WCD Case Study

Large Dams: India's Experience

Final Report: November 2000

Prepared for the World Commission on Dams (WCD) by:

R. Rangachari
Nirmal Sengupta
Ramaswamy R. Iyer
Pranab Banerji
and
Shekhar Singh

Secretariat of the World Commission on Dams
P.O. Box 16002, Vlaeberg, Cape Town 8018, South Africa
Phone: 27 21 426 4000 Fax: 27 21 426 0036.
Website: http://www.dams.org E-mail: **info@dams.org**

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The WCD Knowledge Base

This report is one component of the World Commission on Dams knowledge base from which the WCD drew to finalize its report "Dams and Development-A New Framework for Decision Making". The knowledge base consists of seven case studies, two country studies, one briefing paper, seventeen thematic reviews of five sectors, a cross check survey of 125 dams, four regional consultations and nearly 1000 topic-related submissions. All the reports listed below, are available on CD-ROM or can be downloaded from www.dams.org

Case Studies (Focal Dams)
- Grand Coulee Dam, Columbia River Basin, USA
- Tarbela Dam, Indus River Basin, Pakistan
- Aslantas Dam, Ceyhan River Basin, Turkey
- Kariba Dam, Zambezi River, Zambia/Zimbabwe
- Tucurui Dam, Tocantins River, Brazil
- Pak Mun Dam, Mun-Mekong River Basin, Thailand
- Glomma and Laagen Basin, Norway
- *Pilot Study of the Gariep and Van der Kloof dams- Orange River South Africa*

Country Studies
- India
- China

Briefing Paper
- Russia and NIS countries

Thematic Reviews
- TR I.1 Social Impact of Large Dams: Equity and Distributional Issues
- TR I.2: Dams, Indigenous People and Vulnerable Ethnic Minorities
- TR I.3: Displacement, Resettlement, Rehabilitation, Reparation and Development
- TR II.1: Dams, Ecosystem Functions and Environmental Restoration
- TRII 1. Dams, Ecosystem Functions and Environmental Restoration
- TR II.2: Dams and Global Change
- TR III.1: Economic, Financial and Distributional Analysis
- TR III.2: International Trends in Project Financing
- TR IV.1. Electricity Supply and Demand Management Options
- TR IV.2: Irrigation Options
- TR IV.3: Water Supply Options
- TR IV.4: Flood Control and Management Options
- TR IV.5: Operation, Monitoring and Decommissioning of Dams
- TR V.1: Planning Approaches
- TR V.2: Environmental and Social Assessment for Large Dams
- TR V.3: River Basins – Institutional Frameworks and Management Options
- TR V.4: Regulation, Compliance and Implementation
- TR V.5 Participation, Negotiation and Conflict Management. Large Dam Projects

- **Regional Consultations – Hanoi, Colombo, San Paulo and Cairo**
- **Cross-check Survey of 125 dams**

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- ABB
- ADB - Asian Development Bank
- AID - Assistance for India's Development
- Atlas Copco
- Australia - AusAID
- Berne Declaration
- British Dam Society
- Canada - CIDA
- Carnegie Foundation
- Coyne et Bellier
- C.S Mott Foundation
- Denmark - Ministry of Foreign Affairs
- EDF - Electricité de France
- Engevix
- ENRON International
- Finland - Ministry of Foreign Affairs
- Germany - BMZ: Federal Ministry for Economic Co-operation
- Goldman Environmental Foundation
- GTZ - Deutsche Gesellschaft für Technische Zusammenarbeit
- Halcrow Water
- Harza Engineering
- Hydro Quebec
- Novib
- David and Lucille Packard Foundation
- Paul Rizzo and Associates
- People's Republic of China
- Rockefeller Brothers Foundation
- Skanska
- SNC Lavalin
- South Africa - Ministry of Water Affairs and Forestry
- Statkraft
- Sweden - Sida
- IADB - Inter-American Development Bank
- Ireland - Ministry of Foreign Affairs
- IUCN - The World Conservation Union
- Japan - Ministry of Foreign Affairs
- KfW - Kredietanstalt für Wiederaufbau
- Lahmeyer International
- Lotek Engineering
- Manitoba Hydro
- National Wildlife Federation, USA
- Norplan
- Norway - Ministry of Foreign Affairs
- Switzerland - SDC
- The Netherlands - Ministry of Foreign Affairs
- The World Bank
- Tractebel Engineering
- United Kingdom - DFID
- UNEP - United Nations Environment Programme
- United Nations Foundation
- USA Bureau of Reclamation
- Voith Siemens
- Worley International
- WWF International

Preface

As a part of its global review of the "development effectiveness" of large dams and their adverse impacts and consequences, the World Commission on Dams (WCD) selected India for a country study. The WCD split this study into a number of component parts and assigned them to different individuals and institutions. In pursuance of these arrangements, the following reports were submitted to the WCD:

1. Madras Institute of Development Studies (MIDS), Chennai (under the supervision of Nirmal Sengupta): *Contribution of Large Dams*; and *Laws, Policies and Institutional Framework for Options Assessment and Decision-Making.*
2. Indian Institute of Public Administration (IIPA), New Delhi (under the supervision of Shekhar Singh): *Environmental and Social Impacts of Large Dams: The Indian Experience*
3. Indian Institute of Public Administration (IIPA), New Delhi (under the supervision of Pranab Banerji) *Financial, Economic and Distributional analysis of Dams in India.*

The WCD also commissioned an overall country report based on the above and on other material by a group of four persons, namely Ramaswamy R. Iyer, Shekhar Singh, Nirmal Sengupta and R Rangachari

Separately, the WCD had commissioned case studies of six selected dams by the Institute of Public Auditors of India, New Delhi, under the supervision of A.C. Tiwari (former Deputy Comptroller and Auditor-General of India) and R. Rangachari: Bhakra-Nangal in Himachal Pradesh, Nagarjuna Sagar in Andhra Pradesh, Tenughat in Bihar, Gandhi Sagar in Madhya Pradesh, and Dhom and Paithan in Maharashtra. The case studies and the country study proceeded in parallel, but a connecting link was provided by R.Rangachari.

The country study group (which Pranab Banerji agreed to join on request) has been engaged during the last several months in the preparation of the country report. It became clear at an early stage that for various reasons this could not be a joint report of the group as a whole, but would have to be a collection of papers by the different members on various aspects. However, it was agreed that there would be a final consensus chapter by all the members. In pursuance of discussions and decisions at the meetings of the group, a number of papers (now included in revised form as chapters 1 to 6 in this report) were prepared. (Two of these, namely Chapter 1 by R. Rangachari and Chapter 3 by Ramaswamy R. Iyer, were specially written for this report; the remaining chapters are summaries of longer reports separately submitted to the WCD.) These were circulated in draft form for discussion at two "stakeholder" meetings held at MIDS, Chennai (1 March 2000) and IIPA, Delhi (3 March 2000) To these meetings a wide range of persons was invited, including officials of the State and Central Governments, retired administrators and engineers, academics, non-government organisations (NGOs), social activists, journalists, farmers' representatives, project-affected persons, and others A number of points came up during these meetings, and comments were also received from a large number of institutions and individuals before, during and after the meetings Comments were also exchanged by the members of the group among themselves. Taking all these contributions into account, the authors revised their papers, discussed them again within the group, and then finalised them Thereafter, the group started preparing its final consensus chapter which underwent intensive discussions and multiple revisions before eventually reaching its present form (Ch 7)

For each of the chapters from 1 to 6 the respective authors take full responsibility The authors are not necessarily in agreement with everything that is said in papers other than their own. However, all the authors come together in the writing of the final chapter.

Acknowledgements have been made in the various chapters and need not be repeated here As a group we would like to thank all those who sent papers and comments to us, or made information available, or participated in the Chennai and Delhi meetings.

The difficulty and complexity of the task, and the other pressing demands on the time of the various members, have resulted in the Report taking longer to complete than was initially envisaged. We are grateful to the WCD for their understanding and forbearance.

R. Rangachari, Nirmal Sengupta
Ramaswamy R. Iyer, Pranab Banerji and
Shekhar Singh

New Delhi, 15 June 2000

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ADB	:	Asian Development Bank
AICRPDA	:	All India Co-ordinated Research Project on Dryland Agriculture
ARWSP	:	Accelerated Rural Water Supply Programme
AVARD	:	Association of Voluntary Agencies for Rural Development
BCM	:	Billion cubic metres
BCR	:	BCR
BDO	:	Block Development Officer
BGVS	:	Bharatiya Gyan Vigyan Samiti
BMY	:	Barh Mukti Abhiyan
BOT	:	Build Operate and Transfer
CAD	:	Command Area Development
CADA	:	Command Area Development Authority
CAG	:	Comptroller and Auditor General of India
CAPART	:	Council for Advancement of People's Action and Rural Technology
CASAD	.	Centre for Applied Systems Analysis in Development
CAT	:	Catchment Area Treatment
CAZRI		Central Arid Zone Research Institute
CBIP		Central Board of Irrigation and Power
CCPA		C.C. Patel & Associates
CEA		Central Electricity Authority
CRIDA		Central Research Institute for Dryland Agriculture
CSE	.	Centre for Science and Environment
CSO	:	Central Statistical Organisation
CSS	·	Centrally Sponsored Schemes
CWC		Central Water Commission
CWPC	·	Central Water and Power Commission
DANIDA		Danish International Development Agency
DC		District Collector
DDP		Desert Development Programme
DPAP		Drought Prone Area Programme
DST		Department of Science and Technology
DVC		Damodar Valley Corperation
EAC	:	Environmental Appraisal Committee
EAS	:	Employment Assurance Scheme
EEC	·	European Economic Community
EIA		Environmental Impact Assessment
EIS		Environmental Impact Statement
EMC		Energy Management Centre
EPA		Environmental Protection Act
EPCO		Environmental Protection and Co-ordination Organisation
EqIA		Equity Impact Assessment
FAO	.	Food and Agricultural Organisation
FCA		Forest Conservation Act
FRI		Forest Research Institute
FRL		Full Reservoir Level
GOAP	·	Government of Andhra Pradesh
GBM		Ganga-Brahmaputra- (barak) Meghna
GEF		Global Environmental Facility
GERI	·	Gujarat Engineering Research Institute
GIF	:	Global Infrastructure Fund
GOI		Government of India
GWh	:	giggawatt-hour

