sharpened the dividing line between the urban and the rural, the rich and the poor. The media reports - about starvation[5] deaths, increasing cases of suicide among farmers, mothers selling off their babies, and the rising graph of criminal activities in rural areas - are not too infrequent to be forgotten. They all relate to the plight of rural poor faced with the situation of unsustainable yield from farmland, due to paucity of water.

Scarcity of water has also affected performance of several industries, including power plants. Besides the social and economic angle, the present water situation also has connotations in other dimensions, such as political (e.g. Cauvery dispute between Tamil Nadu and Karnataka), legal (e.g. heightened Supreme Court case on Sardar Sarovar

Project), environmental (e.g. worldwide agitation against large dams) and even religious dimension (e.g. objections on construction of Tehri Dam on Holy River Ganga).

The reasons for present water crisis in India are fivefold: (i) while India's share in world's water resources is roughly 4.0% (CWC, 2001) and remains very small and invariable, its population is ever-burgeoning and presently constitutes 16.7% of the world population (Mehta, 2003); (ii) the per capita consumption of water has been continuously on the rise; (iii) the interstate conflicts on river water sharing issues has jeopardised many of the important viable projects; (iv) the complex impeding factors during construction immensely delay ongoing projects, alter their scope, or immobilize them permanently; and (v) pressure brought by the beneficiaries of completed projects interferes with project operations disrupting judicious, equitable, and efficient distribution of limited resource.

India's inability to bridge the demand and supply gap is the structural aspect of water crisis. The impregnable tenor to the crisis is however given by the non-structural aspects of: (i) absence of a national water vision that is also reflected in absence of an effective population policy; (ii) inadequacy of water usage, water quality, and water regulation laws; (iii) archaic laws on river water rights, lack of centralised planning and absence of meaningful central role on the interstate rivers; and (iv) intense and contradictory influence on the projects from too many players, and inability of the project to sense, pre-empt, or guard against such influences.

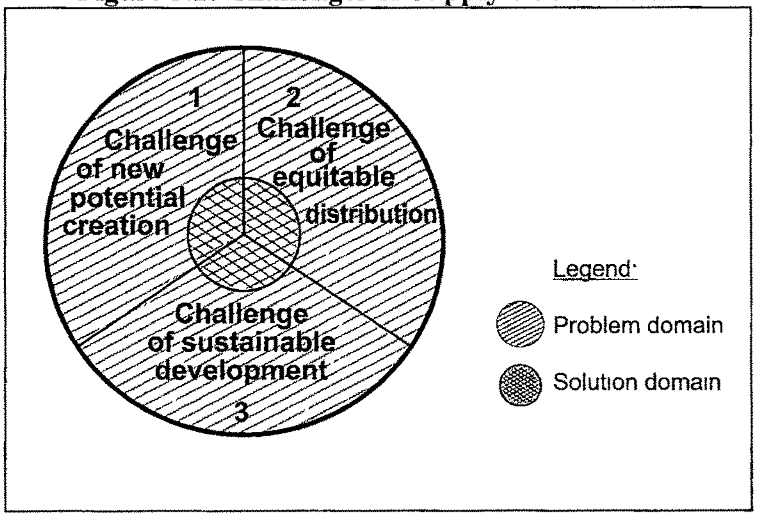
2 CHALLENGES OF MEETING THE DEMAND AND SUPPLY GAP

The ever-increasing imbalance in the demand and supply position of water is the core cause of India's water crisis; solutions for which are often sought by enhancing supply potentials through new schemes. Many of these schemes get shelved even before conceptualisation, mostly because of non-technical reasons; some get stagnated during construction, while many others fail in delivering intended benefits despite completion. Evidently, the demand and supply imbalance can be managed by enhancing supply (supply-side solution), or by curtailing demand (demand-side solution), or by both. Till now the option of demand-side solution has been grossly ignored, as the challenges posed by it are seemingly complex. But since the challenges of supply-side solution are increasingly becoming difficult, the option of demand-side solution presents a viable option for containing the crisis.

2.1 Challenges of Supply-side Solutions

The domain of supply-side challenge of meeting our present and future demand is constituted of three components; viz., (i) creating new potentials for enhancing supply; (ii) achieving equitable distribution; and (iii) meeting the needs of sustainable development. An acceptable and sustainable solution for enhancing supplies has to be found within the domain of supply-side challenge, encompassing domains of all three components, as illustrated in Figure 3.1.

Figure 3.1: Challenges of Supply-side Solution



2.1.1 Creation of New Supply Potential

The first challenge is the creation of new supply potential for meeting ever-growing demand of water, with a finite resource. Given the water demand projections, by year 2050 India would be required to tap every single drop of utilizable water resources. Although utilizable water resource potential of the country has been estimated at 1086 km^3, only about 600 km^3 has been put to use till date (NCIWRD, 1999). Evidently, with almost 45% of water resources remaining untapped, the country's water supply capacity has not been exhausted. But, considering the social and environmental constraints, and technical and financial inadequacies, the possibilities of potential creation for full utilization of balance resources are not easy and assured.

The minimum live storage of manmade reservoirs required to reap full potential of surface water is estimated at 385 km^3, against which the total completed capacity of reservoirs is 174 km^3, while another 76 km^3 is under construction (Table 3.4). Thus, to utilize available potential fully, a total of 135 km^3 of storage needs to be created from scratch. The task of this addition - which is about 78% of the existing capacity - may not be a cakewalk. The reservoirs are created in river plains or river valleys by submerging a notable portion of the river's plain and fertile land or the valley forest. Population pressure[6], which even at present level is leading to encroachment of forestland and fast dwindling of forest reserves, would make it nearly impossible for the country to afford vast tracts of land for submergence by future reservoirs. The impact of population growth added with increased public awareness on social and environmental matters would make the task of acquiring land for new reservoirs a tight ropewalk.

Table 3.4: Basin-wise Storage Capacity Created and Under Construction

Sl. No.	River basin	Live storage capacity in km^3		
		Completed	Under construction	Total
1	Indus	13 83	2.45	16.28
2	Ganga – Brahmaputra –Meghna Basin .			
	(a) Ganga sub –basin	36.84	17.12	53.96
	(b) Brahmaputra and Meghna sub –basin	1 09	2.40	3.49
3	Subernarekha	0.66	1.65	2.31
4	Brahmani – Baitarani	4.76	0.24	5
5	Mahanadi	8.49	5.39	13.88
6	Godavari	19.51	10.65	30.16
7	Krishna	34.48	7.78	42.26
8	Pennar	0.38	2.13	2.51
9	Cauvery	7.43	0.39	7.82
10	Tapi	8.53	1 01	9.54
11	Narmada	6.6	16.72	23.32
12	Mahi	4.75	0.36	5.11
12	Sabarmati	1.35	0.12	1.47
14	West flowing rivers of kachchh, Saurashtra & Luni.	4.31	0.58	4.89
15	West Flowing Rivers south of Tapi	17.34	4.97	22.31
16	East flowing rivers between Mahanadi & Godavari.			
17	East flowing rivers between Godavari and Krishna	1.63	1.45	3.08
18	East flowing rivers between Krishna and Pennar.			
19	East flowing rivers between Pennar & Kanyakumari	1.42	0.02	1.44
20	Rivers draining into Bangladesh and Myanmar.	0.31	0	0.31
	Total	**173.71**	**75.43**	**249.14**

(Source: CWC, 1997)

From the point of view of storage creation, the advantageous topographical locations closest to the human habitat were first explored so as to keep the cost of water conveyance minimal. These advantageous locations have been exhausted and the projects for creating remaining potential would be located at higher altitudes and in complex terrain. For new projects, canal lengths and the number of cross-drainage structures would be above normal levels. The complex topology and geology would make the cost of storage creation and water conveyance much more than the costs of earlier projects. Because of increased public sensitivity, proportionate cost of mitigating social and environmental impacts would also be higher. Militancy related and other law and order problems in certain areas - especially in northeast region with substantial untapped potential - would also become factors for project delays and excessive cost overruns.

2.1.2 Achieving Equitable Distribution

The second challenge is about equitable distribution of water between different regions of the country; within regions, between urban and rural areas; and within urban and rural areas, between the rich and the poor. The aggregate supply and aggregate demand can be matched at macro level only by extraordinary efforts for creating new supplies, but matching the supply and demand positions at micro levels, by judicious and equitable distribution of water, are Herculean tasks.

Regional Imbalance and Interlinking of Rivers

There is large imbalance in availability of water between different regions of the country. Out of 24 river basins of India, Ganga-Brahmaputra-Meghna[7] basin alone accounts for more than 60 % of total water resources of the country. The availability of utilisable water per capita (1991 population level) varies from 182 m^3 in Sabarmati basin to 3082 m^3 in Narmada basin while its availability per hectare of culturable area varies from 1244 m^3 in Sabarmati basin to 8320 m^3 in Mahanadi basin (NCIWRD, 1999). This vast spatial variation in availability of water, coupled with variation in timing of the availability, creates a 'flood-drought-flood' syndrome experienced by the country. While the states of Karnataka, Tamil Nadu, Rajasthan, Gujarat, Andhra Pradesh, and Maharashtra, are more often the drought prone states; the states of Uttar Pradesh, Bihar, West Bengal, Orissa, and Assam, frequently face the problems of floods.

It is technically feasible to achieve regional balance in distribution of water, by inter-basin transfer of water. The scheme essentially involves interlinking of rivers to transfer water from those water surplus regions where sufficient storage sites are not available, to those water scarce regions where good storage sites are available. Implementation of such options have potential to help India to overcome its notable limitation of the skewed distribution of water (both in space and time), and also to resolve the technical issue of inadequacy of storage sites in India's surplus basins.

Few schemes involving inter-basin transfer of water already exist, and there is substantial potential for new ones. As early as 1960s, Captain Dastur has proposed a 4200 Kms long garland canal across the Himalayas, and a 9300 Kms long garland canal encircling southern peninsula. Later, in 1970s, K.L.Rao, then Union Minister for Irrigation, has proposed a national water grid involving a 2640 Kms long Ganga-Cauvery link (NCIWRD, 1999). In 1982, the NWDA (National Water Development Agency) was set up by the Central Government for preparing a detailed plan for interlinking India's major rivers. Though, the NWDA's plan was ready for quite some time, no consensus were forthcoming from the concerned states for its implementation. However, recently, when the Cauvery water-sharing dispute between Karnataka and Tamil Nadu became murkier[8], snowballing into a complex constitutional situation, the NWDA's river interlinking plan came into limelight. Later, on a PIL (Public Interest Litigation) related to cleaning of river Yamuna, the issue of networking of rivers got raised in the Supreme Court as well. Based on a Supreme Court's order (of 31st October 2002) on the issue, the Government of India has set up a high powered task force to study NWDA's plan, and to go into modalities for bringing consensus among the sates for its implementation (Jain, 2003).

The NWDA's ambitious plan – most part of which is based on preliminary investigations only - envisages interlinking of 37 rivers, through 30 canal links with an aggregate length of about 9600 Kms. The Himalayan component of the proposed plan involves (i) transferring surplus flows of Kosi, Gandak and Ghagra to west (ii) transferring surplus flows of Ganga and Yamuna to Haryana, Rajasthan and Gujarat, and (iii) transferring Brahmaputra's flow to augment dry weather flow of Ganga. The Peninsular component of the plan involves (a) transferring surplus flows of Mahanadi to Godavari, and further to Krishna, Pennar and Cauvery, (b) transferring west flowing rivers of kerala to Tamil Nadu, (c) diverting small rivers flowing along west coast north of Mumbai and south of Tapi, to Mumbai, Saurashtra and Kutch, and (d) interlinking southern tributaries of river Yamuna (Jain, 2003). It is estimated that implementation of river-interlinking plan can increase irrigation potential to an extent of about 35 million hectares (25 million hectare from surface water and 10 million hectare from groundwater) over and above the ultimate potential of 139 Million hectares (Gurumurthi, 2002).

Understandably, above plan of interlinking rivers would involve construction of many more reservoirs and large water conductor systems; and a significant proportion of capital. A rough estimate for the plan indicates requirement of about Rs.5,60,000 crore, needed to be spent over a 35 year period (Jain, 2003). On an average, this works out to about Rs.80,000 crore required for next 7 five-year plans. For the creation of normal irrigation potential alone (for major and medium projects, not envisaging potential creation by interlinking of rivers), the total agreed outlay under the 9th five-year plan was only about Rs.43,000 crore (CWC, 2001); evidently means of mobilizing additional resources are quite difficult.

Apart from colossal finances, the efforts for large-scale inter-basin transfer of water would involve considerable displacement of people and significant environmental implications. The time and cost of mitigating the social and environmental impact would also be large. Further, without achieving a breakthrough in resolving the non-structural aspects of water crisis, even if the plan of river interlinking is completed, management of such systems will pose problems owing to the conflicts among upper-end and lower-end beneficiaries.

Social Imbalance of Water Distribution

The rural areas have been deprived of their fair share in water resource development despite heavy investments and the focus given to them in early five-year plans. Not surprisingly, 90% of India's rural population relies on shallow or deep groundwater for drinking purpose (IWRS, 1999), and only 8% of them have access to sanitation facilities (World Bank, 1999). About 56% of the irrigation in the country is by wells and tubewells (CWC, 2001), for which most part of the investment is by private sector. Prioritisation of potential creation over network development has often excessively delayed the irrigation benefits reaching tail ends. In such cases, the change in land use pattern of command area with increasing urbanisation[9] has lead to rejection of planned irrigation, while unplanned urban consumption has grown by leaps and bounds.

Within the urban sector, there is gross deficiency in equitable distribution of water among the rich and the poor. The unhygienic or nearly non-existing sewerage facility, due to non-availability of sufficient water, has made the condition of urban slums pathetic. Only 58% of urban population has access to sanitation facilities (World Bank, 1999). Safe drinking water is no more accessible to one and all; only the rich can afford it. Use of aqua-filters, even on municipal supplies, is increasingly becoming necessary. The potable bottled market – estimated at Rs.1000 crores, growing at the annual rate of 50%, with over 200 brands jostling for their share in the market (*The Economic Times*, 11th June

2001) – is an indication of the extent of commercialisation of this life sustaining resource. In rural sectors where surface irrigation facilities are inadequate, excessive ground water usage has depleted ground water table to extreme depths rendering rural poor in a disadvantageous position over their rich counterparts having access to deeper bore wells.

2.1.3 Meeting the Needs of Sustainable Development

The third challenge is about attaining sustainable level of development in which the needs of the present can be met without compromising ability of the resources to meet the needs of the future. If India exhausts full potential of utilisable water resources to meet the projected demand of 50th year henceforth, where would it turn to meet the water demand of 60th or 70th year? Since creation of new potential of water resources is to some extent at the cost of land resources, which is already under high population pressure, the issue of sustainable development of land resources also gets linked. Undoubtedly, the perpetual efforts to create new supplies to match growing demand would go against the principle of Sustainable Development.

One point of view is that the Indian population would stabilise by the year 2050, and the total aggregate water resource of the country would be just enough to meet the projected demand of that time. The implied suggestion is, not to take an alarmist view and tap every available potential of water resources in India. The three assumptions made here are (i) the population would stabilise by year 2050, (ii) the per capita needs, 50th year henceforth, would stabilise and (iii) the estimated water resources of the country would be enough to meet the demand. During the decade of 1991-2001, India's population grew at a rate of 21.34% (Census India, 2001). To satisfy the first assumption, this decadal growth rate would be required to be brought down to 0% within next five decades. The per capita demand of water has been continuously growing with development and even in the projections made for future demand, it has been assumed to grow right up to year 2050. The second assumption is contradictory to this trend. The estimate of 1086 km^3 as being the total utilisable water resources potential of India is probably the best estimate, out of many available estimates with serious limitations. Further, studies have provided the first tentative evidence that relatively small changes in regional precipitation and evapotranspiration patterns, besides global warming[10], might result in large-scale changes in regional water availability (Kumar, 1999; and Kaul, 2000). Hence, total reliance on estimated sufficiency of water, as made out in third assumption, does not seem tenable.

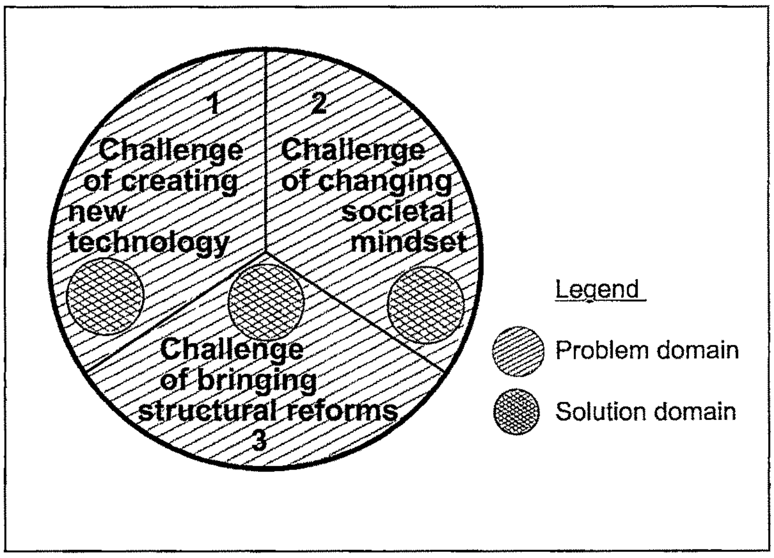
The social and environmental impact of water resources development is being widely and vigorously debated upon today. However, most of the time debate is focused on pressing issues related to submergence by reservoirs, but its impact on river stretches downstream of projects, is less debated upon. The impounding of rivers, generally being in hilly reaches, affects thinly dense population pockets in terms of submergence, while the consequential reduction in river flows affects a larger area and population of river plains.

For ages, the river due to its self-cleansing property and final access to sea has been the ultimate cleansing agent for semisolid and liquid wastes created by man. The unregulated industrialisation of the country has woefully increased the burden of rivers by adding chemical wastes to the ever-increasing biological wastes. Though Indian habitat continues to pour its wastes in rivers, sufficient discharges are no more available in them for self-cleaning process or for carrying the wastes to sea. Even at present when only 45% of the total reservoir capacity of India is developed, many beautiful wide water lines that existed on the landscape earlier have become minuscule or disappeared altogether. Most of the rivers, whose water resource potentials have been tapped in the hills, look like wastewater drains in the plains. The holiest river Ganga, swallowing 1.3 million litres of sewage daily, is probably the most polluted river today. Thirteen major river basins of India, representing 80% of total surface water, are polluted with pollution levels ranging from 20 to 1000 times above normal levels (*India Today*, 25th June 2001). As the untapped potential of water resources is now confined mostly to very high altitude areas, its further exploitation would exacerbate threat of river pollution along longer downstream stretches; thus, denting the principle of sustainable development.

2.2 Challenges of Demand-side Solutions

The three formidable challenges posed by the demand-side solution are (i) creating new technologies for reducing water demand (ii) bringing change in the societal mindset about water usage, and (iii) initiating and enforcing water related structural reforms. As illustrated in Figure 3.2, preferably the solutions should be found for all three components of demand-side challenges, and success in each would independently add to overall success of the demand management.

Figure 3.2: Challenges of Demand-side Solution



2.2.1 Creating New Technologies

The first challenge of demand-side management is the creation of new technologies for reducing water demand. Nearly 83% of water usage is in agricultural sector (NCIWRD, 1999), for which contribution through advancement in agricultural technology can be two-pronged. One way, is to develop higher yield crop varieties so that water consumption per unit of the food-grain produce is reduced. In the existing 80.76 million hectares of gross command area of irrigation projects or in the 44.35 million hectares of groundwater irrigated areas (NCIWRD, 1999), the use of high yielding varieties can increase crop production by many folds from the present national average yield ranging between 1.0 to 2.33 tonnes per hectares, which is lower than 6.0 tones per hectares or more, achieved by some of the countries even today (NCIWRD, 1999). Thus bringing Indian technology at par with developed nations alone can cut down India's irrigation water requirement to one third, or even less, of its present day demand. The second way of reducing agricultural water demand is to develop crop varieties that would require lower frequency and less quantum of water application. Today about 68% of land, which accounts for nearly 40% of country's total food grain production, remains under dryland or rainfed farming (Chakraborty, 2001). In this large area, use of low water consuming plant varieties can help farmers produce food and non-food crops on a sustainable basis.

Researches in certain other areas of agriculture can also help in reducing demand for fresh water. For example, (i) breakthrough in developing crop varieties with resistance towards low to moderate salinity can augment the total area available for cultivation. This could increase potential for food-grain production substantially without increasing fresh water demand. With such a breakthrough, possibilities of utilising seawater for irrigation - after its dilution with river water - can also be explored. (ii) Technological advancements in the field of soil moisture retention, enhancement of soil productivity by crop rotation, conjunctive use of water (from rains, tanks and wells), recycling of animal manure etc. would help in increasing sustainable yields of farmers in low rainfall areas (Nanwal, 2001). (iii) Further development of pest and insect resistant crop varieties can help in checking chemical contamination of surface and groundwater from excessive use of pesticides and insecticides.

Technological developments are also called for in the area of irrigation methodology. The national weighted-average value of Net Irrigation Requirement is estimated as 0.36 metre depth of water application, against which the Gross Irrigation Requirement is on an average estimated as 0.65 metre in the case of groundwater usage and 0.9 metre in the case of surface-water usage (NCIWRD, 1999). The surplus water requirement of about 80% (for groundwater usage) to 150% (for surface water usage) is mainly on account of conveyance and application inefficiencies. It is argued that implementation of Micro Irrigation Technology (MIT) can increase crop productivity as well as save water up to 50% (Jain, 2000). If made adaptable to Indian conditions, the MIT can considerably increase application efficiency. In the open canal water-conductor system presently in use, the conveyance efficiency is adversely affected due to excessive seepage, evaporation, leakage, evapotranspiration (through weeds), pilferage etc. Developments to make water conveyance through cost effective pressurised pipes will encourage its usage, thereby removing most of the water losses associated with open canal system. In addition, this may help in implementation of MIT and also reduce the number of canal-affected oustees.