ha	:	hectare
HIV	:	Human Immune-Deficiency Virus
HYV	:	High Yielding Variety
ICAR	:	Indian Council of Agricultural Research
ICID	:	International Commission on Irrigation & Drainage
ICOLD	:	International Commission on Large Dams
ICRISAT	:	International Crop Research Institute for the Semi-Arid Tropics
IDA	:	International Development Agency
IIPA	:	Indian Institute of Public Administration
IISc	:	Indian Institute of Science
ILO	:	International Labour Organisation
IREDA	:	Indian Renewable Energy Development Agency
IREP	:	Integrated Rural Energy Programme
ISP	:	India Sagar Project
ISWD Act	:	Inter State Water Disputes Act
IWDP	:	Integrated Wasteland Developments Project
IWRS	:	Indian Water Resource Society
JRY	:	Jawahar Rojgar Yojana
km	:	kilometres
km^2	:	square kilometres
kW	:	kilowatt
KWH		Kilo Watt Hours
lakh ha	:	10^4 hectares
M&M	:	Major and Medium (projects)
m^3	:	cubic metres
MAF	:	Million Acre Feet
M cu m	:	Million cubic metres
m ha	:	million hectares
MIDS		Madras Institute of Development Studies
MNES	:	Ministry of Non-Conventional Energy Sources
MoEF	:	Ministry of Environment and Forests
MoIP		Ministry of Irrigation and Power
MoSJE		Ministry of Social Justice and Empowerment
MOU		Memorandum of Understanding
MP		Madhya Pradesh
MPEB		Madhya Pradesh Electricity Board
MW	:	megawatt
NABARD	:	National Bank for Agriculture and Rural Development
NBA		Narmada Bachao Andolan
NCAenv		Narmada Control Authority, Sub-group on Environment
NCEPC	:	National Committee for Environmental Planning and Co-ordination
NEEP	:	National Energy Efficiency Programme
NEEPC		North Eastern Electric Power Corporation
NGO		Non-Government Organisation
NHPC		National Hydro Power Corporation
NPV		Net Present Value
NSP		Narmada Sagar Project
NTPC		National Thermal Power Corporation
NWDPRA		National Watershed Development Project for Rainfed Areas
NWDT		Narmada Water Dispute Tribunal
NWMP	:	National Water Management Project
NWP		National Water Policy (1987)
NWRC		National Water Resources Council
O&M	:	Operations and Management

OTEC	:	Ocean Thermal Energy Conversion
PAC	:	Public Accounts Committee of the Parliament
PAD	:	Projects Appraisal Division (of the Planning Commission)
PIB	:	Public Investments Board
PIL	:	Public Interest Litigation
PIM	:	Participatory Irrigation Management
PLF	:	Plant Load Factor
PSI	:	Peoples' Science Institute
PWD	:	Public Works Department
R&D	:	Research and Development
R&R	:	Resettlement and Rehabilitation
RBI	:	Reserve Bank of India
RCE	:	Revised Cost Estimate
RIS	:	Reservoir Induced Seismicity
SAP	:	Structural Adjustment Programme
SEB	:	State Electricity Board
SSP	:	Sardar Saravar Project
STDs	:	Sexually Transmitted Diseases
T&D	:	Transmission and Distribution
T.B.	:	Tuberculosis
TAC	:	Technical Advisory Committee
THDC	:	Tehri Hydro Development Corporation
TISCO	:	Tata Iron & Steel Company
TOR	:	Terms of Reference
TVA	:	Tennessee Valley Authority
UHPP		Uri Hydroelectric Power Project
UN	:	United Nations
USAID	:	United States Agency for International Development
VLW	:	Village Level Workers
WAPCOS	:	Water and Power Consultancy Services (India) Ltd.
WB	:	World Bank
WCD		World Commission on Dams
WDP		Wasteland Development Programme
WRCP		Water Resources Consolidation Project
WUA		Water Users' Association

1. An Historical Review

R. Rangachari

1.1 Introduction

Agriculture has remained the major occupation of the people of India from prehistoric times and hence its sustained development has also remained one of the prime concerns of its rulers. The diversity of India's landforms and the diversity of its climate are well known. The rainfall is dependent on the monsoons, with most of the precipitation occurred during the brief three to four months period between June and October, and then in some concentrated spells of rainy days. That successful agriculture is dependent on the monsoon rains makes it vulnerable to the spatial and temporal distribution of the monsoons and also to the possibility that the monsoon may fail from time to time. Successive rulers in India have directed their energies towards some protection against such failures or inadequacies of rainfall by establishing irrigation for crops and storages and wells to supply drinking water for use by people and animals.

References to the efforts of past rulers regarding irrigated agriculture and community water supplies exist in India's ancient scriptures, literature and history. Mention is made of wells, tanks, reservoirs, dams and canals and their operation and maintenance as well as the duties of the State in this respect. A reference exists to an ancient enquiry by Rishi Narada of King Yudhistira (circa 3150 BC). "Are the farmers sturdy and prosperous? Are there dams full of water and big enough and distributed in different parts of the kingdom and does agriculture not depend on rains only?" (CBIP, 1965: 35; see also Sengupta, 1993: Appendix)

Magasthenes, the Greek ambassador to the court of Emperor Chandragupta (circa 300 BC), recorded that the district officers "inspect the sluices by which water is distributed into the branch canals (watercourses) so that every one may enjoy his fair share of the benefit". Ruins of ancient irrigation works and reservoirs are found scattered over many parts of India. The older works were essentially confined to the construction of tanks and reservoirs to collect and store excess rainfall and to direct the water flows through canals

In peninsular and western India, where rainfall is scanty, such practices were widespread. The functions of water resource development, particularly for irrigation, were steadily taken over by the State

The Grand Anicut on the Cauvery was one of the earliest canal systems built, dating back probably to the 2nd century (Sengupta, 1993:1). With successive improvements and enlargements this canal system is functional even after nearly 2 000 years. The Vijayanagar Empire gave an impetus to irrigation development in the south in the 15th century. The 19th century British rule in India witnessed renovations, improvements and extensions of the earlier works as well as new developments such as the Upper Ganga canal, and Krishna and Godavari delta irrigation systems. Such schemes were the logical approach as the fertile delta and the plains were the first targets for irrigated agriculture. In northern India, conditions were suitable for starting irrigation by canals fed by perennial rivers. In the water-deficit regions like the south and west, the extension of irrigation from storage reservoirs utilising the hilly and rolling topography became necessary. Many earthen dams of moderate height were built in south India from the very early days and there are presently over 39 400 such reservoirs in Tamilnadu alone [1] Many of these were built by the different ruling dynasties between 500 AD and 1500 AD. Advances in technology coupled with greater confidence arising out of experience in undertaking such measures boosted dam construction. The Ramappa Lake (1213) in Andhra, Karla (1514) and Vihar (1860) in Maharashtra, Rajsamand (1671), Jai Samand (1730) in Rajasthan and the Barwasagar (1500?) are instances of such works of the past.

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In the late 19th century, the technology of high head hydraulic structures began to be developed. Nearly a century ago there were some very bold initiatives in storage dams in India, largely instigated by some well-known British "Royal Engineers". In 1886, at the initiative of Col. Pennycuick, work on the Periyar Project, involving the construction of a 48m high and 378m long concrete dam commenced. This dam attempted to store the waters of the west-flowing Periyar River in the jungles of the western ghats and to divert them eastwards to the drought-prone Madurai and Ramanatha puram districts of Madras. The reservoir area was 33 square kilometres (km^2) and the water was led across the high ridge between Periyar and Vaigai through a 1.8km long tunnel. This was a pioneering, major inter-basin diversion to a water-deficit area. Moreover it was an Indian project, conceived and built with great concern for the environment, well ahead of such initiatives elsewhere in the world. This work, which was completed in 1895 at a cost of Rs8.5 million, is still functioning and serves the irrigation needs of 81 000ha. The area is also a wildlife park.

The Periyar and Peechiparai (1906) dams were of considerable height and significant storage Many more large dams came into being in the 20th century. When work started on the Krishnarajasagar Project in 1911, it was a pioneering large dam project undertaken by a native princely State on the pattern of similar works of lesser magnitude, which had been undertaken in the princely States of Hyderabad, and many others in the present day Rajasthan. The Mettur Dam was begun and completed between 1925 and 1934.

1.2 Large Dams

The International Commission on Large Dams (ICOLD) defines a "large dam" as one having a damwall above 15m in height (from the lowest general foundation to the crest) However, even dams between 10-15m in height could be classified as large dams if they satisfy at least any one of the following criteria:

- crest length > 500m;
- reservoir capacity >1 million m^3;
- maximum flood discharge >2 000 m^3
- it has difficult foundation problem
- it is of unusual design.

Adopting the ICOLD definition, the Central Water Commission (CWC) has compiled the National Register of Large Dams in India, expressed in Table1.1

Table 1.1 Large Dams in India

S.No.	Period	Number of large dams		
		> 15m high	10 -15m high	Total
1	Up to 1900	28	14	42
2	1901-1950	118	133	251
3	1951-1970	418	277	695
4	1971-1989	1 187	1 069	2 256
5	1990 and beyond	56	60	116
6	Details not available	74	162	236
7	Under construction	461	234	695
8	TOTAL	2 342	1 949	4 291

SOURCE: Central Water Commission, 1994a

The compilation relates to large dams to the extent known in May 1994, the list is seen to contain a multiple counting of dams. A careful check may change the position to some extent but the broad picture of large dams as presented in the CWC compilation is unlikely to be much different India, thus, has over 4 000 large dams. Just fewer than half of these are less than 15m high but were included in the list, based on the other criteria indicated earlier. Even at the start of the 20^{th} century India had 42 large dams. By 1950 there were another 250 and the rest were undertaken in the second half of the 20^{th} century. It is also noted that half the large dams were undertaken in the period 1970 to 1989.[2]

An examination of the statewise picture of the distribution of large dams indicates that nearly half the large dams are in the two states of Maharashtra and Gujarat. It is also seen that almost three-fourths lie within the three states of Gujarat, Maharashtra and Madhya Pradesh. The position is summarised in Table 1 2:

Table 1.2 States with a Significant Number of Large Dams

S.No.	State	Number of large dams with the height		
		>15m	10 to 15m	Total
1	Maharashtra	861	668	1 529
2	Gujarat	349	188	537
3	Madhya Pradesh	406	687	1 093
4	Total Mah. +Gujarat	1 210	856	2 066
5	Total Mah.+Guj.+MP	1 616	1 543	3 159
6	All India	2 342	1 949	4 291

(SOURCE: Central Water Commission. 1994a)

A significant number of these dams were built for irrigation purposes and the multi-purpose projects among them had irrigation as a major aim. However, some were undertaken mainly or wholly to serve the purpose of hydro-power generation. A few others were undertaken mainly to serve as industrial and domestic water supply sources.