Presently the share of drinking and municipal water in the overall usage is about 4.5%, which is likely to increase to 9% in the year 2050. Similarly the present share of 3% of industrial water usage is estimated to rise to 5% by year 2050 (NCIWRD, 1999). Being essentially non-consumptive, the domestic and industrial water is available for reuse. Advancements in the area of cost-effective treatment and recycling of domestic and industrial wastewater would reduce demand for water and also abate pollution of fresh water sources. Advancements in the area of desalination technology could also reduce demand for domestic and industrial water substantially.

2.2.2 Changing Societal Mindset

The second challenge of demand side management is about changing the mindset of society towards usage of water. Despite pockets and periods of deficient rainfall, Indians by and large use water in an abundant manner. The Indian proverb "drop by drop the pot can fill up" underlines the importance of savings, but is rarely practised in case of water. Open taps in homes and public places needlessly waste precious water. Most of the leaks in urban distribution systems go unreported, resulting in water losses to the extent of 20 to 40 percent (IWRS, 1999).

Apart from a faulty sense of abundance, the common Indian farmer believes that larger application of water yields larger produce, and hence overuses water. This not only allows water to go waste by surface drain, ground seepage or evaporation, but also affects soil fertility by washing away its nutrients, water logging and salination effects[11]. Excessive use of water is damaging to farm fertility and also detrimental to crop yield. This calls for changing the traditional view about watering of fields, which will enhance the farm yield and phenomenally reduce irrigation water demand. In the recent past, significant work has been done by a few to initiate water conservation and bring about change in people's mindset about water usage. Success stories of some of the non-governmental organizations in villages of Maharashtra (*pani panchayats*) and Rajasthan have received good media coverage, which has even encouraged a few others to emulate them. But such efforts are few, and most of the time localized to areas that are already water-stressed. What is needed more is to bring change in societal mindset of areas where groundwater situations have not yet deteriorated alarmingly, or where surplus capacities can be created from existing irrigation schemes by curtailing requirement of present command.

The population growth has also been a cause of fragmentation of the farmland holdings, which in turn again becomes a factor of aggravating water situation. For instance, there has been a sharp decline in the average size of operating holding in India from 2.7 hectares in 1960-61 to 1.6 hectares in 1985-86. During the period 1970-71 to 1990-91, the number of holdings under the category of marginal and small farmers has increased by 65% (TERI, 1998). There is an urgent need for creating the mindset for cooperative farming, leading to consolidation of farmland and thereby reducing the farm-water demand.

The Indian society has an aversion for recycling of wastewater, especially for domestic reuse. It is generally accepted that consumptive use of water is only about 20% of the gross urban demand (IWRS, 1999) and hence huge quantity of wastewater is generated in urban areas. With increasing population pressure, the supply potential in and around urban centres is no longer sufficient and water is required to be brought from far-off sources, which is expensive and difficult to develop. For example, the new sources[12] for major cities like Bangalore, Ahmedabad, Hyderabad, Delhi and Chennai are located at distances of about 100 Kms, 150 Kms, 160 Kms, 300 Kms and 400 Kms respectively (IWRS, 1999). If wastewater were to be treated and put to reuse, it would be possible to reduce freshwater demand for domestic use considerably. The society needs to be educated about necessity of recycling wastewater, and wherever possible the treated wastewater should be allowed to re-enter water conveyance systems so as to augment the downstream supply potential.

2.2.3 Structural Reforms for Restraining Water Demand

The third challenge of demand side management lies in bringing structural reforms for restraining demand. In India, while sources of surface water are generally public property, the ground water sources are treated as part of private property. Even with limited land properties, people can have access to unlimited groundwater reserves by deploying powerful pumps. This has resulted in uncontrolled exploitation of water in many places leading to falling of groundwater table to alarming levels[13]. There are practically no laws restraining people from pumping out large quantities of water from private wells or boreholes. The Government of India prepared a model bill for scientific regulation of groundwater as early as 1970, but very few states like Gujarat, Tamil Nadu, Madhya Pradesh and Maharashtra have enacted groundwater legislations so far (Sekar, 2001). Even in these states, the legislations are either not implemented or are not sound enough to bring effective control over groundwater abuse. The Central Ground Water Board (CGWB) was created as per the Supreme Court direction of December 1996 for the purpose of regulation and control in groundwater management and development. However, the powers vested with CGWB seem to be inadequate, and CGWB has not been able to deal with the sensitive issues of water effectively (Sekar, 2001).

While an absolute control on withdrawal of groundwater may not be desirable or practicable, there is an urgent need for putting control on the capacity and power of the privately owned groundwater pumps. Proper environment for groundwater marketing needs to be created to facilitate sharing of groundwater sources. An 'area approach' should be adopted for control and efforts should be made to reduce the total number of tube-wells in an area. Area-wise documentation of tube-well inventory, water extraction and water recharging should be carried out as tool for groundwater monitoring. In areas where at times recharging falls short of extraction, suitable controls should be exercised to regulate groundwater demand. In areas subjected to alarming levels of groundwater depletion, irrigation by groundwater should be banned for appropriate periods, till the situation gets normalised. Meaningful structural reforms needs to be brought about by enacting appropriate laws and suitably empowering regulating agencies. Reforms will be more effective if controls are decentralised and local level bodies (*Panchayats*, Municipalities etc.) are empowered with regulating powers. Imparting education to people about pitfalls[14] of groundwater misuse, and about necessities of regulation, need to precede enforcement of regulations.

Another aspect calling for structural reforms to improve demand-side management is the pollution of surface and ground water bodies. Sometimes though available in good measure, water with excessive pollution becomes unfit for drinking or even farming usage. A case in sight is that of Ahemedabad City, where water of Sabarmati River as well as groundwater are increasingly getting polluted by industrial toxic waste. Besides, domestic waste and farm waste (with high chemical contents of pesticides and insecticides) are also responsible for increasing pollution of the water sources. The

Environment Protection Act - 1986 empowers the Central Government to take expedient measures to protect and improve quality of environment, including that of water (NCIWRD, 1999). There are several other acts and regulations at central and state levels, to safeguard water bodies from disposal of toxic and hazardous wastes. Nevertheless, vast stretches of rivers, lakes and ponds, and also subsoil water are subjected to onerous levels of pollution today. There is an urgent need to educate people about their duties and rights on pollution related issues, and to strengthen regulatory institutions.

Demand for irrigation water is considerably affected by the farmer's choice of crops and cropping pattern. The choice of crops is largely influenced by the differential money available to the farmer, which in turn is governed by the pricing of farm inputs and outputs. With the highly subsidized energy charges[15] (diesel, as well as farm electricity charges) for groundwater, and abysmally low surface irrigation charges, water as an input-cost factor seldom influences the farmer's choice of crops. On the other hand, intervention in regulating the prices of other inputs and outputs, and the export-import restrictions by government plays vital role in influencing the crops and cropping pattern of the area. Many a time this leads to serious distortion in the cropping pattern, with water intensive crops becoming the prime choices of farmers. This affects the ground water table adversely, and in cases of surface irrigation schemes, deprives the tail end farmers even the minimum irrigation water. This problem has already taken serious proportion, and even new irrigation projects are being subjected to doubts on their promised irrigation potentials in light of the farmers' tendency to go for water-intensive and cash-rewarding crops like sugarcane. There is an urgent need to check distortion in cropping pattern by suitable policy initiatives in farm input and output pricing and export-import regulations.

Reform in the area of water pricing is probably the most crucial change needed for influencing irrigation water demand. Presently, irrigation water rates in most states are a trifle of the total farm input costs, and in a few cases, such as in Punjab, water comes to the farm free of cost. In some of the states the water charges are hidden as they are levied with land revenues, while in others they are levied per hectare basis, rather than on volumetric basis. Thus a large number of Indian farmers enjoy the benefits of irrigation from numerous water resources projects with scant regard for volumetric consumption. For sure, they draw more water from the irrigation systems than what is genuinely needed, thereby inflating irrigation demand considerably. There is an urgent need to correct the manner and magnitude of water pricing so as to bring an impact on irrigation demand. The charges for irrigation water should be levied on volumetric basis at the last government-controlled outlet. Logically the annual recovery made should cover a portion of capital investment and full portion of operation and maintenance (O&M) cost. But since irrigation projects in India are constructed and operated at very high costs - often on account of organisational inefficiencies - levying water prices on actual cost basis would be inappropriate and impracticable. In absence of a viable alternative to the farmer, this would mean loading cost-inefficiencies of the projects to the farm-input costs; thereby reducing farm's cost efficiency. So, instead of cost recovery aspect, the focus of irrigation pricing should be on creation of a deterrent level against overuse or misuse of water. One such way is to raise water prices to a level, where its impact per unit of the produce becomes comparable with cost impacts of other farm inputs, such as seeds, fertiliser etc. Since enhanced irrigation water prices will affect the competitiveness of farm-produce, it should be comparable with the tangible cost of pumped groundwater, and should be uniformly implemented across different states. A meaningful irrigation pricing reform (to check total irrigation water demand) can be accomplished only if subsidies on energy charges of groundwater pumping are also curtailed rationally.

Reform in the area of pricing of domestic and industrial water will also influence the total water demand. While there will be reduction in the wasteful consumption of water in domestic sector; in the industrial sector, this will encourage introduction of technologies for recycling of water. However, once again with the organizational inefficiencies of government controlled supply set-up, the water prices cannot be governed by economic factors alone. Further, with the increase in water prices, there is an increasing tendency for tampering of water meters and water thefts, which usually goes unchecked in the government set-up. Limited privatisation for distribution of domestic and industrial water will allow economic and market driven factors to govern water prices, which will improve the demand situation significantly.

3 ISSUES OF RIVER WATER RIGHTS AND INTERSTATE WATER SHARING CONFLICTS

In the recent past years, India has seen a number of river-water related conflicts among its states, but rarely any resolution at sight. With the already water stressed conditions in most parts of the country, these conflicts have aggravated the crisis by impeding construction of some of the otherwise viable water resources projects. The dominant water conflicts are amongst co-basin states of some of the major river systems in the country, thereby significantly denting the overall supply potential. Furthermore, the water sharing conflicts on existing projects have been a constant source of friction amongst many states of the country.

The attempts to resolve the inter-state conflicts so far have been through the route of judicial tribunals created by the Central Government. For deriving water allocations to states, the tribunals have generally not given large weighted consideration to the factor of water contribution by a state to the total river resource, though the factor forms the core of conflict in most of the cases. However, going by strict legal sense followed by Tribunals, the states not contributory to the river flow (and hence not a party to the conflict) were generally ignored, even if their genuine demands were to be technically met from the project. Thus, in absence of an adequate constitutional provision, the solution of a complex water crisis situation through the route of Tribunals has been somewhat restricted in approach and confined only to the artificial boundaries of states that (because of narrow perspective) have been the root cause of conflict itself.

Undoubtedly, India's failure to meaningfully resolve the numerous interstate water disputes has impeded implementation of some of its best mega projects. In the case of smaller projects, so far there has been not much of controversy on the issue of state river rights, though the situation is seemingly altering with people at many places insisting for greater control of water bodies at local levels. As is evident from recent events, such self-motivated people have started constructing check dams on small rivers and rivulets, with consequential effects on the gross inflow to the existing state owned reservoirs. The effects of such unregulated activities may lead to interregional conflicts; and when the accumulated effects of such activities start affecting feeder flow to the downstream reservoirs in neighbouring states, the situation is bound to cause interstate turmoil. Thus, the lack of will in evolving a national consensus on resolution of the pressing interstate water sharing issue, affects not only the ongoing projects and the projects on anvil, but also the future operation of many successfully completed projects.

3.1 Water Rights – Concept and Present Form

The dictionary meaning of the word 'right' (applicable to this discussion) implies 'moral or legal claim'. With this broad expression, and in absence of a constitutional or an established legal parlance, the definition of water rights may vary according to the context of the term. The typical three references for water rights relate to (i) right of ownership (solely or jointly) on a source of water, (ii) right on a quantum of water for use from a specified source of water, and (iii) a citizen's (civil) right to a fair quantum of water. These are described here under:

3.1.1 Right of Ownership on Source of Water

The individual or collective right of ownership on a source of water is derived from the right on (land) property, in which the source exists. These ownership rights are generally restricted to very small resources like wells, ponds or small lakes, and that too without establishing rights on the feeder or primary sources.

The primary water sources (rivers, groundwater reserves etc.) are public goods, on which neither individual's or community's rights can be established. In legal parlance, the running water, along with air, sea etc. are called the '*negative community*' (i.e. things, which remain in the ancient state of the negative community where things were common to all, belonged no more to one than to the others). Thus running water of a primary source (like stream) is not the subject of property and not susceptible to absolute individual ownership (i.e. regarded as *res communis* in law) (NWDT, 1978).

3.1.2 Right on a Quantum of Water for Use

The second and the most predominantly discussed water rights relate to the use of water from a specified source, recognizing the right to take and use water from the natural stream. These rights can be established on all water sources, including primary resources like rivers and ground reserves. As per these rights, when water taken from its natural stream, so much of the substance as is actually taken is captured, and, passing under private possession and control, becomes private property during the period of possession.

The right on quantum of water for use are also created only if the main source or its feeder component (fully or partly) is situated in the land owned by an individual or the collective entity. In case of larger resources, these rights can generally be established by collective entities only. In the present constitutional situation (where river water is a state subject), these rights for river water can be legally established at state levels only.

In the case of river water, the rights for use of water are governed by the following well-established doctrines (NWDT, 1978):

(a) *Doctrine of proprietary (sovereignty) rights:* This entitles the user sovereignty right on a particular volume of water on the basis of his (land's) contribution to the total available flow of the river.

(b) *Doctrine of riparian rights:* This entitles the users along the whole course of river, the water of the stream in its natural flow without sensible diminution in quantity or quality.

(c) *Doctrine of equitable apportionment:* The water in the river is considered a public (or common pool) good with equitable rights to all rightful users.

3.1.3 Citizen's Civil Rights to a Fair Quantum of Water

The third reference of water rights as alluded to above is most crucial today, giving rise to most of the water sharing conflicts; but is surprisingly the least discussed. The first two references of water rights imply existence of an inherent condition that the water source (fully or partly) lies within the limits of property owned by the collective entity. In the context of the water rights of states, absence of this inherent condition makes both types of water rights irrelevant. The implication of a different condition (where a state owns no part of the river resource) brings into focus the third reference for water rights; namely, the rights of citizen's (of such states) to a fair quantum of water.

Historically, water law has developed into two distinct types: firstly, limiting the right of water use to first users, or to all owners of adjacent land; and secondly, placing the disposition of water in hands of the Government or an administrative authority. Evidently, the second type of law helps to break the barrier of the river basin boundaries, for the equitable rights on use of water to all. However, in case of India, the administrative authority for water is at the state level (and not at the national level), thus limiting the applicability of this law within the state limits only which gives rise to inter-state water disputes. The citizen's water right, in context to whole nation, has not been considered a fundamental need so far.

3.2 Interstate Conflicts on Sharing of River Water

Mostly, the surface water resources projects are developed by impounding the river water in man-made reservoirs. The water to the project-reservoir is fed by the main river, which in turn gets its contribution from direct drainage area, and / or from a network of rivers forming part of a larger drainage basin system. Thus, the water utilised by a project is contributed by the project's catchment area, which is essentially a part of the larger river basin system that drains up to the project site. Often, the catchment areas of river valley projects extend beyond the boundaries of any one state. If not, in all probability the river basin (of which project's catchment area forms a part) will extend over multiple states. This is naturally so because states of India are not carved out along watershed lines; and practically all river basins - except few small ones - are spread over multiple states.

Most of India's attractive projects - from techno-economic considerations - are susceptible to interstate conflicts. Such projects are considerably large in scale, both in terms of reservoir impounding and the consequential irrigation, drinking or hydropower benefits, and huge investment. If the catchment areas of such projects extend beyond the boundaries of a single state, more than one state may stake claim –akin to *proprietary rights* - on project benefits. Even if the catchment area of a project is confined to one state (or more than one mutually agreeing states), a situation for interstate conflict may still arise because of the project affecting the *riparian rights* of a distant and lower basin state.

3.2.1 Present Mechanism for Resolution of Interstate River Disputes

There have been many instances of interstate water conflicts amongst erstwhile princely states or the now existing reconfigured states. As early as in 1956, Indian parliament enacted the Inter-State Water Disputes (ISWD) Act, for facilitation of early adjudication of such disputes (*ISWDA*, 1969).

The ISWD Act essentially provided for a mechanism for resolution of the river water dispute, between one state and another, by referring the dispute to a Tribunal for adjudication. Separate Tribunals, to be constituted by the Central Government for each disputed river basin, are to consist of a Chairman and two other members nominated by the Chief Justice of India from among persons who at the time of such nominations are Judges of the Supreme Court or of a High Court (Section 4. *ISWDA*). The Tribunals are to be given the same power as vested in a civil court under the Code of Civil Procedure 1908 (Section 9. *ISWDA*). The grounds of the dispute covered by the Act are stated as: situation arisen or likely to arise where interests of one state (or any of the inhabitants thereof) in the waters of an inter-state river or river valley have been, or likely to be, affected prejudicially by (i) any executive action or legislation taken or passed, or proposed to be taken or passed, by the other state; (ii) the failure of other state, or any authority therein, to exercise any of their powers with respect to the use, distribution, or control of such water; or (iii) the failure of the other state to implement the terms of any agreement relating to the use, distribution or control of such waters (Section 3. *ISWDA*).

The Act states that decision of the Tribunals (to be published in Official Gazette) shall be final and binding on the parties to the dispute, and shall be given effect by them. The Central Government may also establish any authority for the implementation of the decision of the Tribunal, if needed so (Section 6. *ISWDA*). The Act also states that neither the Supreme Court nor any other court shall have or exercise jurisdiction in respect of any water dispute that may be referred to a Tribunal under the Act. (Section 11. *ISWDA*).

3.2.2 Limitations of Water Dispute Tribunals

The ISWD Act barred the jurisdiction of court in the matter of river water dispute and it became mandatory for the states to settle the dispute through Tribunals, if not settled by mutual negotiations. Following the enactment of the Act, the Central Government has constituted Tribunals for resolution of interstate water disputes in case of five major river basin systems, namely (i) Krishna, (ii) Godavari, (iii) Narmada, (iv) Cauvery, and (v) Ravi-Beas rivers of Indus basin system.

The ISWD Act was intended to bar the intervention by courts and to resolve complex river disputes with a holistic view. However, these objectives were not fully achieved. In the case of Cauvery dispute, the Central Government could set up the Tribunal - four years after the request was made by Tamil Nadu - only on the direction of the Supreme Court. Even interim orders of the Tribunal generated further disputes, resulting in re-intervention by the Court. Even after 12 years of its constitution, the Cauvery Tribunal is still engulfed with tasks of interim solutions, rather than in resolution of the basic conflict itself. In the case of Ravi-Beas river dispute also, the route of dispute resolution by Tribunals seems to have lost relevance as the matter lies with Supreme Court for a final judgement on the fate of Sutlej-Yamuna-Link Canal. There are quite a few issues of dispute still alive and also sporadic instances of conflict amongst riparian states of the Krishna and Godavari rivers. In the case of river Narmada, even after a lapse of two decades since declaration of the final award of NWDT (Narmada Water Disputes Tribunal), the Award and the fate of the mega Sardar Sarovar Project has been discussed in courts umpteen number of times.

Obviously, the attempts to resolve interstate conflicts under the present provisions of ISWD Act have not given satisfactory results. Another limitation of the judicial tribunals formed under ISWD Act – for which tribunals in themselves cannot be faulted - related to the absolute focus given by tribunals to the state's rights on a quantum of water for use from the disputed river source, sidelining the larger issue of every citizen's (civil) right to a fair quantum of water. Thus possibilities for development of full potential of river resources for overall benefit of the country have been ignored. The Tribunals, in right earnest, did not give cognisance to the absolute *proprietary rights* or the *riparian rights* (on river water) of disputing states, and have instead tried to evolve sharing formulas based on the *doctrine of equitable apportionment*. However the Tribunals totally ignored the states not having *riparian rights* on the disputed rivers (and hence not being a party to the conflict), even if their genuine demands were to be technically met from such river valley projects.

In absence of a comprehensive constitutional provision for water rights, the *riparian rights* - as seen by the Tribunals - meant rights on the water of a stream, to people owning land along the stream. Since constitutionally the rights on rivers could be established only by the states, this was translated as the *riparian rights* of states, thereby meaning all people of the states irrespective of the distance of their land from the disputed river. However, in Tribunal's legal sense, this generosity in interpretation of *riparian rights* could not be extended to involve people of non-riparian states, even if they were to be geographically nearer to the disputed river. Thus, the manmade boundaries (of states) not only created the premises for the problem (interstate disputes) but also ensured confinement of solutions to the narrowest limits.

4 IMPEDIMENTS AT CONSTRUCTION STAGES OF THE PROJECT

From the conceptualisation stage, the water resource projects take a very long time to reach the implementation stage; and this time may range from (a minimum of) one decade to many decades even in case of projects of moderate proportions. Apart from the time needed for surveys, investigations and preparation of Detailed Project Report (DPR), the reasons for slow progress in reaching the implementation stage are many; crucial ones being (i) the interstate river conflicts, and slow pace of dispute resolution through mutual agreements, or through the route of Tribunals; (ii) local level political interferences intending to effect alterations in the scope of project; (iii) long process of Techno-economic clearance by Planning Commission, and clearances from the Ministry of Environment and Forest, and the Ministry of Social Justice and Empowerment.

Even after passing through the slow conceptualisation (and also evolutionary) process during which the shape and scope of project undergoes numerous changes, the projects are rarely able to sail through the well-defined construction stage without facing towering hindrances. This happens despite India's long history[16] of water resource project development and its vast and varied experience in project construction. Notwithstanding India's technical competency in project construction, the impeding challenges faced by the project during construction stage are severe and highly complex today; and most often result in immense delays, atrocious alteration in project scope, and sometimes abandonment of the project itself.