Many water storage structures had to be built exclusively or largely for meeting the drinking water needs of megacities, large towns and major industries With the rapid growth of industry and commercial activities there has also been rapid urbanisation and the local water sources have become inadequate Megacities like Bangalore, Bombay, Chennai, Delhi, Hyderabad, Vishakapatnam and major fertiliser, steel and other industries became dependent on storage reservoirs, including some inter-basin diversions.[3]

The two great famines of 1897-98 and 1899-1900 in India led to the appointment of the First Irrigation Commission in 1901 to report on irrigation as a means of protection against famine in India. The Commission proposed a number of measures, which included the construction of storage dams in different parts of India.

The more important public works recommended more recently by the Second Irrigation Commission included the following

- Bombay-Deccan,
- Chankapur storage on the river Girna and Maladevi storage on the Pravara,
- Storage works to feed Nira and Gokak canals;
- Catchment area of all rivers originating in the Western Ghats to be investigated for locating as many storage reservoirs as possible to provide irrigation to areas with little water,
- Madras;
- Storage works on the Cauvery and Krishna rivers;
- Investigation of the Tungabadhra project;
- Gujarat;
- Location of suitable storage sites on the rivers Sabarmati, Mahi and Narmada,
- Comprehensive survey of the river basins in the princely States of Rajputana.
- Kathiawar, and Gujarat.

(GOI. Irrigation Commission. 1972 v.I, 62-63)

Almost all the major recommendations were implemented in full or with modifications before Indian Independence. Although the commission had attached great importance to protective works in famine stricken areas, interest in these works gradually tapered off. Irrigation works in the Punjab however. continued to receive favoured treatment throughout.

(GOI. Irrigation Commission, 1972 v.1, 64).

The net irrigated area in the Indian subcontinent, comprising the British provinces and the princely States just before the partition of India, was about 28.2 million ha, amounting to almost one-fourth of the cultivated area. Sourcewise, 54% of the area was irrigated by canals and 12% by tanks. Partition brought about sudden and drastic changes in the position; a disproportionately higher percentage of the irrigated area went to Pakistan, as shown in Table 1.3:

Table 1.3 Net Sown and Irrigated Area in India and Pakistan at Partition

Country	Net Sown Area	Net Irrigated Area	%Net Sown and Irrigated Areas	Area Irrigated by	
				Canals	Tanks
Undivided India	116.8	28.2	24.1	15.2	3.3
Pakistan*	18.3	8.8	48.1	7.0	-
India	98.5	19.4	19.7	8.2	3.3

**Figures for Pakistan are estimated figures*
Area expressed in million hectares (m ha)
(SOURCE : GOI, Irrigation Commission Report, 1972: v.1, 69)

With the cultivated area that went to Pakistan was about 16% of the total, it also enjoyed higher levels of irrigation facilities or assured rainfall.

The net irrigated area in India in 1950-51 was 20.9 m ha. As 1.7 mha. were irrigated in more than one season, the total gross irrigated area in India at the start of planned development stood at 22.6 m ha. The exact extent served by large dams is however not available.

1.3 Progress Under the Five-Year Plans

Ensuring food security to the population has been one of the major objectives of India's development policy[4]. Food security, broadly interpreted, means on the one hand, ensuring adequate availability of basic food products, particularly food grains, in the country as a whole and, on the other hand, simultaneously making available the necessary purchasing power to have access to these products at the household level. Agricultural development based on increases in productivity and income meets both these demands of food security simultaneously.

The World Bank (WB) (1998a) has stated that: " Various analyses of the role of irrigation in India's agriculture have shown that irrigation has played a core role in agricultural production and growth. Irrigation enables a higher productive potential from the land, and significant production response from associated use of high yielding varieties, fertiliser and other inputs." After pointing out the difficulty in ascertaining the precise contribution of irrigation because of the lack of all relevant data, the WB stated that: "Nevertheless, various estimates point to a contribution from irrigated agriculture to overall agricultural production of about two thirds, and under some estimates an even higher contribution." A further observation was that, by far, the most important contribution to Indian agriculture was in facilitating the spread of the green revolution".

The Planning Commission of India, in its Ninth Five-Year Plan Document (1997-2002), assessed that "the yields on irrigated areas are generally two times higher than those for rainfed areas" (1999: 474). Thus irrigation development is important for achieving food security and higher agricultural growth, it also provides stability to agricultural growth. The fact that the country has been able to build much greater resilience in agricultural production, particularly food grains, has been achieved by the contribution in no small measure of the extension of area and increased productivity of agriculture under irrigation.

India's irrigation potential increased from 22.6 m ha. in 1951 to about 89.6 m ha by 1997, marking a fourfold growth over the last 50 years (Table 4). The food grains production has increased from 51 million tonnes in 1950-51 to almost 200 million tonnes by 1996-97. According to the Planning Commission (1999:475) "about two thirds of this increase has come from the irrigated area, which is around one third of the cultivated area". A. Vaidyanathan (1999:79), on the basis of time series estimates of the productivity of irrigated and rainfed crops in different States of India in the 1970s and 1980s, concluded that:

> *"The trend analysis of these series indicates that, in a large majority of States, irrigated yields show a statistically significant rising trend over this period even as production per unit of unirrigated area does not exhibit a statistically significant trend in either direction. Productivity of unirrigated land is thus more or less stagnant and the productivity differential between irrigated and rainfed areas has progressively widened both in absolute and relative terms. Moreover, irrigated yields are generally more stable than rainfed yields.*

Table 1.4 Development of Irrigation through Plans

Plan	Major and Medium Irrigation		Minor Irrigation		Total Irrigation	
	Potential	Utilisation	Potential	Utilisation	Potential	Utilisation
Pre-plan (1951)	9.70	9.70	12.90	12.90	22.60	22.60
First plan (1951-56)	12.20	10.98	14.06	14.06	26.26	25.04
Second plan (1956-61)	14.33	13.05	14.75	14.75	29.08	27.80
Third plan (1961-66)	16.57	15.17	17.00	17.00	33.57	32.17
Annual plans (1966-69)	18.10	16.75	19.00	19.00	37.10	35.75
Fourth plan (1969-74)	20.70	18.69	23.50	23.50	44.20	42.19
Fifth plan (1974-78)	24.72	21.16	27.30	27.30	52.02	48.46
Annual plans (1978-80)	26.61	22.64	30.00	30.00	56.61	52.64
Sixth plan (1980-85)	27.70	23.57	37.52	35.25	65.22	58.82
Seventh plan (1985-90)	29.92	25.47	46.61	43.12	76.53	68.59
Annual plans (1990-92)	30.74	26.32	50.35	46.54	81.09	72.86
Eighth plan (1992-97)	32.96	28.44	56.60	52.31	89.56	80.75

(SOURCES. Ministry of Water Resources and Reports of Working Group.s and Ninth Five-Year Plan proposals). *Area expressed in m ha.*

In the early stage of irrigation development, the emphasis was on diverting a part of the flow in rivers through weirs, anicuts, barrages etc. Smaller storages through ponds, lakes and tanks were also common The landscape of central and southern India is studded with thousands of irrigation tanks, built over many centuries. By the middle of the 20th century, it was realised that larger surface water storages were inescapable in many places for consolidating irrigation supplies as well as for hydropower generation.

In the 1970s the Government of India (GOI) benefitted from the advice of the Second Irrigation Commission and its Report (1972) in regard to the development of irrigation thus far and the directions to be taken for the future. The Commission had made a specific recommendation in respect of big storages, expressed in the Summary as follows:.

> *More than 90% of the river flow occurs in the monsoon months of June to September. It is imperative that storages should be built to impound monsoon flows for utilising that water for irrigation in winter and summer. Big storages have big catchment areas, and variations in*

rainfall do not affect them to the same extent as they do small tanks. These reservoirs provide assured irrigation.

(GOI. Irrigation Commission, 1972: v.1, 19.37)

The Summary (GOI. Irrigation Commission, 1972: v.1, 19.41), however, includes the relevant caution about maintaining the ecological balance, in the following words: "*We are of the opinion that proper attention should be given to maintain the ecological balance in the planning of major irrigation works.*"

As regards flood moderation, the earliest approach of independent India was based on storage reservoirs, as attempted through the Damodar Valley Corporation (DVC) to tackle the flood problems of the Damodar. The first national policy statement on flood control of 1954 also considered that "construction of storage reservoirs and diversion channels, wherever feasible, is obviously among the most effective measures for the control of floods".[5]

The Report of the National Commission on Floods (GOI. 1980: v.1, 228, 365), also proposed recommendations on the future approach. It stated that "there is a need for storage in various forms, which would even out the flow, and also conserve water for use during dry periods" (Recommendation no 83). It further recommended that "reservoirs, to the extent technically and economically feasible, must be considered as an important component in any package of measures for flood management" (Recommendation no. 85).

1.4 National Water Policy

The National Water Policy adopted in 1987 lays down the broad principles that govern the management of the nation's water resources. The policy recognises that water is a scarce and precious national resource to be planned, developed and conserved as such and on an integrated and environmentally sound basis, keeping in view the needs of the States concerned. It asks that the water resources available to the country should be brought within the category of utilisable resources to the maximum possible extent. Further, water resources should be made available to water-short areas by transfer from other areas including transfer from one river basin to another based on a national perspective, after taking into account the requirements of the areas/basins.