4.1 Project Opponents

The most serious and relentless challenges faced by a project under construction come from the diehard opponents of the water resource projects. Unlike the case elsewhere, opponents of projects in India are seldom seen interested in the projects during its conceptualisation phase, and apparently mobilize their activities only after its commencement. This anomaly in the behaviour of project opponents may be arising because of fact that most of the projects under construction today were introduced decades ago, when opponents were hardly an organized entity. This may also be because of opponents' reluctance to counter initial enthusiasm and reaction of the masses towards projects when they are envisioned and announced from the highest political platforms of the country (as is being seen in case of recent launching of the river-interlinking project scheme). This pro-project enthusiasm generally gets over by the time project reaches the construction stage, paving the way for the opponents to occupy the central spot[17].

Today in India, the prevalent opinion is that large-scale water resource projects are inevitable considering the demand for food, water and energy for the ever-increasing population[18] of the country. Countering this general view, the opponents of the project carry the view that assumed benefits of the projects cannot outweigh its social and environmental costs. Expectedly, they often cite the cases of past projects that failed in delivering the envisaged benefits (i.e. promised targets of irrigation, drinking water, or hydropower). They also cite the fate of displaced people of early projects about whom records are rarely available with government machineries for authentic verification. And, the main thrust is given to the citing of environmental fall-off (e.g. damage to flora and fauna, water logging in command areas etc.) of such projects. The opponents give umpteen reasons to oppose the project; the most common being (a) uprooting and displacement of people - especially the indigenous and tribal population - that constitutes the poorer and weaker sections of the society; (b) exorbitant and spiralling cost of projects; (c) projects becoming source of corruption and means of siphoning money by corporate, bureaucrat and political clouts; (d) thinning of resources for other (more important) schemes like local water conservation and watershed development; (e) loss of forest cover and possibility of extinction of rare species of flora and fauna; (f) damage to river morphology and riverine ecology; (g) possibility of triggering tectonic activities; etc. Broadly, such issues can be divided into two categories; namely, social and environmental.

4.1.1 Social Issues Raised by Project Opponents

Anti-dam agitations by the project-displaced people have impeded the progress of many important projects in India, though so far such agitations have not succeeded in completely halting a project. Perhaps, this is because of the dominant feeling – amongst governments, media, judiciary and common people - that someone has to pay the price of development. Nevertheless, these agitations have created an atmosphere that is now more receptive to humane issues of displaced people. More importantly, it has allowed and empowered the indigenous populace (generally tribal, and poor) to speak-out and make their voices heard. The ambitious projects that were initiated even without a thought about this meek segment are now facing stiff resistance from them. Often, their cause has been taken up by the judiciary; resulting in in-depth and independent probing of issues of their resettlement and rehabilitation. Also, a resettlement and rehabilitation policy has come in place at the central level, while many of the states are formulating resettlement and rehabilitation policies of their own. Understandably, all of this has resulted in an increase in the proportionate cost of rehabilitation works by many folds.

Though official figures are not available, it is generally indicated that 14 to 22 million people might have been displaced by projects since 1950, and only 25% of them might have been resettled and rehabilitated (CSE, 2002). Indicated as ranking fifth in the world on this count, India has for long ignored the issue of displacement as a consequential factor for viability assessment of the projects. In most cases, it is the innocent tribal populace of hilly tracts who endure the worst project effects. The impact of displacement is severe on these tribal populations not only because they have to leave the land, river, and forests on which their livelihood intricately depended, but also owing to the fact that they have neither skills nor any knowledge of surviving in today's market driven society. Generally, being thinly populated and isolated from the mainstream society, they do not appear as political priority groups, and hence rarely ever get political support. In absence of a compassionate and professionally managed rehabilitation policy, upheaval from native environment leads to further dispersion and fragmentation of their fragile groups.

A very large proportion of people getting displaced are that of farmers; and the most common problem associated with their rehabilitation is related to not getting new land satisfactory to their needs. If not adequately compensated with land - which is the only source of their livelihood - they move on to cities in search of alternate employments. The construction of mega projects often requires relocation of a large number of such people at the same time. In a densely populated country like ours, most of the arable land is already occupied, and finding new land for displaced people becomes almost impossible. Compared to their lost rich riverine lands, less fertile land made available from government reserves are often rejected by the project oustees. The available alternative is to purchase quality land from private market, but being very expensive such a move can risk the project economics itself. Also, buying large-scale private land for rehabilitation presents a threat of secondary displacement, raising another social issue. The land related limitation thus often forces the rehabilitation to spread over wide areas, dispersing the closely held communities and families. With the existing population pressures in host villages, the government-facilitated entry of project oustees is also often seen as an encroachment on the limited sharable resources like pastureland, water sources, and even temples, graveyards etc. This also leads to complex social issues with new dimensions.

The opponents on one hand focus on project's submergence areas by raising the cause of oustees; on the other hand they also seek to oppose the project in command areas by raising a different set of social issues. The most commonly raised issue pertains to neglecting of locally viable schemes for conservation and augmentation of water. The argument often goes on to suggest that even with a fraction of the resources diverted for larger projects, the water harvesting schemes at local levels can lead to much better results. They allege that large projects are taken up, not because of sound technical or economic reasons, but because of huge financial involvements triggering bureaucratic corruption and business - political collusions. Though not as successful as in areas of project submergence, yet some times project opponents trigger anti-project sentiments in command areas as well, specially in the tail-end areas where promised benefits are often viewed doubtfully. The allegations by project opponents also put the project machinery on guard; often forcing them to evolve more transparent ways of project execution.

4.1.2 Environmental Issues Raised by Project Opponents

The most fervently raised issue on environmental front pertains to submergence of large forest cover by projects. The issue naturally carries merit because of acute imbalance in the present forest cover that stands barely at 12% (for dense forests) of country's total land area, which is considerably less than the desired 33% level (CSE, 2002).

Since the water resource projects are mostly built across river valleys and involve impounding of water across vast stretches of riverbed and valley slope, they invariably submerge some tracts of forest covers. Depending upon the exploitation of forest reserves in the past, and the present population density of such areas, the quality of such forests may differ from project to project, varying from extremes of dense forests to that of highly degraded forests; later being the most commonly encountered situation. The pristine and untouched forests - supposedly very rich and valuable in terms of biodiversities - are rarely ever encountered in today's projects, as they probably account for less than 3.5% of country's total land area (CSE, 2002). However, wherever such situation has arisen in the past, as seen in the case of Silent Valley, Bodhghat or Bedthi projects, the environmentally active opponents have been largely successful in halting the projects. Though, India has already lost 99% of its natural (original) frontier forests, and the remaining is under threat from factors like natural pests and timber smugglers; the water resource projects are rarely ever sighted as significant factor for India's (natural) forest cover decline. On the other hand, India's plantation forest cover has been increasing (3.18 million hectare in 1980 to 18.90 million hectare in 1990 (CSE, 2002), for which compensatory afforestation programs of water resource projects are responsible to a certain extent.

The case for preservation of forests is directly linked with the cause of flora and fauna, especially those that are threatened with the possibility of extinction. The World Conservation Union has registered 11,046 species threatened with extinction, of which 5,611 are plants, and 5,435 are animals; in the animal kingdom alone, 12% of threatened animals are birds, while 24% are mammals. In the list of countries with greatest number of threatened species, India stands fifth with 459 (mostly plants) threatened species (Allem, 2002). The threat to these species has come from all form of human development, including water resource projects. However, in most cases of development – such as expansion of farming, spread of human habitat, industrial growth, network of roads and railways etc. - the damage caused to the flora and fauna is apparently not considered alarming. But, in case of water resource projects the same issue is viewed alarmingly because of (i) concentration and scale of works involved, (ii) mandatory impact assessment studies, (iii) involvement of the state machinery, and (iv) excessive media attention. Evidently, the very same reasons also ensure remedial measures that minimize the damage of projects to the flora and fauna.

Another environmental issue relates to the heavy abstraction of freshwater for irrigation and other uses that leaves practically no water for ecological preservation[19]. Apart from the cause of dried-up downstream stretches, some environmentalists also consider dams as hazardous to river ecology[20]. Manmade reservoirs are considered as creating new biotopes, transforming the ecosystem in a manner somewhat different from lakes or rivers. Many believe that when trees and other ground vegetation drown because of dam, most of the species of insects and birds disappear from the area (Uttangi, 2002). Often, opponents also cite the case of dense vegetation not getting removed before commencement of submergence, leading to rotting of large-scale organic material causing environmental problem. The resulting decomposition releases hydrogen sulphide, which makes water acidic causing disappearance of fish from the area. Besides, the reservoir formation is also often associated with occurrences of diseases like malaria, schistosomiasis etc.

4.2 Cost Escalation and Issues of Project Finances

Though the opponents may influence all (large, medium, or small) projects in future, their influence till now has been confined to mega projects only. However, a much more critical factor of influence for all types of projects – with significant bearing on past, present as well as future projects - is the issue of project's spiralling capital cost and its inability to bridge the ever widening fund-gap.

Often, initiated with greatest fanfare, activities in most of the projects peak up in their initial years of construction, but gradually decline, and finally come to naught just before reaching ultimate milestones. Despite needing only a small proportion of funding in completion stages – in comparison with the present value of spent up costs - most of these projects move onto their lowest gears a few notches below the finishing point, and stagnate there for too long; thereby snowballing the fund-gap into mammoth proportions. Thus, the otherwise viable and attractive projects fall in the deep traps of spiralling project costs, from where only a few are able to raise their heads.

Data contained in table 3.5 illustrates that out of 292 major projects taken up till the end of eighth-plan, only 130 projects (less than 45%) could be completed. And, the spillover cost of remaining 162 projects - estimated to be over Rs. 1,36,133 crore at the 1996-97 price level (NCIWRD, 1999) – is overwhelming.

Table 3.5: Projects Taken-up and Completed During Eight five-year-plan Periods

Five Year Plans	Major Projects (Cumulative)			Medium Projects (Cumulative)		
	Taken	**Finished**	**Unfinished**	**Taken**	**Finished**	**Unfinished**
First Plan (1951-56)	44	5	39	169	35	134
Second Plan (1956-61)	77	25	52	271	131	140
Third Plan (1961-66)	109	35	74	315	181	134
Annual Plan (1966-69)	130	40	90	345	226	119
Fourth Plan (1969-74)	152	55	97	418	288	130
Fifth Plan (1974-78)	222	61	161	718	354	364
Annual Plans (1978-80)	235	63	172	770	371	399
Sixth Plan (1980-85)	265	95	170	861	519	342
Seventh Plan (1985-90)	277	111	166	894	655	239
Annual Plans (1990-92)	288	130	158	894	668	226
Eighth Plan (1992-97)	**292**	**130**	**162**	**944**	**698**	**246**

(Source: NCIWRD, 1999, Table 10.1, P.259)

Practically, all of the ongoing major and medium projects in India are suffering from grave financial crisis because of manifold jumps in the estimated costs of construction. Apart from varying reasons like technical deviations, unforeseen natural mishaps, change in forex-rate, contractual complications, etc; the major common reason for the sharp increase in costs has been the factor of price escalation linked with project's time overrun. Ironically, barring a few projects that have been delayed for reasons beyond the control of project authorities, all of them have been delayed for want of sufficient and timely funding.

4.2.1 <u>The Flaw in Original Cost Estimations</u>

The cost estimates of project are initially prepared on the basis of prices prevailing on a specified year, often the financial year of estimate preparation or the previous year. Although, the planned construction activities of water resource projects span over long durations (say, 10 years in case of medium projects, to 15 or 20 years in case of mega projects), yet the cost estimates of all activities are prepared for the same specified price level. Thus, even definite factors of price escalation - matching with planned activities - are ignored in original project estimate; leading to gross underestimation of project costs.

Understandably, with the high inflation rates prevalent in the past – and with prices of project components nearly doubling up every 5 or 6 years - the manifold jump in the capital cost of a completed project could not be termed unusual. For example, with an annual inflation rate of 12% - frequently encountered in past projects - a project with 10year construction period with uniformly spread out expenditure would get subjected to a cumulative escalation of about 75.49%, provided the project gets completed in the stipulated 10 years period. In similar ways, the annual inflation rate of 12% can cause project costs of the 15year and 20year projects to escalate by about 148.53% and 260.26%. Even the impact of relatively lower annual inflation rates of 10% and 8% would be substantially high as brought out in the Table 3.6.

Table 3.6: Impact of Price Escalation on the Final Project Cost

Rate of annual inflation (Percentage)	Planned duration of project completion (Years)	Total escalation on the original cost estimate (%)
12%	10 years	75.49%
	15 years	148.53%
	20 years	260.26%
10%	10 years	59.37%
	15 years	111.82%
	20 years	186.37%
8%	10 years	44.87%
	15 years	81.01%
	20 years	128.81%

(Detailed computations are given in Annexure –I).

The original project estimates are generally prepared with minute details and are subjected to stringent scrutiny, as they form the basis for projects' economic viability studies and clearances. Despite this, the amply evident flaw on account of annual price escalation has continued to exist in the original estimates, and also in subsequent revised estimates, for three reasons. Firstly, the inflation rates in India have been highly dynamic, and hence their future values can be nothing but assumptions with possibilities of their going far-off the mark. The unreliable factor of price escalation is thus ignored in the otherwise concrete exercise; and the correction for the omission is apparently sought by (frequent) closely spaced revisions. Secondly, the projects being taken up by the state governments are only subjected to economic viability analysis on the lines of benefit-cost ratio studies, and the original estimates are prepared to suit this intent only. Since the benefits are deemed to be subjected to same inflations as the costs, the factor of price inflation is considered irrelevant in the analysis and estimates, and hence ignored. Thirdly, the projects - mostly envisaged to be financed through annual budgets of state governments - are generally not subjected to lining-up (or tiding) of the financial resources. Since the project finances are planned to be met on year-to-year basis, the reliable and exact knowledge of full project cost in the beginning is not considered as essential.

4.2.2 Excessive Delays in Projects Completion

For a plethora of reasons, projects slip in meeting the target dates of completion. In most cases slippages get introduced right from beginning of the construction stage and keeps on accumulating as project activities move forward. In some cases, despite starting smoothly the projects come across stumbling blocks midway or just before the final destination.

The reasons for slippage in the initial years are mostly on account of delay associated with various mandatory clearances, such as techno-economic clearance from planning commission, clearances from ministry of environment and forests, and that of ministry of social justice and empowerment. Sometimes, delays also occur in lining-up the main contractors due to interferences brought about by influential players. With the commencement of construction phase, the delays in project completion may come on account of (i) technical reasons: such as shortfall or delayed mobilisation of resources (men, material and machine), delays in submission of drawings or clearing of work sites, encountering of tougher geological settings than expected, failure of contractor in delivering desired progress, or contractual litigations etc.; (ii) outside interruptions: such as stay orders by judicial courts, non-clearance or hindering-directions by any empowered agency (e.g. labour welfare officer, forest department, railways, explosives controller, dam safety panel, etc.), intense social or environment related agitation, mounting of public opinion against project, etc.; and (iii) the financial crunch leading to non-payment of bills to contractors and suppliers, resulting in delays or total stoppage of works.

Irrespective of associated reasons all delays cause sharp escalation in the project costs; and the extent of escalation is intricately linked with timing of the delays. If delays get introduced in the early stages of project construction, the cost escalation factor is very high. On the other hand the cost escalation is relatively low when delays are encountered in the final years of project construction. For example, assuming 10% inflation rate on a project with a 10year construction period, a two-year slippage in the beginning of project construction can cause an extra jump of 33% in the original cost estimate over-and-above price escalation factor. Similarly, if the cumulative two-year slippage is uniformly spread over total construction period, it will cause an impact of about 19%. But, if the same two-year slippage is encountered just before the final year of construction, its impact on total cost escalation will be about 5% only. In reality, the delays encountered are of much more prolonged durations and thus ensuing impact on the final project costs - for the portrayed three conditions - are summarised in the Table 3.7.

Table 3.7: Impact of Construction Delays on the Final Project Cost

Delays in 10-year planned project	**Timing of the delays**	**Cost escalation on completed project with 10% annual inflation rate**	
		Total	**Attributable to factor of delays**
Nil	----	59.37%	---
2 years	On project commencement	92.84%	33.47%
	Uniformly spread over total construction period	78 20%	18.83%
	At the end of the planned construction period	64.33%	04.96%
4 years	On project commencement	133.34%	73.97%
	Uniformly spread over total construction period	99.82%	40.45%
	At the end of the planned construction period	70 32%	10.95%
6 years	On project commencement	182.34%	122 97%
	Uniformly spread over total construction period	124 69%	65.32%
	At the end of the planned construction period	77.57%	18.20%
8 years	On project commencement	241.63%	182.26%
	Uniformly spread over total construction period	153.33%	93 96%
	At the end of the planned construction period	86.34%	26.97%
10 years	On project commencement	313.38%	254.01%
	Uniformly spread over total construction period	186.37%	127.00%
	At the end of the planned construction period	96.95%	37.58%

(Detailed computations are given in Annexure –II).

4.2.3 Failure of Timely Bridging the Fund Gap

Irrespective of the nature and cause of delay, the project's inability to bridge this ever-rising fund-gap becomes the ultimate cause of project failure. Understandably, most of the present languishing projects have come to such a pass because of the failure of management to bridge the funding-gap at early stages of the project. Since these projects are essentially state financed, the blame for their funding crisis necessarily lies on the shoulders of central and state governments.

The reasons for the inability of the union and state governments to bridge the gaps between promised and delivered funding, are two-folds. One, steep decline in the plan allocation for water resource projects, with share of major and medium irrigation projects in the overall plan funding falling from 19.20% in the first-plan (1951-56) to 4.18% in the eighth-plan (1992-97) as brought out in Table 3.8. And two, steep rise in the number of projects undertaken, resulting in thinly spread of the limited resources.

Table 3.8: Plan-wise Expenditure on Irrigation as Percentage of All Sectors

Sl. No.	Plan period	Major /medium irrigation as percentage of all sectors	Total irrigation as percentage of all sectors
1	First Plan (1951-56)	19.20	22.54
2	Second Plan (1956-61)	8.13	11.59
3	Third Plan (1961-66)	6.72	11.86
4	Annual Plans (1966-69)	6.49	14.88
5	Fourth Plan (1969-74)	7.87	15.27
6	Fifth Plan (1974-78)	8.78	14.27
7	Annual Plans (1978-80)	9.06	14.25
8	Sixth Plan (1980-85)	6.74	10.55
9	Seventh Plan (1985-90)	5.08	8.57
10	Annual Plans (1990-92)	4.00	7.39
11	Eighth Plan (1992-97)	4.18	6.69

(*Source: CWC, 1996*)

The inability of our nation to bridge the fund-gap timely has become the single most important reasons for dismal financial performance of all projects. This fact can be appreciated better by looking at the grave financial situation of the 162 ongoing major projects. Against their balance estimated cost of Rs.1,36,133 crore, at the beginning of the Ninth Five Year Plan (1997-2002), the provision made in the plan outlay has been only Rs.42,974 crore (NCIWRD, 1999). With this meagre outlay applied on the total cluster of ongoing projects, only about 31.57% of their outstanding works can be completed. For the uncompleted projects, if we apply price escalation factor during the plan period of Ninth Plan, the resulting financing-gap at the end of Ninth Plan could be Rs.1,59,606 crore, Rs.1,46,840 crore, or Rs.1,34,785 crore depending upon the price escalation rate of 12%, 10% or 8% respectively (Table 3.9). Thus, at the end of Ninth Plan, the estimated cost of outstanding works of the ongoing major projects would be nearly same, or more than that encountered at the beginning of the plan period.

Table 3.9: Impact of Funding Gap on the Balance Project Cost

Assumed annual price escalation	Cost of balance works at the beginning of 9th plan (Rs. Crore)	Expenditure envisaged in 9th Plan (Rs. Crore)	Projected cost of balance work at the end of 9th plan (Rs. Crore)
12%	1,36,133	42,974	1,59,606.46
10%	1,36,133	42,974	1,46,840.21
8%	1,36,133	42,974	1,34,785.18

(Detailed computations are given in Annexure –III).

Despite insufficiency of funds, large number of projects have been taken up ostensibly to encounter the acute water crisis; a reflection of our tendency to meet the crisis by supply side solutions alone. The recently started projects and future projects – including those for river interlinking - are also prone to similar fate.

4.2.4 Excessive Overhead-costs of Projects

Post independence, most of the state governments in India took up the task of water resource development through major projects as an exercise in perpetuity. With this endeavour, they not only recruited a large technical workforce and matching non-technical and support personnel; but also created permanent establishments of rather generous proportions, involving office premises, staff quarters, guesthouses, transports, communication facilities, etc. Manpower recruitment was often done to match the assumed peak work-quantum, and establishment was also created accordingly. But, most of the workforce and the corresponding establishment liabilities have outlived the peak-period requirements by several years resulting in huge overhead-costs to the projects.

In the initial years of planned development, the Central Waterways Irrigation and Navigation Commission (CWINC) and its later version of Central Water and Power Commission (CWPC) was the sole agency involved in investigation, planning, and design of water resource projects spread all over India. Though, this central agency (now called Central Water Commission) has continued to exist with sufficient strength and expertise, yet many of the states created separate investigation and design organizations to support their own upcoming projects. Huge amounts were spent on these organizations for manpower recruitment, training, and establishments; and all such costs were levied to projects. Although investigation and most of the design works gets over at the early stages of project construction, yet surplus manpower and facilities have continued to exist long after project completions. With the failure of most state governments to curtail or redeploy such surplus capacities, the projects have incurred huge recurring overhead-costs besides incurring the high capital investment.

Often creation of infrastructure facilities and preliminary works (e.g. dam-foundation excavation, slope stabilization, core drilling, drift tunnelling, etc) get started even before formal project clearances. These works are generally done departmentally or through small time contractors; and the required machineries and ancillary equipments are procured at project costs. Such works continue for short durations - till lining up of main contractors - and thus utilities of expensive machineries come to naught much before expiry of their depreciable periods. Often, the sufficiently equipped main contractors avoid hiring of such machines because of their high rental charges worked out on the basis of depreciated values of the relatively new machines. Despite such situations, the salvaging option - though most logical – is also not considered because of apprehensions of audit objection. Instead, the new machines are put to irrelevant and uneconomic uses incurring further operations and maintenance (O&M) costs, or abandoned to rust in yards.