Land use statistics in Indian agriculture are not reported in a dis-aggregated manner for different irrigation commands or for dam-backed areas. These statistics are presented mostly by political or administrative units such as districts, blocks, *taluqas* or villages and not by hydrologic units. Water resource and irrigation authorities in the various States maintain scheme-wise particulars. Unfortunately, however, these are not always reconciled with land use and production statistics maintained by other departments. Often the figures are challenged as being not accurate. It will, therefore, not be possible to present reliable details of irrigation systems backed by large dams

The Government estimated that, 1997, the gap between potential and utilisation was about 8.8 m ha. Of these, the major and medium schemes accounted for 4.7 m ha. The persistent gap (see Table 4) between the estimated potential for irrigation and the area reported to be actually irrigated has attracted much attention and discussion.[6]

In the 50 years of planned development, a sum of about Rs. 91 943crores (a crore being equal to 10 million, this would amount to 919 billion rupees) at current price levels was invested for irrigation, from all categories of schemes. This is indicated to be equivalent to Rs.231 386 crores at the 1996-97 constant prices. Major and medium projects accounted for Rs 52 606 crores (equal to 132 390 crore at 1996-97 prices) and the minor schemes for Rs.29 162 crores (equal to 73 387 crores at 1996-97 prices). A further sum of Rs. 5 419 crores (or Rs.13 386 crores at 1996-97 prices) was spent in command area development schemes. Flood management accounted for Rs 4 857 crores (or 12 222 crores at 1996-97 prices). Summarised details are given in Table 1.5. It is not possible to indicate precisely how much is attributable to dam-backed schemes.

Table 1.5 Investment in Irrigation and Flood Control by Plan Periods
(Rupees in crore at current price level)

Plan	Major & medium	Minor	C.A.D	Flood Control	Total
I-1951-56	376.24	65.62	-	13.21	455.07
II-1956-61	380	161.58	-	48.06	589.64
III-1961-66	576	443.10	-	82.09	1 101.19
A.P.1966-69	429.81	560 93	-	41.96	1 032.70
IV 1969-74	1 242.30	1 17 3.34	-	162.04	2 577.48
V 1974-78	2 516.18	1 409.58	-	298.61	4 224.36
A.P 1978-80	2 078.58	981.90	362.96	329.96	3 753.40
VI 1980-85	7 368.83	3 416.82	743.05	786.85	12 315 55
VII 1985-90	11 107.29	6 179.30	1 447.50	941.58	19 675 67
A.P 1990-92	5 459.15	3 030.07	619.45	460.64	9 569.31
VIII 1992-97	21 071.87	11 739.36	2 145.92	1 691.68	36 648 83
TOTAL	52 602.25	29 168.60	5 418.88	4 856.67	91 943.40
Totals at constant prices of 1996-97					
	132 389.93	73 388.66	13 385.66	12 222.39	231 386.59

SOURCE: India. 1999· v.2, p 532) (Figures expressed roundly)

Substantial investments have been made by the private sector in developing groundwater irrigation and to make rainfed lands fit for irrigated agriculture. The total extent of such investment has not been assessed. However, public sector financial institutions have provided over Rs 70 billion by way of loans at concessional rates for private investors. There was a marked shift of emphasis in favour of minor irrigation works after the third five-year plan. Within minor irrigation, groundwater received great emphasis

In respect of investments also, separate totals are not available regarding large dam-backed irrigation A total number of 292 major schemes and 944 medium schemes were undertaken during these plans. There is no authentic figure of the number of dam-backed irrigation schemes that were taken up as part of plan projects

1.5 Hydropower and Large Dams

Hydroelectric power is a renewable and non-polluting source of energy which can be developed on a large scale and for which well-proven technology is available. Further, hydroelectric generation provides a number of economic, operational and social advantages over other modes of energy generation. it is relatively cheaper at the time of initial installation and, with the escalation of fuel costs over the passage of time for other modes of generation, it grows relatively much more economical Hydroelectric plants have longer plant life. Also, hydro projects with their inherent ability for quick starting and almost instantaneous load acceptance and rejection are ideally suited for supply during peak demand. As a result these plants enhance system reliability and also enable optimal operation of thermal plants (Navasimhan & Singh, 1994. 263).

Storage-based hydropower schemes often form part of multipurpose river valley projects, including flood control, irrigation, water supply etc. There are, however, a few cases where the only or the most important benefit envisaged is hydropower. It is possible to generate hydropower by run-of-river schemes without a significant storage but the benefit cost ratios vastly improve with multiple purposes added onto power generation, wherever possible

The first hydropower project in India, of 4x200 kilowatts (kW) installed capacity, located at Darjeeling dates back to 1897. The first hydropower station with the significant capacity of 4.5 megawatts (MW) was completed soon after in1902, at Sivasamudram in the princely State of Mysore (now Karnataka). The Krishnaraja Sagar Dam, work on which commenced in 1911, provides irrigation to 50 000 ha in addition to supplying water to the Sivasamudram Hydropower Station for generation of electricity (GOI, 1972: v.3, pt. 2:324).

The pace of progress of power development, including hydropower, was rather tardy till Independence, when the total installed capacity was 1 362 MW, including 508 MW hydropower. There has been impressive growth in the power sector in the last five decades of planned development. The installed capacity as of March 1998 stood at 89 000 MW, which includes hydropower capacity of 21 891 MW. About two-thirds of the hydropower installed capacity is attributed to storage-backed schemes and one-third from run-of-river schemes. The per capita consumption of electric power is however very low; it has increased from 15 kW in 1950 to 173 kW in 1980 and to 459 kW in 1996 kW (United Nations Development Programme, 1999)

The development of thermal and hydropower plants are being pursued side by side in India. Studies to determine a reasonable hydro-thermal mix indicate that to enable efficient operation of the system as a whole, the share of hydro in the mix should be around 40% (Navasimhan & Singh, 1994). This ratio, which was around 50% in 1963 had come down to 40% by 1980 and has dropped further to around 25% by the year 1998. India's hydropower potential has been estimated by the Central Electricity Authority (CEA) as over 84 000 MW at 60% load factor or 148 700 MW installed capacity. A substantial part of exploitable and economic hydropower potential remains untapped for power generation while scarce fossil fuels are being rapidly exhausted.

The details of major basinwise hydroelectric power potential assessed by the CEA and the probable hydropower installed capacity are given in the Table1.6

Table 1.6 Hydroelectric Power Potential in India

S. No	River Basin(s)	Potential at 60% Load Factor (MW)	Probable Installed capacity (MW)
1	Indus Basin	19,988	33,842
2	Ganga Basin	10,715	20,711
3	Brahmaputra Basin	34,920	66,005
4	Central Indian Rivers system	2,740	4,152
5	West flowing Rivers of South India	6,149	9,418
6	East flowing rivers of South India	9,532	14,511
	TOTAL	84,044	1,48,699

(SOURCE: CEA, Government of India)

Small-scale hydel schemes in India have been categorised as micro (up to 180 kW), mini (up to 2 MW) and small (up to 15 MW). The total potential of small-scale hydel projects in India has been broadly assessed as10 000 MW. The CEA had in 1998-99 assessed the small hydropower potential at 6 000 MW based on 1 604 identified sites

1.6 National Hydroelectric Policy

The Government of India (GOI) adopted the "Policy on hydropower development in August 1998 with the objective of exploiting the vast hydroelectric potential of the country at a faster pace. Selected extracts from the Policy are reproduced below:

Hydropower is a renewable economic, non-polluting and environmentally benign source of energy. Hydropower stations have inherent ability for instantaneous starting, stopping, load *variations etc. and help in improving reliability of the power system. Hydro stations are the best choice for meeting the peak demand. The generation cost is not only inflation free but reduces with time. Hydroelectric projects have a long, useful life extending over 50 years and help in conserving scarce fossil fuels. They also help in opening up avenues for the development of remote and backward areas.*

Our Country is endowed with enormous economically exploitable and viable hydro potential assessed to be about 84 000 MW at 60% load factor (148 700 MW installed capacity). in addition, 678 181 MW in terms of installed capacity from small, mini and micro hydel schemes have been assessed. Also 56 sites for pumped storage schemes with an aggregate installed capacity of 94 000 MW have been identified.

Despite hydroelectric projects being recognised as the most economic and preferred source of electricity. the percentage of hydropower has been declining steadily since 1963. The ideal hydro thermal mix should be 40:60. Because of an imbalance in the hydel thermal mix, especially in the eastern and western regions. many thermal power stations are required to back down during off peak hours. The capacity of the thermal plants cannot be fully utilised resulting in a loss of about 4 - 5% in the plant load factor. Even if the share of hydropower is to be maintained at the existing level of 25%. the capacity addition during the 9th and 10th Plan would work out to 23 000 MW. If the share were to be enhanced to 30 %, it would require a further addition of 10 000 MW of hydro capacity.

1.7 Storages Created and Under Creation on Indian Rivers

The average annual rainfall in India is 1 170 mm. However its distribution in time and space is not uniform. One-third of the country is drought-affected as well.

The Central Water Commission estimated the average annual runoff carried by the rivers in India to be around 1 869 billion cubic metres (BCM). However the National Commission for Integrated Water Resources Development Plan has revised this estimate to 1 961 BCM. As noted earlier (in Section 1.3). over three-fourths of this annual flow is concentrated in the brief monsoon months. In order to ensure optimum use of the water resources, storage of the surplus monsoon runoff is necessary at suitable dam sites. The extent of such possible storage is dependent on a number of factors: the hydrology of the river flows at different places, the topography of the land, the geology at possible reservoir and dam areas, the extent of acceptable social and environmental dislocations in the overall context of the positive and adverse impacts of the proposed developments, the availability of investible funds, etc.

The extent of total live storage created under the various completed schemes so far is around 177 BCM. The additional storage that is anticipated through the schemes under construction is around 75 BCM. Thus all the storage schemes undertaken so far will eventually have the total capacity of 250 BCM. Basinwise details are given in Table 1.7

If any storage scheme that has a storage capacity (gross) of more than 1 BCM is considered as a large storage, then there are about 40 such completed schemes accounting for a storage of 141 BCM gross or 113 BCM live. Similarly there are about 22 such schemes under execution which together would account for a further gross storage of 66 BCM or 51 BCM live. Thus, these 62 schemes completed and under execution together would account for a storage of 208 BCM gross or 164 BCM live. The details of these schemes are given in Table 1.8.