If the above stated cost components were to be of one-time nature only, these would not have caused any serious dent on the overall project cost because the fact that initial costs get minuscule in relation to the long-term costs under inflationary pressure. However, in most cases of such cost components - manpower, vehicles, office premises, guesthouses, transit camps, office automation, communication equipment, heavy-duty machineries, etc – they have recurring cost elements that are subjected to inflation as well. Evidently, in almost all cases of the languishing projects of today, the limited annual budgetary allocations given by state governments have been going in financing these unwarranted overhead-cost components only; and practically no part of the funding is getting utilised for the actual project progress.

5 POST CONSTRUCTION ISSUES AND DILEMMA OF PROJECT OPERATION

Water resource projects in India are not only daunting to construct, but also highly complicated in terms of their day-to-day operations. Large rainfall variations in the catchment areas cause changes in the inflow patterns of a project reservoir, thus affecting inconsistency in project's capacity to deliver results. This factor - often a cause of grave dilemma in project operations - is understandably beyond human control. More germane to the discussion are the social aspects of water supply, and the precarious financial situation of the projects.

5.1 Conflicts on Benefit Sharing

Benefits of a typical major water resource project extend over many thousand hectares of area, bringing notable impact on the lives of millions of people. The large number of beneficiary people represent several user groups, which can be classified on the lines of geographical and social segmentation, or sectors of water allocation and uses. Understandably, these user groups have common causes – such as punctuality, sufficiency, quality and tariff of water supplies – and may unite at times to bring intense pressure on the project management. At the same time, these groups also conflict with each other and bring extremely diverse influences on project management.

5.1.1 Geographical and Social Segments of Users

The geographical segmentation of water users is easy to comprehend because of the vast geographical spread of project's command. The number and classes of these user segments depend on the network design of the project's canal and distribution system. A project may have separate main-canals to cover distinct regions (e.g. different banks of the river), or to cover low-level and high-level areas; thus affecting first tier of division. The users of each main-canal system get further divided on the lines of branches taking off from the main-canals. The user group of each branch canal system will have many more sub-sub groups depending upon further distribution pattern of the canal network. Some projects - in order to economise on the cost of construction - build single mega-size main-canal from which numerous large branches take off on one side or either sides; and in this case branch canals constitute the first tier of division.

The numerous water users based on geographical spread of canal network are prone to intense conflicts, especially in times of water scarcity. Though, the conflicts among users of different main-canals are not uncommon, the major conflicts arise amongst beneficiaries of the same main-canal or branch-canal system. This conflict is essentially on the lines of upper-reach (initial) and lower-reach (tail end) user groups of the same canal system. With the view of judicious and equitable supply to all users, some form of control and regulation mechanism is always envisaged in the projects; but they often fail to serve the intended purpose. Because of the open canal system, the water intended for exclusive use of lower-reach groups conspicuously passes through the territories of upper-reach users. In case the upper-reach users' water demand is not satisfactorily met, they exert enormous pressure on the project management to fulfil their demands first. At times, they also tamper with the canal flows - by illegally operating gates, creating canal breaches, or pumping out water from canals - to the prejudice of tail-end users. Because of above reasons, barring few exceptions, in all cases of water resource projects the impact of scarcity falls more on the lower reach user groups.

Often divided along caste lines the rural India is not cohesive, creating social segments of water users. The historical and deep-rooted enmity on caste lines comes into play in the rotational distribution of water amongst villages, and also amongst individual farmers. Understandably, the caste based hostility and the resulting water conflict gets heightened at times of water scarcity. In some regions such social segmentation and imbalance at grass-root level of users builds up to mammoth proportions with political overtones, causing immense strains in project operations.

5.1.2 Sectors of Water Allocation and Uses

Practically, all major water resource projects are constructed with the intent of deriving multiple benefits. The most common of these benefits are irrigation, drinking water, hydropower, flood control, and the regulated releases for downstream uses or projects. Generally, the allocation of reservoir capacities and water uses for above benefit-sectors are made at the planning and design stage itself. However, because of the allocation interdependencies and the operational overlapping the collisions of sectoral interests are frequently encountered.

The most commonly visible sectoral conflict in recent times has been between irrigation usage and drinking water usage. Evidently, the canal water is also used by farmers to meet their drinking and domestic needs apart from meeting needs of irrigation and cattle breeding; but the 'drinking water' term is in essence applied for the exclusive drinking and domestic use of water by urban areas (i.e. small and big towns, and cities). The sanitation water needs and common municipal needs cannot be segregated from the water supplies to the towns and cities, and hence are generally covered by the broad 'drinking water' term. Thus the irrigation usage and drinking water usage conflict is essentially a conflict between the rural areas and urban areas. In times of scarcity, the urban masses impart immense pressures on project management to stop irrigation water. Often the pressures are exerted fearing an impending drought situation - rather than the actual one - forcing project management to conserve reservoir water by cutting down irrigation supplies. On the other hand, seeing their crops wilting away under reduced or no water supply situation, the farmers agitate and clash with project management demanding release of water. With passions and tempers running high on both ends - as often seen in parts of Gujarat - the operation of projects becomes a frightening task for management.

Often, the hydropower generation is seen as a by-product of the water supplies for irrigation and drinking; and hence a clash of interest between power generation and water supply is deemed not to exist. But, the real situation is never as simple as stated. Since the limited water drawn into canals of the project can accommodate only small capacity powerhouses, the main powerhouses are mostly built separately so as to draw large quantum of water for running the turbines. The water drawn by such main powerhouses is lead back to the river at a downstream point, thereby depleting a part of reservoir storage. The operations of such powerhouses may be put to the advantage of downstream-regulated releases, but are likely to clash with the normal water supply operations of the project. Again, the conflicts become pricklier during impending or real situations of water scarcity, when on one hand the power generation is stopped so as to preserve the reservoir storage for irrigation and drinking water usages; and on the other hand, the demand for power shoots up mainly because of the farmers resorting to heavy groundwater pumping to bridge their unmet irrigation requirements.

The flood control function of a project reservoir is somewhat complementary to its other functions. For the best performance of its regular functions of irrigation, drinking water supply, power generation, regulated downstream releases, etc, the project reservoirs should be kept filled up to the highest possible levels. Conversely, for best flood control performance, the project reservoirs should remain at lowest possible levels so as to provide maximum flood cushion. Generally the project reservoirs have a well-demarked flood cushioning space (between the full reservoir level and the maximum water level) that is not encroached by the normal storages. Apart from this, the project management is required to create extra flood cushion by timely depletion of reservoir before the flood;

instructions for which are spelt out in the reservoir operation manuals of every completed project. However, because of the extreme pressures brought out by different user groups, the project management is generally apprehensive about letting out their precious storages, and prefer to gamble on the likely flood situations. With this tendency, some times projects fail in performing flood protection functions of the intended scale causing havoc[21] in the downstream areas.

Except for the tail-end projects, all other projects on a river also perform the tasks of regulated releases to downstream projects. Even in case of tail-end projects, the regulated releases are required to meet the downstream requirements of stretches extending up to the river-mouth. The downstream releases are generally the first casualty of scarcity conditions, and often the cause of intense conflicts, especially if downstream releases are needed by the projects falling in another state. Having tapped almost full potentials of many rivers, this situation is frequently being encountered in India; and is a cause of continuous friction between many of its states. The well-publicised conflict between Karnataka and Tamil Nadu, on river Cauvery, is one of many such cases.

5.2 Defective and deficient financial framework

The water resource projects in India are not only constructed with states' budgetary financing; but when completed, their operation and maintenance is also carried out with the same budgetary funding. Thus, the money needed for operation and maintenance of the project is drawn from the state's common pool (i.e. state treasury) on annual basis, while the revenues from the projects are also passed on to the same common pool. The revenue generating capacity of the state puts constraints on allocation of funds in sufficient amount and in proper time.

5.2.1 Insufficient Allocations for Operation and Maintenance of Projects

The states' budget allocations are made by dividing a limited pie among various core sectors of allocation (often represented by separate ministries), with water resource sector - often narrowly termed as irrigation sector - being one of them. The total allocation as well as its proportions to various sectors varies from year to year depending upon states' monetary situation and priorities of the then governments. Unfortunately, exempting few instances, the allocations to the water resource sector has been declining steadily over past many years in almost all states.

The paltry allocation made to the water resource sector is split-up amongst its numerous ongoing and operational projects in proportion to their planned estimated expenditures. The ongoing projects –especially prestigious ones - get the lion's share while the balance gets divided amongst operational projects. Since in many cases of the operational projects the tail-end canal networks remaining incomplete, the sizeable portion of fund gets earmarked for further construction activities. Thus, the allocation for operational and maintenance requirements of such projects turns out to be grossly inadequate; and the question of allocating funds for improvements, enhancements or strengthening measures – so as to match the growing demands - obviously becomes redundant.

5.2.2 Systematic Flaw in the Financial Set-up

In the states' budgetary allocation system the correlation between a project's revenue, and project's expenditure, never gets factored in the financial management of the project. The adopted practise thus does not allow for creation of profit margins for project by implementation of universal routes of increasing revenues, or reducing operational expenditures, or both. This situation also forbids application of even the basic financial wisdom needed for survival of any going-on concern; namely, the concept of breakeven-cost for recovery of at least the variable-cost component of the project.

If actual financial analyses of completed projects were to be done, the financial returns would be negative in all cases of water resource projects. Even then operational projects are continued and new projects are also taken up, ostensibly on the assumption of positive economic returns from the projects. Avenues and possibilities of improving the financial situations of projects get circumvented because of the prevalent financial system, which evidently hides the gap between revenue and expenditure of the project. In an indirect way, it also fillips the widening of gap by (i) inducing financial inefficiency leading to the enhancement of project expenditure, and (ii) politically motivated encouragement to low water tariff resulting in the reduction of project revenues.

In general the operational projects are almost always fund starved. Besides, in absence of a yardstick for financial performances, even the limited funds made available to them are often put to blatant misuses or inefficient uses. This leads to increase in working expenses without tangible improvements in the operational and maintenance aspects of the projects. Certainly, reduction in expenses - by modernization of the operational system, better water management, organisational reforms (including curtailment of manpower and establishment), improved infrastructure, efficiency in revenue collection, etc – is practically viable; but remains unattained in the prevailing non-responsive environment.

In many projects, the canal water rates for irrigation are based upon the measure of cultivated areas; in some projects water tariff depend upon the crop-types; and in others, they are based upon the seasons. Despite being more rational, the charging of water tariff on actual volumetric consumption basis has not been put into practice in any of the states. Further, there is wide variation in the water rates of different states, even for the same crop. In some states, different rates are applied for perennial and non-perennial canals; and some states have different prices for different categories of projects. But, in most of the states, the low rates levied are decades old, with very little or no revisions. The NCIWD (1999) points out that the proportion of gross revenue to the working expenses of projects has gone down from 85% in 1974-75, to about 42% in 1986-87; the reason being that working expenses rose to a large extent while water rates remained more or less stagnant. Unfortunately, far from correcting the obvious wrongs, the state governments have been compounding the financial infirmities of the projects for short-term political gains. Not surprisingly, some states (e.g. Punjab and Rajasthan) do not levy any water tariffs for their irrigation projects.

Evidently, the present financial system of project operation involving state budgetary support has inherent flaws. However, the alternatives for better management of the completed projects are not being explored. With the result, the water resource projects of today have not only become financially unviable ventures, but a turnaround in their financial situation also looks improbable.

Notes:

1. Several rivers merge together before draining into the sea, and the combined watershed of all such rivers define the larger river-basin system. The drainage area of the whole country has been divided into 24 major and medium basins (NCIWRD, 1999).

2. The rainfall in the country depends on the Southwest and Northeast Monsoons, shallow cyclonic depressions and disturbances, violent local storms, and occasional cyclones. It generally exceeds 1000 mm in areas of the East of Longitude 780E. It extends to 2500 mm along almost the West Coast and Western Ghats, and over most of Assam and sub-

Himalayan West Bengal. On the west of the line joining Porbandar to Delhi, and thence to Ferozepur it diminishes rapidly form 500 mm to less than 150 mm in the extreme West. The Peninsula has large areas of less than 600 mm rainfall (CBIP, 1998). On an average, 12% of the country receives an average rainfall of less than 610mm annually and only 8% receives more than 2500mm (NCIWRD, 1999).

3. Food self-sufficiency for the country has been generally considered as essential from both strategic and socio-economic considerations. The case for food self-sufficiency has been propounded mainly on four arguments; (i) unreliability of foreign source of food supply for a large country like India, (ii) foreign exchange constraints in case of large scale imports, potential of augmenting food supplies by improving existing low yields, and (iv) income and employment considerations for large work force dependent on foodgrain production (NCIWRD, 1999). Ironically however, the food security of the country has not translated into food security of the poor. The recent time has seen the mountains of grains going up, while the purchasing power of poor has been going down. And, with the piling up of food reserves and the faulty government policies, the export prices of rice and wheat has been lower than the below-poverty-line rates observed in many of the distressed states (Sainath, 2001). Besides, this piling of foodgrain stock - which has risen to the level of 75.5 million tonnes – is also costing the pubic exchequer around Rs. 21000 crore annually (*The Hindu*, 9th November 2001).

4. The population density of India has increased from 267 in 1991, to 324 people per square Kms in 2001 (Mehta, 2003). The northern plains and the coastal areas account for about one-third of the landmass of the country, but they support about two-third of its population. The upland areas, though covering about one-half of India's land area, support only one-third of its population. The northern plains cover about 17% of the total area, but contain about 37% of the population. The coastal areas spread over about 14% of the land area, support about 25% of the population (CBIP, 1998).

5. On a single day, *Times of India* (10th September 2001) has given three separate news items reporting about vast spread and critical starvation in the states of Orissa, Maharashtra, and Andhra Pradesh.

6. India is the seventh largest country in the world in terms of area, but it is second largest populous country, next to China. The Table 3.10 brings out the pressure of population growth on India's limited land, especially the farmland.

Table 3.10: Pressure of Population Growth on Land

Year	Population in Millions	Per capita availability of land (hectare)	Per capita availability of farmland (hectare)
1951	361.1	0.91	0.64
1961	439.2	0.75	0.50
1971	548.2	0.60	0 41
1981	683.3	0.48	0 36
1991	846.3	0.39	0 30

(Source: CSO, 1996)

7. The Ganga, Brahmaputra, and Meghna rivers flow into a common terminus before joining the Bay of Bengal, hence Ganga-Brahmaputra-Meghna is considered a basin; while Ganga, Brahmaputra, and Meghna are considered its sub-basins (NCIWRD, 1999).

8. The year 2002 witnessed highly tense relations between Tamil Nadu and Karnataka over the release of Cauvery water for saving the paddy crops in Tamil Nadu. Despite the tall orders issued by the Supreme Court, the matter dragged on for long, placing the *Samba* crop at great jeopardy, after having virtually nipped the *Kuruvai* in its bud. The problem erupts almost every year during the months of June-July; with no solution at sight for the vexed issue, except intervention of mother nature by way of heavy downpour in the catchment areas (Gurumurthi, 2002).

9. India's urban population in 1901 constituted 10.84% of total population, while its present proportion of about 30.9% is expected to touch 50% mark by year 2050 (IWRS, 1999).

10. World Meteorological Organization warns that average global temperatures are rising rapidly. The 20th century has been the warmest in the last 1000 years, with the 90s as the hottest decade. It is predicted that by 2050, India will be at least 3 degrees Celsius hotter, and many of its rivers would have dried up. International Commission for Snow and Ice warns that by 2035, most glaciers in India would have melted. The Gangotri glacier which feeds rivers like Ganges has already lost one-third of its 15 mile length in last 50 years. It looses 18 metres every year, while the Pindari glacier melts over 130 metres every year. Another indication of global warming is high variability in rainfall. Monsoon trends between 1991-99 have shown serious abnormalities – states like Punjab, Haryana, and Rajasthan have got 40 to 80 percent more rainfall, while otherwise heavy rainfall states of Kerala and Northeast have shown consistent drop in volume (Kaul, 2000).

11. The Working Group on 'Water logging, Soil salinity and Alkanity' set up by Ministry of Water Resources in 1991 reported 2.41 million hectare as water-logged and 3.30 million hectare as salinity affected areas in the command of major and medium irrigation schemed as per the details in Table 3.11 below:

Table 3.11: Waterlogged and Salt-affected Areas

State	Waterlogged area in thousand hectare	Salt affected area in thousand hectare
Andhra Pradesh	266.40	28
Bihar	619.70	224
Gujarat	172.59	911
Haryana	249.00	197
Jammu & Kashmir	1.50	-
Himachal Pradesh	0.20	-
Karnataka	24.54	51
Kerala	11.61	-
Madhya Pradesh	73.12	36
Maharashtra	15.35	5
Orissa.	196 26	-
Punjab	200.00	490
Rajasthan	179.50	70
Tamil Nadu	16.19	140
Uttar Pradesh	430.00	1150
Total	**2455.96**	**3302**

(*Source: MOWR, 1991*)

12. Some of the identified new sources of water for major cities are given in Table 3.12:

Table 3.12: Identified Sources of Water for Major Cities

Name of City	New water supply source	Distance to new source in Kms
Ahmedabad	River Sabarmati Dharoi Dam	150
Bangalore	River Cauvery (K.R.Sagar)	100
Chennai	River Krishna (Telugu Ganga)	400
Delhi	River Bhagirathi (Tehri Dam)	250
	Renuka Dam (Planning Stage)	280
	Kishau Dam (Planning Stage)	300
Hyderabad	River Krishna (Nagarjunasagar)	160
Mumbai	Bhatsa Dam	54

(Source: IWRS, 1999)

13. At an aggregate level, though only 30% of the annual utilizable groundwater potential is actually exploited, the overexploitation of groundwater is still a serious problem across the country as brought out in table 3.13.

Table 3.13: Blocks With Over Exploitation of Groundwater

State	Number of Blocks	Over Exploited		Level of Ground Water Development (%)
		Number	%	
Punjab	118	62	52.54	94
Haryana	108	45	41.67	84
Rajasthan,	236	45	19.07	51
Tamil Nadu	384	54	14.06	61
Gujarat	218	14	06.42	42
Karnataka	175	06	03.43	31
Uttar Pradesh	895	19	02.12	38
Andhra Pradesh	309	02	00.65	24
Other States	2722	Nil	Nil	-
Total	**5165**	**247**		-

(Source: CGWB, 1995)

14. Examples of the pitfalls of groundwater misuse: (i) because of scanty rainfall and continuous groundwater exploitation, the water table in areas of north Gujarat, Saurashtra and Kachch have been lowered beyond 1000 feet, which has caused advancement of salinity ingress by about 6 Kms from the coastline of these areas (SSNNL, 2001); (ii) Even in water rich Kerala, the groundwater level in 11 of the 154 blocks in the state are in critical state (*The Hindu*, 9th November 2001).

15. Comment of Shri A.Vaidyanathan, former Planning Commission Member, on the overexploitation of groundwater resources: "The spread of high-yielding varieties, which are more profitable but also require more water, and the reduction in the cost of lifting water by energised pumps and rural electrification programs have given a powerful impetus the groundwater exploitation in agriculture. This exploitation has been entirely left to the decision of individual with little, if any, effective regulation". (*Time of India*, 10th June 2003).

16. The Grand Anicut across Cauvery river delta was built in second century. During the five decades of planned development, India has completed 96 major projects with Cultural Command Area (CCA) exceeding 10000 hectare, and several hundred medium projects with CCA between 2000 and 10000 hectare (CBIP, 1998).

17. Quite often at the conceptualisation stage the project ramifications in a multi-dimensional civic society are not properly gauged either by the initiators, or by the society at large which fragments into different stakeholder groups.

18. The census of 2001 indicates a population increase of over 21.34% over the previous decade. In terms of decadal rate of growth of population, there has been only a marginal decline from 23.85% in 1981, 24.66% in 1971, and 24.80% in previous decade (Census India 2001). This phenomenon has come to be referred as a 'demographic status quo for the country'. The rise of India's population from about 250 million in 1950-51 to the present 1,027 million, is presented in the Table 3.14.

Table 3.14: Dynamics of India's Population Growth

Period	Population at the end of period (Million)	Decadal growth rate in %	Annual average growth rate in %
1901-1911	252.09	6.16	0.56
1911-1921	251.32	-0.31	-0.03
1921-1931	278.98	11.01	1.04
1931-1941	318.66	14.22	1.33
1941-1951	361.09	13.32	1.25
1951-1961	439.23	21.64	1.96
1961-1971	548.16	24.80	2.20
1971-1981	683.33	24.66	2.22
1981-1991	846.30	23.85	2.16
1991-2001	1027.01	21.34	1.95

(Source: TERI, 1998; and Census India, 2001)

19. The perennial river Yamuna is left with nearly no water at Tajewala (Haryana) after the Eastern Yamuna Canal and Western Yamuna Canal abstract all the water for irrigation. It then practically runs as a drain through Delhi (TERI, 1998).

20. The riverine life depends on river factors that are physical (substratum, water depth, sediment load, light, temperature, and seasonal fluctuations), chemical (mineral-nutrient status, acidity/salinity, oxygen, and presence of pollutant), and biological (interaction of organisms that compete for light, nutrition, food, territory, mates, predation etc.); and these are disturbed by the transformation brought about by dams. Hundreds of plants and animal species, valued for conservation, survive in river habitats. There are also organisms with habitat such as surface of stem above and below water, undersides of leaves, crevices in bark, holes in tree trunks, inside flowers etc. The continuum of habitat variation also occurs along the mid-channel zone, channel edge, bank-side vegetation, and bank-top vegetation. There are bees, butterflies, moths, and hoverflies, which depend on flowers; wood lice, beetles, and other similar flies which live on dead wood or dried up trees; spiders, centipedes and lady beetles provide the food for a variety of birds (Uttangi, 2002).

21. The unprecedented flooding of the Surat City by Tapi River in September 1998 (CWC, 1998[b]) was partly because of the failure of Ukai Project in performing its flood protection function to the needed extent.

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