Table 1.7 Water Storage Schemes in India

S.No	River Basin	Average Annual Flow	Live Storage Capacity		
			Completed Schemes	Schemes under Construction	Total
1	Indus	73.31	13.83	2.45	16.29
2a	Ganga	525.02	36.84	17.12	53.96
2b	Brahmaputra	629.05	1.09	2.40	3.49
2c	Meghna	48.36	-	-	-
3	Godavari	110.54	19.51	10.65	30.16
4	Krishna	78.12	34.48	7.78	42.25
5	Cauvery	21.36	7.43	0.39-	7.82
6	Pennar	6.32	0.38	2.13	2.51
7	EFR Mahanadi to Pennar	22.52	1.63	1.45	3.08
8	E.F.R. Pennar to Kanyakumari	16.46	1.42	0.02	1.44
9	Mahanadi	66.88	8.49	5.39	13.88
10	Brahmani and Baitarani	28.48	4.76	0.24	5.00
11	Subarnarekha	12.37	0.66	1.65	2.31
12	Sabarmati	3.81	1.35	0.12	1.47
13	Mahi	11.02	4.75	0.36	5.11
14	WFR Kutch Saurashtra Luni	15.10	4.31	0.58	4.89
15	Narmada	45.64	6.60	16.72	23.32
16	Tapi	14.88	8.53	1.01	9.54
17	WFR Tapi to Tadri	87.41	7.10	2.66	9.76
18	WFR Tadrito Kumari	113.53	10.24	2.31	12.55
19	Minor basins	31.00	0.31	-	0.31
	Total	1961.18	173.73	75.42	249.15

(SOURCE: Central Water Commission)

Notes

1. The table relates to schemes having live storage capacity of 10 M.cu.m and above only

2. An additional live storage capacity of 3 BCM is estimated (by CWC) to have been created by medium schemes having capacities of less than 10 M cu. m each, thus making the total live storage of 177 BCM in the completed schemes

3. EFR: east-flowing rivers; WFR: west-flowing rivers

4. Volume expressed in billion cubic metres.

Table 1.8 Abstract of Large Storage Schemes in India

River Basin	Completed Schemes			Under Execution			Total Schemes		
	No.	Storage BCM		NO.	Storage BCM		No.	Storage BCM	
		Gross	Live		Gross	Live		Gross	Live
Indus	2	17.20	14.48	1	3.28	2.24	3	20.48	16.82
G B M	9	29.94	24.67	9	20.49	15.52	18	50.43	40.19
Godavari	7	15.57	10.33	3	4.70	3.10	10	20.27	13.43
Krishna	9	35.03	26.78	2	6.43	6.10	11	41.46	32.88
Pennar	-	-	-	1	2.21	1.99	1	2.21	1.99
Cauvery	3	5.14	4.91	-	-	---	3	5.14	4.91
Mahanadi	1	8.14		1	3.42	3.05	2	11.56	8.43
Subarnarekha	-	-	-	1	1.96	1.62	1	1.96	1.62
Mahi	2	3.64	3.30	-	-	-	2	3.64	3.30
Narmada	2	6.23	5.04	2	21.72	15.55	4	27.95	20.59
Tapi	1	8.51	7.09	-	-	-	1	8.51	7.09

River Basin	Completed Schemes			Under Execution			Total Schemes		
	No.	Storage BCM		N0.	Storage BCM		No.	Storage BCM	
		Gross	Live		Gross	Live		Gross	Live
WFRTapi to Tadri	1	4.40	4.10	-	-	-	1	4.40	4 10
WFRTadri to Kumari	3	7.56	6.77	2	2.25	1.95	5	9 81	8.72
TOTAL	40	141.36	112.85	22	66.46	51.22	62	207.82	164.07

Notes: GBM: Ganga-Brahmaputra- (Barak) Meghna Basin; WFR west-flowing rivers.

The details of the 62 large storage schemes completed and currently under execution are given in Table 1.9

Table 1.9 Large Storage Schemes in India

Completed z					Schemes under Execution			
S.No.	Scheme	Year	Storage (BCM)		S.No	Scheme	Storage (BCM)	
			Gross	Live			Gross	Live
Indus Basin								
1	Bhakra	1963	9.62	7.19	1	Ranjitsagar	3.28	2.34
2	Pong	1974	8.58	7.29				
Ganga-Brahmaputra-Barak Basin								
3	Matatila	1964	1.13	0.78	2	North koel	1.17	0.97
4	Gandhisagar	1965	7.74	6.92	3	Bansagar	6.37	5.41
5	R.P. Sagar	1967	2.90	1.57	4	Kishau	2.40	1.23
6	Rihand	1962	10.80	9.00	5	Rajghat	2.17	1.94
7	Ramganga	1978	2.44	2.20	6	Tehri	3.54	2.61
8	Maithon	1957	1.37	1.16	7	Bisalpur	1.09	0.89
9	Panchet	1959	1.50	1.32	8	Vyasi	1.16	0.36
10	Tenughat	1981	1.02	0.81	9	Doyong	1.50	1.22
11	Kangsabati	1965	1.04	0.91	10	Bisalpur	1.09	0.89
Godavari Basin								
12	Nizam Sagar	1931	1.50	0.50	11	Gosikhurd	1.15	0.74
13	Donkaravi	1974	1.67	1.25	12	U.Indravati	2.30	1.43
14	Sriramasagar	1983	3.17	2.32	13	U Kolab	1.25	0.93
15	Jayakwadi	1976	2.91	2.17				
16	Pench	1992	1.24	1.09				
17	Balimela	1974	3.83	2.03				
18	Isapur	1982	1.25	0.97				
Krishna Basin								
19	Nagarjuna Sagar	1974	11.56	6.80	14	Almatti	6.43	6.10
20	Srisailam	1981	8.72	8.29	15	Varna		
21	Tungabhadra	1953	3.71	3.28				
22	Bhadra	1963	2.02	1.79				
23	Malaprabha	1973	1.07	0.97				
24	Ghataprabha	1979	1.44	1.40				
25	Narayanpur	1982	1.07	0.86				
26	Koyna	1964	2.80	2.68				
27	Ujjani	1980	3.14	1.51				
Pennar Basin								
					16	Somasila	2.21	1.98
Cauvery Basin								
28	Krishnaraja Sagar	1932	1.38	1.25				
29	Mettur	1934	2.71	2.65				
30	Hemavathi	1983	1.05	1.01				
Mahanadi Basin								
31	Hirakud	1957	8.14	5.38	17	Hasdeo-bango	3.42	3.05
Brahmani-Baitarani Basin								
32	Rengali	1985	4.00	3.43				
Subarnarekha								
					18	Subarna Rekha	1.96	1.62
Mahi basin								

Completed z					Schemes under Execution			
S.No.	Scheme	Year	Storage (BCM)		S.No	Scheme	Storage (BCM)	
			Gross	Live			Gross	Live
33	Kadana	1978	1.54	1.47				
34	Bajajsagar	1985	2.10	1.83				
Narmada Basin								
35	Tawa	1975	2.31	1.94	19	Sardar Sarovar	9.50	5.80
36	Bargi		3.92	3.10		Narmada Sagar	12.22	9.75
Tapi Basin								
37	Ukai	1977	8.51	7.09				
West flowing rivers between Tapi and Tadri								
38	Supa	1987	4.40	4.10				
West flowing rivers between Tadri and Kanyakumari								
39	Linganamak-ki	1965	4.44	4.29	20	Mani	1.02	0.93
40	Idamalayar	1977	1.12	1.02	21	Puyankutti	1.23	1.02
41	Idukki	1974	2.00	1.46				

SOURCE: Different publications of Central Water Commission on storages in India Irrigation Commission Report 1972 (The figures in the various documents do not tally.)

1.8 The Growing Controversy

Generally speaking, for centuries dams have played a key role worldwide in development. Dams were built all over the world to resolve the problems of spatial and temporal insufficiencies of natural precipitation resulting from growing needs. Dams were built to supply water, control floods, irrigate agricultural lands and provide for navigation. They have also been built to generate electric power. As technology advanced increasingly large dams and complex structures were undertaken.

As the President of ICOLD recently (Hoeg 2000) pointed out "fresh water resources were limited and very unevenly distributed. Seasonal variations and climatic irregularities impeded the efficient use of river runoff with flooding and drought having catastrophic consequences". He claimed that about 45 000 dams higher than 15m (and about 800 000 smaller ones) "were improving the living conditions of many of the world's six billion people".

Different countries or regions, at different stages of development, have developed and will continue to pursue their own policies to face their challenges and fulfil their needs. These policies cannot be labelled intrinsically "bad" or "good" merely because they favour or oppose construction of large dams. The impacts of large dams are location specific. However, the recent debates on large dams have increasingly become polarised and polemical which has tended to cloud issues.

As development priorities changed, particularly in the affluent developed world, and experience accumulated, various groups argued that the expected economic benefits of large dams were not being obtained and that major environmental, economic and social costs were not being taken into account. In recent decades, proposals for new dams and even ongoing dams began to be questioned by affected interests and global coalitions. Some critics (Robbroeck, 1999) of this critical approach asked vehemently if the poor South should stop developing dams because some armchair critics in rich countries want to do whitewater rafting or salmon fishing, while profiting from the lifestyle enabled by decades of dam construction in their part of the world. Yet others (Economist, 1997) point out that predictions of ecological doom have such a poor track record that they should be taken with a pinch of salt. This second group argues that it is possible to be in favour of the environment without being a pessimist. There ought to be room in the environmental movement for those who think that technology and economic freedom will make the world cleaner and will also take the pressure off endangered species.

Large dams have become the subject of controversy and a growing international debate in which India has also been caught up. As India is influenced by the monsoon regarding its water resources, the need for such large dams and storage schemes has been felt even more acutely. However, untill India became an independent nation there was acute poverty and frequent famine with too little economic activity. By the time India launched her belated planned development, the world had gone forward leaving a large gap between the industrialised nations and the poor developing countries. In the 1950s, 1960s and even early 1970s, there was also very limited awareness of the environmental and social issues relating to large dams. The most visible impact of a large dam lay in the submersion of lands and the displacement of people. It has also been pointed out (Verghese, 1999) that while dams displace, so does acute deprivation, but to a far greater degree: also that while the migrants of deprivation are just condemned, those displace by reservoirs are a charge on the Project, with a better package of rehabilitation. It is important to consider not only those displaced by dams, but also those afflicted by drought (Omvedt, 1999)..

It is true in many cases that displacement was seen more as an inevitable concomitant of development There was no dedicated agency or system for dealing with the trauma of displacement or for handling rehabilitation sensitively. It is however equally true to say that India was on a learning curve, which is not the same thing as condoning mistakes, if any, of the past. The question remains if any scientific endeavour has advanced without some mistakes, for example, would NASA stop its shuttle programme because of some failures, would roads or railways be discontinued because accidents continue to happen on them? Rather, such setbacks provide opportunities, for instance, the rehabilitation package for the Sardar Sarovar Project is a vast improvement on how such issues were looked at earlier. Even globally, it was perhaps the World Environment Conference at Stockholm in 1972 that awakened consciences and brought into focus the social, environmental and economic impacts of large dams.

In India, few large dams have aroused as much controversy or such a bitter campaign of hatred as the Sardar Sarovar Project. It had been likened by some to a disaster and yet regarded by others as the most desired and most delayed answer to their problems. Pressure was brought to bear on the World Bank to "step back" from this project, virtually terminating the approved loan. The Sardar Sarovar Project is not an isolated case; there are many others which are the targets of virulent criticism

In the enthusiastic build up of criticism against large dams, all the ills of faulty agricultural planning, improper use of the developed water made available by the dam, corruption in society, malgovernance, perceived inability of the Government to lay down and enforce right and progressive policies etc, are also heaped on the large dams themselves.

Some critics (Arundhati, 1999) seem to have already come to a firm conclusion that big dams do more harm than good and that in any case they are a brazen means of taking water, land and irrigation away from the poor and giving it to the rich. Large dams lay the earth to waste, they cause floods, waterlogging, salinity, they spread disease and so on.

Another analyst (Verghese, 1994:239-253) considers that these critics have not been able to prove their case by rational argument. He points out that the ecological impacts are greatly outweighed by project benefits in the absence of which environmental degradation, migration and distress would take a further toll. The benefits in each case are far greater than the costs, howsoever computed, and if social and indirect costs and benefits are compared, with and without the project, the net gains would be all the greater Many analysts and even the Central Water Commission concur

Arguments on the basis of the human rights of the displaced people, particularly the tribals have also been advanced to support the case against large dams. It has been argued (Arundhati, 1999) that no one should take the poor tribals away from their forests, their river, submerge their lands and sacred sites smash their community links and resettle them against their will. The counter arguments (Verghese, 1994) are forceful: It is wrong to attempt to divide Indians on the analogy of the tribals being akin to "indigenous" people, such as the American Sioux Indians. The tribal Indians of India are as much a part of "have-not India". They too must have access to education, better health, and economic and social opportunity. The choice must be theirs. Under-privileged communities, including the tribals, are moving out from undammed catchments in vast numbers because of the lack of development and opportunity. Satisfaction of a basic water requirement must be considered a basic human right. There is clearly an emerging consensus (Gleick, 1998) which accepts the right to development itself as a basic human right.

The present study is concerned only with the development effectiveness of dams. This is not a study about irrigated agriculture or energy management in India. This is not a study on the social, environmental and economic discrimination that is deemed to be present in India today, nor an outline of the steps needed to make India a welfare state without any discrimination, as is indeed enshrined in India's constitution.

The World Commission on Dams was set up to address the central issues of controversy with respect to large dams and to provide an independent review of their effectiveness in sustainable development. The Commission cannot deal with matters that are, appropriately, the concern of India, that need to be handled within the country by its lawful government and people. The India case study should, therefore, aim at eschewing passion and sentiment and seek to look at the scene objectively in the light of the Indian experience of large dams and the related needs and aspirations for the future as perceived by the Indian people as well as the lessons these might offer to the developing people of the world.

2. A Brief Review:

Nirmal Sengupta

2.1 Introduction

The geographical area of India is about 329 m ha with a wide range of physiographic and climatic variation. Average annual precipitation including snowfall is estimated to be around 4 000 BCM, of which the monsoon rainfall during June to September itself is around 3,000 BCM. The average natural runoff, according to the estimate of the CWC, is 1 869 BCM which is about 4% of global supply. The network of rivers comprises 12 major basins having a combined catchment area of about 256 m ha. In addition, there are 46 medium basins varying in size from 2 000 to 20 000 km^2 covering a total area of about 25 m ha. Basinwise distribution of surface water potential is given in Table 1. According to per capita water availability per year, India ranks 42out of 100 countries. This average applies only to India as a whole. Distribution of water resources in the country is highly uneven. The average per capita annual availability of water in the Brahmaputra Basin is as high as 18 400 cu.m while it is as low as 380 cu.m, in some of the areas of the east flowing rivers of Tamil Nadu.

Immediately after Independence and Partition in 1947, it was found that the country did not produce enough foodgrains to meet its domestic demands. In the years immediately after Independence, rapid extension of irrigation facilities was the prime objective. In the strategy that was chosen large dams had a pivotal role. In the pre-Independence period, the canal-irrigated area of the Indian sub-continent was about 28.2 m ha, the largest in any country of the world. After Partition, the canal-irrigated area that remained in India was only 8.8 m ha. In the immediate post-Second World War period, the Grow More Food Campaign was initiated in colonial India and this campaign promoted minor irrigation enthusiastically. Extensive tubewell irrigation was first introduced during this campaign. The strategy that was chosen for irrigation development was based primarily on canal and tubewell irrigation

At the time of Independence, 22.6 m ha of arable land in India was irrigated by different sources. A considerable part was irrigated by several indigenous surface irrigation methods classified in the government sources as "private canals"[7], "tanks" and "other sources of irrigation". Analysing the available data, Sengupta (1993: 94-95) shows that, till 1960-61, the net area irrigated by tanks and other sources of irrigation increased, on an average, at the rate of 123 000 ha every year. After 1960-61 the trend has been reversed; declining at the rate of 86 000 ha a year. Stress was laid on canal and tubewell irrigation. Large dams have been an important component of the canal irrigation designs. In addition to irrigation, dams have been constructed also for flood control and hydropower generation.

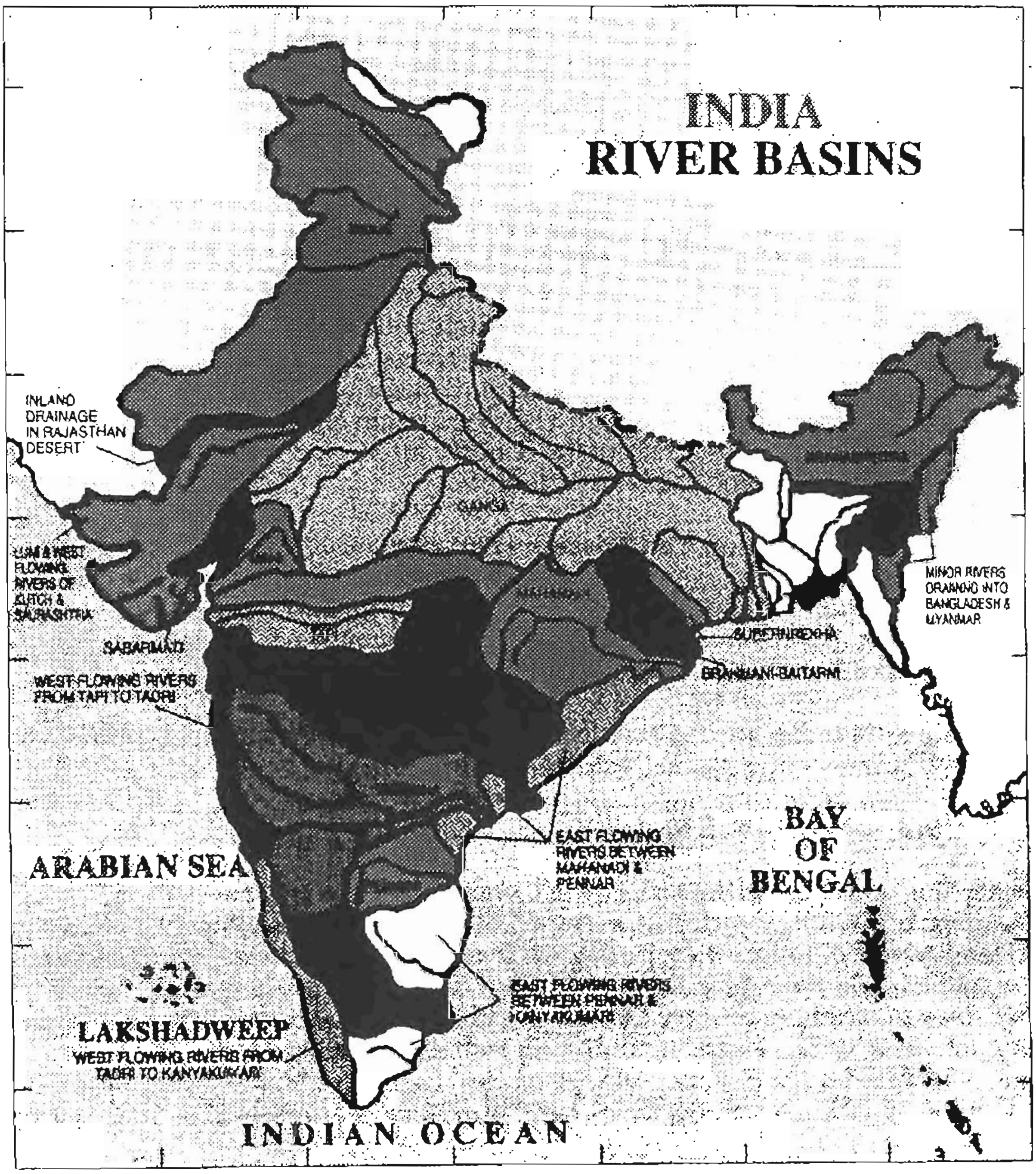
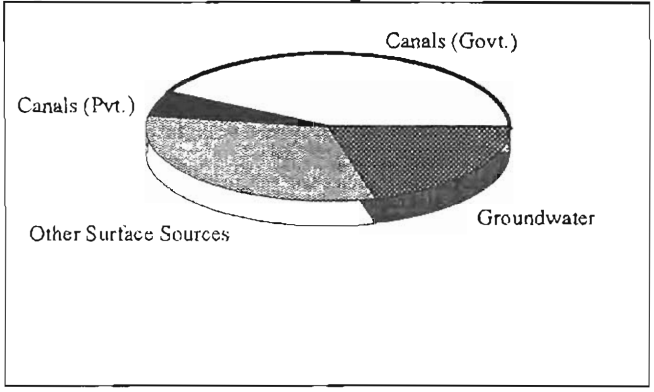


Figure 2.1 Map of India

Table 2.1 Water Resources Potential in the River Basins of India

sl. no.	Name of the River Basin		Average annual potential in the river (%)	Estimated utilisable flow excluding groundwater (%)
1	Indus (up to border)		3.92	6 66
2	a) Ganga		28.09	36 22
	b) Brahmaputra, Barak & others		31.33	3.48
	West Flowing Rivers			
3	From Tadri to Kanyakumari		6.07	3.52
4	From Tapi to Tadri		4.68	1.73
5	Narmada		2.44	5.00
6	Tapi		0.80	2.10
7	Of Kutch, Saurashtra including Luni		0.81	2.17
8	Mahi		0.59	0.45
9	Sabarmati		0.20	0.28
10	Area of Inland drainage in Rajasthan		0.00	0 00
	East Flowing Rivers			
11	Godavari		5.91	11.05
12	Krishna		4.18	8 40
13	Mahanadi		3.58	7 24
14	Brahamani and Baitarni		1.52	2.65
15	Subarnarekha		0.66	0.99
16	From Mahanadi to Godavari and Krishna to Pennar		1 20	1 90
17	Cauvery		1.14	2 75
18	Pennar		0.34	0 99
19	Between Pennar and Kanyakumari		0.88	2.42
20	Minor River Basins Draining into Bangladesh and Burma		1 66	
	Total	percentage	100.00	100.00
		in BCM	1869.37	690 32

Figure 2.2 Sources of Irrigation 1947



2.2 Spread of Large Dams

Dam construction has a very long tradition in India. With the development of modern engineering, the construction of dams took a quantum leap. As early as 1897 the Periyar Dam was constructed in the Deep South, 54 m above the foundation level. Other high dams were the Wilson Dam (82m, 1926) and Mettur Dam (70m, 1934). After Independence, there was rapid growth in dam building. The Koyna (103m) completed in 1961, was the first dam above 100 m in height But it was never much in the news because work on a giant 226m high dam had started eight years before work was begun on the Koyna. The Bhakra Dam was commissioned in 1963. On the other side of the country there were no high dams. But the Damodar Valley Corporation (DVC) with a chain of four dams, and four more in the pipeline, opened up the Tennessee Valley Authority (TVA)-type of development in India. DVC dams were between 45 - 60m high. The giant of the east was the Hirakud Dam, commissioned in 1957 With its reservoir area extending over 727km^2 Hirakud alone had twice the aggregate reservoir area of the four dams of the DVC, and more than four times the reservoir area of the Bhakra In 1966 construction work commenced on the 169 m arch dam of Kerala, the Idukki Dam. In the course of time even more impressive works have been built or are under construction. The Tehri Dam will be higher than the Bhakra. In reservoir area, several dams like the Sriram Sagar, Srisailam and Sardar Sarovar surpass the Hirakud. From fewer than 300 large dams existing at the time of Independence, the number of dams constructed and under construction has risen to about 4 291. The following table (Table2.2) shows the rate of progress of large dam construction in India.

Table 2.2 Progress of Dam Construction

Year of Completion	No. of dams	% of total
Up to 1900	42	0.97
1901-1950	251	5.85
1951-1960	234	5.45
1961-1970	461	10.74
1971-1980	1 190	27.73
1981-1990	1 066	24.84
1991-1996	116	2.70
Year of construction not available	236	5.50
Under construction	695	16 20
Total	4 291	100 00

SOURCE:CWC. 1994a. National Register of Large Dams

In Section 1.3 the institutional background was sketched to the undertaking of such a large number of dams in the 1970s. However, progress has slowed down in the last decade largely because of the paucity of funds. As already discussed, financial constraints have delayed completion of many projects already undertaken. As is evident from Table 2.3, the distribution of dams by number is highly uneven, depending on the topography of the States. The Peninsular Highlands and the Himalayan ranges have many suitable locations. Heights of dams also differ according to locations: some Himalayan States have only a few dams, but these are very large.

Table 2.3 Distribution of Dams by States

Name of the State	Completed	Under Construction	Total	Above 100m	
				Existing	u/c
Maharashtra	1 229	300	1 529	1	
Madhya Pradesh	946	147	1 093		
Gujarat	466	71	537		1
Karnataka	188	28	216	1	
Andhra Pradesh	158	26	184	2	
Orissa	131	18	149		
Uttar Pradesh	123	22	145	2	3
Rajasthan	122	4	126		
Tamil Nadu	84	13	97	1	
Bihar	61	33	94		
Kerala	38	16	54	5	
West Bengal	22	5	27		
Jammu and Kashmir	7	2	9	2	
Himachal Pradesh	4	1	5	3	
Punjab	1	1	2		
Goa	5	2	7		
Meghalaya	6	1	7		
Manipur	2	3	5		
Assam	2	1	3		
Arunachal Pradesh	0	1	1		
Tripura	1	0	1		
INDIA	3 596	695	4 291	17	4

There were no dams even under construction in Haryana, Sikkim, Nagaland and Mizoram

2.3 The Dam Builders

A brief introduction to the people who promoted the large dams in India will be useful for an appreciation of the institutional process. Modern canals were introduced into India by the British engineers who even made tanks. The post-Independence developers, while they were guided by revenue earning and market profits, had noble ambitions. Although leading politicians like Nehru, and world-famous scientists like Saha and Bhaba were among the promoters of large dam technology, not all engineers were in favour, in fact some of them opposed large dams as inappropriate. Some enthusiastic engineers and officials in important positions were the major architects. In their memoirs, the legendary Dr K.L. Rao (1978) and Dr Sudhir Sen (DVC, 1998) recall how they were opposed at almost every step by some very senior officials and politicians. Rarely were they in tune with the local State engineers. Both Rao and Sen described their opponents as people lacking foresight and expertise or as just simply parochial. The facts do not always corroborate their opinions. Objections were raised also because of the low rates or financial returns, problems of submergence and displacement and inappropriateness of designs. In many cases we learn that it was Nehru's personal intervention that settled the impasse in favour of large dams. In later years protagonists like Nehru or Saha, had been far more restrained in their advocacies of large dams.

The Central Waterways, Irrigation and Navigation Commission (later the CWC) had a decisive role in the choice of designs for water resource development. The Commission and its related offices inducted young engineers, mostly trained in the USA, who were hand-picked from all over the country and from abroad. Many of them had served as apprentices in dam construction companies and engineering concerns. Educated in the West, they were conversant with not only advanced engineering and global problems but also with Sanskrit epics. But they belonged to an era which was obsessed with "modernisation", which looked down upon any technology that could be called "traditional". In general, the educated elite of that era, or even of the present, have little regard for old farming systems in India and traditional irrigation systems. In his memoir, K.L. Rao (Rao, 1978: 49, 136) mentions that his three weeks' visit to Colombo in 1956 gave him an opportunity to see the "ancient irrigation tanks". His own State, Andhra Pradesh, had 50 000 tanks but none of his writings make any mention of these. The only conclusion to be drawn is that he either did not know of Indian tanks or did not think them worth consideration. Dr. Rao was the architect of many great dams in India, such as the Nagarjunasagar Dam in Andhra Pradesh. The alignments of the canals of this dam however, could not have had any bearing on the thousands of tanks and their drainage and supply systems that might have existed in the Nagarjunasagar command area, and least of all could there have been a bottom-up approach to water resource development beginning with the existing tanks. Yet, unlike in some other parts of India, good quality records existed regarding the tanks of Andhra Pradesh

In some other areas engineers were fully aware and active in promoting the interest of the country and the locality. At the dam site of the proposed Nagarjunasagar Dam, an abundant supply of granite was locally available. Rao decided to use it for construction. This was a radical idea; until then no one had used granite as a structural material (Rao, 1978)[8] Rao was determined and established his point through research papers in engineering science. Nagarjunasagar Dam was constructed completely with stone set in cement mortar. Except for some high cranes, very little machinery was used which saved a considerable amount of foreign exchange, generated a great deal of employment, and set a labour-intensive course of construction for large dams in India. Under the DVC Act, soil conservation and watershed management were taken up on a statutory basis from the beginning of the project which was also a radically new idea. In a way, organised environmental activity in the country began with the DVC dam.

Long before the Tennessee Valley Dams in North America, several projects in India had initiated the saga of displacement and misery. In the first quarter of the nineteenth century, the Tata Steel Industries and the Tata Power Company had displaced thousands of tribal and other people for development purpose (Mahapatra, 1999). The coal mines and other industrial activities continued these activities. In this context it is meaningful to discuss how the dam technologists, guided by India's developmental goal, behaved

In late 1950s, while designing the Hirakud Dam site, K.L. Rao (1978:29) as the Director of Designs, was not happy about the fact that "There was also heavy submersion of fertile lands". When he found the Nagarjunasagar Project site, which needed "very little submersion as the river flows through a gorge practically for 80 km" he was overjoyed (Rao, 1978: 36). The Hirakud Dam, in constrast, with its live storage capacity of 4.72 m. a. ft. and reservoir area of 743 km^2, had submerged 115 thousand hectares of good agricultural land and had affected 22 144 families. Nagarjunasagar Dam with a higher storage capacity (5.47 m. a. ft.) has a reservoir area of only 285 km^2 and had submerged only a quarter (29.5 thousand hectares) of the agricultural land that Hirakud had and had affected an estimated 1 500 to 5 098 families (Thukral , 1992: 36, 57, 60).

In general, the public sector policies towards displacement of people were more considerate than those in the private sector, though a lot was and is, still wanting. The situation differed from project to project, depending on the concern shown by the personnel in charge. Agreeing that "the rehabilitation pattern as stipulated by NWDT (Narmada Water Dispute Tribunal) is the most liberal . . . in recent decades", Roy Burman (1995:28) compared its provisions with those the Rehabilitation Policy of Rourkela Steel Company, a public sector project in the 1950s. He came to to conclusion that ". . . the rehabilitation pattern as prescribed at Rourkela in the fifties was certainly much more liberal and comprehensive and was inherently community oriented" . Large dam projects too have their share of similar imagination. In this regard the case of the Chambal valley projects (CBIP, 1987a: 101-111; Bhavanishankar, 1999) is worth recollecting (See box).

> At the Gandhisagar Dam site the project authorities marked the submergence area well in advance, identified the project-affected people and announced the rehabilitation package. All arable government lands lying within a radius of 30 miles of the periphery of the Gandhisagar Dam were reserved for the displaced. After identifying the village sites for the project-affected people, the authorities undertook the tasks of facilitating the provision of drinking water, land levelling for agriculture, construction and renovation of tanks for irrigation till the project was completed, building of roads, schools, dispensaries, maternity homes, panchayat buildings, and the protection of towns against submersion. Individual choices were attended to in the construction of new houses. The displaced could transport salvaged materials to the new site using project vehicles free of cost. The project authorities decided to avoid contracting jobs as far as possible in order to provide employment to the displaced. Not only were the displaced given construction jobs but arrangements were also made to bring them to the worksite, all at the cost of the project. Arrangements were made for hands on training, and after satisfactory completion of such training, some of the displaced were promoted to higher levels. The engineers volunteered to conduct evening classes for some of the brightest people After a year these students were examined by academic institutions and those who passed the examinations were appointed Junior Engineers at the construction site. After the completion of the dam, the new villagers were the first to get electricity.

Such rehabilitation policies were designed decades before the World Bank made any initiative in this sphere. Were they implemented? According to the rehabilitation policy, 110 wells should have been constructed; only 46 actually were. Similarly, as against the 67 school and panchayat buildings proposed, only 29 were actually built. The total number of tanks constructed was just three (Gupta, 1999). The Gandhisagar Displaced Peoples' Association is alive after forty years, even to this date demanding better rehabilitation.

Rehabilitation problems are discussed in greater detail in Section 5.3 of this report. Here attention is drawn to another aspect relevant for this part of the study. The actual flow into the 660 km^2 wide Gandhisagar Dam has been much less than the anticipated flow. In order to obtain maximum inflow of water into the reservoir, the State discourages rainwater harvesting and lift irrigation in the catchment area. The whole district of Mandasore is, therefore, totally dependent on groundwater irrigation. As a result, groundwater is being depleted at a very fast rate affecting a much wider area (the whole of the massive catchment) than just the submerged villages. The distress has spread over a large area beyond the submerged villages; Gandhisagar Displaced Peoples' Association is now campaigning on behalf of the people of the whole district (GBS, n.d.). The experience clearly shows that good rehabilitation policies, even when properly imlemented, are not the panacea for ill-conceived development plans.

Years later, as a Central Minister, Dr. Rao visited Bhakra Dam, which was commissioned in 1963, and wrote about this visit (Rao, 1978:79-80) as follows.

> *The Bhakra Project was completed in all respects and the Prime Minister dedicated it to the nation on 22 October 1963 There was a large gathering and everybody felt happy that the dam*

would confer immense benefits for all industrialists and agriculturists. It is curious to observe how we handle our projects without sparing a thought for the affected people. When the Bhakra dam was built, the village of Bhakra, situated on the banks of the Sutlej, was submerged and the people built their houses on the adjacent hills. The project resulted in great suffering to the people of the village, but nobody took note of the peoples' representations. It was many years later, during one of my visits to the dam site, that I found that the new village of Bhakra had neither drinking water nor electricity, though surrounded by blazing brilliant lights. This was indeed unfair and I asked the Bhakra Management Board to supply both power and water to the village. Even then, there were objections. The Management Board thought that this was not a proper charge on the Project. This indeed was an absurd approach which I overruled. I hope that in future proper amenities are made available in the rehabilitated villages.

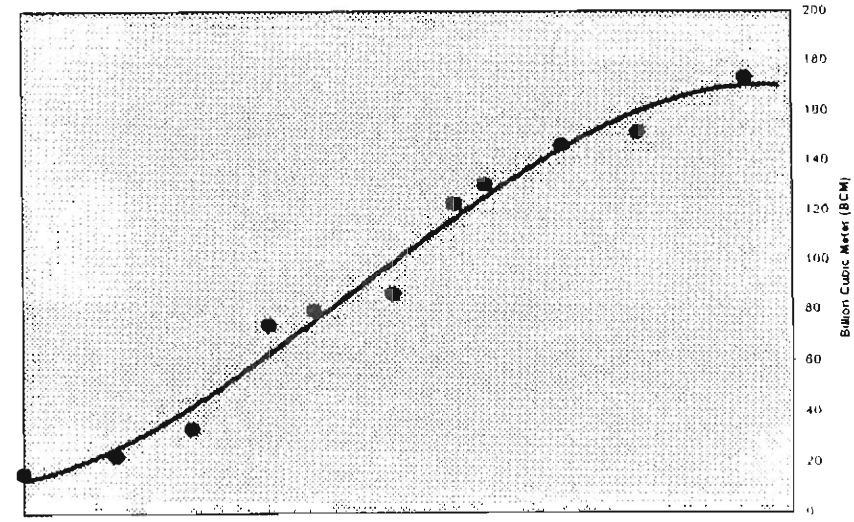
Dr. Rao was one of the rare great men who would not spare himself from criticism. With growing experience of dam construction, not only was technological knowledge increasing, but also that of the mistreatment of affected people.

2.4 Objectives and Achievements

> Large or small dams, if built without adequate preparatory work, can fail to deliver expected results.
> ICID position paper

In 1995, the total live storage capacity of dams and reservoirs completed in the country was about 177 BCM. Another 75 BCM were under various stages of construction. No work has commenced for 132 BCM, about a third of the storage potential of the country. The growth of storage capacity in the country is shown in Figure 2.3. The overall storage in all the 12 major river basins varies from 74 – 96% (CWC) This is not a dismal performance. However, some works have problems. The Central Water Commission has been monitoring the actual storage in 60 important reservoirs of the country, together which accounts for about 66% of total live storage capacity created. The average storage attained in different basins has been ranging from 54-90%. Over a ten year period (1983-1992), the Gobindsagar reservoir did not attain its designed live storage capacity for a single year. Mettur, Jayakwadi, Idukki and Gandhisagar reservoirs have touched their full reservoir levels only once in ten years (Mohile et. al. 1994).

Figure 2.3 Growth of Storage Capacity



Irrigation is either the only one or at least one of the objectives of at least 96% of the 4 291 dams. Only about 4.2% have power generation as one of the objectives. About 1% of dams has drinking water supply and less than 0.5% have flood control as one of the objectives. Navigation and industrial water supply are also included amongst the objectives of a handful of dams. However, the objectives are closely related to dam size. Almost all of those dams intended also to achieve flood control are above 30m. There is hardly one amongst those dams above 100m which does not have hydropower generation as one of its objectives.

Considerable care is needed in commenting on the achievements of different objectives. In the power sector, contributions are measured by the immediate output of generating plants. For the irrigation sector the approach is different. Contributions are very rarely measured in terms of the actual quantity of water delivered. Achievements are noted in terms of actual increase in agricultural production. This is definitely more meaningful even in cases of volumetric supply. But agricultural outputs are determined through the interaction of many different factors from which the contribution of the irrigation component has to be singled out. Also, hydropower has a specific role in power grids, and power output is not always the appropriate indicator of hydropower achievement. The result of flood control measures is only notionally described.

Immediately after Independence, India was an importer of foodgrains with domestic production at only 51 million tons. By now the foodgrains production has reached the 200 million ton mark. The country now has a marginal surplus in foodgrains which is cited as the greatest indicator of the achievement of large dams. The following table shows the shares of rainfed and irrigated areas in foodgrains production immediately after Independence and in the latest year for which data were available.

Table 2.4 Contribution of Irrigated Area in Foodgrains Production

		Rainfed	Irrigated	Total	Observed
1	Gross area under foodgrains, 1950-51 (m ha)	78.98	18.32	97 3	97 3
2	Approximate productivity in 1950-51 (t ha)*	0.4	1		
3	Estimate of Production in 1950-51 (m t): (1)x(2)	31.59	18.32	49.91	50 8
4	**Relative shares in 1950-51 : (3) as %**	**63.29**	**36.70**	**100.00**	
5	Gross area under foodgrains, 1993-94 (m ha):	76.45	48.25	124.7	124.7
6	Actual Productivity in 1993-94 (t ha)	1	2.33		
7	Estimated Production in 1993-94 (m t): (5)x(6)	76.45	112.43	188.88	185 0
8	**Relative shares in 1993-94: (7) as %**	**40.47**	**59.52**	**100.00**	

(SOURCE CWC, 1996)
** Productivity estimates for 1950-51 are not given in the source. These are the authors estimates*

In 1993-94 irrigated agriculture accounted for about 60% of foodgrains production. This too was not due solely to dam-based irrigation strategy. Irrigation projects in India are classified under three categories. major (CCA>10 000ha), medium (CCA=2 000-10 000ha), and minor (CCA<2,000ha) Minor irrigation projects include both surface and groundwater as their source, while major and medium projects exploit surface water resources alone. At the end of 1996-97, the "irrigation potential created" was 91 8 m ha as against 22.6 m ha in 1951 and of this major and medium irrigation contributed 33.8 m ha or just 36.8%. Assuming that all major and medium irrigation projects include large dams, at the most 21.9% (59.52 x 36.8) of total production foodgrains in 1993-94 may have come from irrigation based on large dams. The actual figure will be still less since not all major and medium projects include large dams.

There are many factors which can be credited with the achievement of self-sufficiency in foodgrains production In particular, the Agriculture Department claims that its productivity increase measures, like introduction of HYV seeds in the mid-1960s, rapid increase in fertiliser use, promotion of agricultural research and education, systematic extension, supply of credit for agricultural purposes, price support through administered prices etc., have been the major contributing factors. Table 2.5 is an analysis of factor contributions.

Table 2.5 Contribution of Irrigated Area in Foodgrains Production

		Rainfed	Irrigated	Total	Observed
1	Gross area under foodgrains, 1950-51 (m ha)	78.98	18.32	97.3	97.3
2	Approximate productivity in 1950-51 (t/ha.)*	0.4	1		
3	Estimate of Production in 1950-51 (m t): (1)x(2)	31.59	18.32	49.91	50.8
4	Extension of gross area under foodgrains till 1993-94 (m ha)	+27.4			
5	**Marginal Contribution of area extension** between 1950-51 to 1993-94 (m t): (4)x(2)	+10.96		+10.96 [7.89]	
6	Gross area under foodgrains, 1993-94 without any extension of irrigation (m ha): (1)+(4)	106.38	18.32	124.7	
7	Actual Productivity in 1993-94 (t/ha)	1	2.33		
8	Production in 1993-94 due to area extension and productivity increase (m t): (6)x(7)	106.38	42.69	149.07	
9	**Marginal Contribution of productivity increase** between 1950-51 to 1993-94 (m.t.): (8)-(3)-(5)	+63.83	+24.37	+88.2 [63.47]	
10	Area converted to irrigation	-29.93	+29.93		
11	Gross area under foodgrains, 1993-94 (m ha): (6)+(10)	76.45	48.25	124.7	124.7
12	Estimated Production in 1993-94 (m t): (11)x(7)	76.45	112.43	188.88	185.0
13	**Marginal Contribution of irrigation extension** between 1950-51 to 1993-94 (m t): (12)-(8)	-29.93	+69.74	+39.81 [28.65]	
14	**Share of major and medium irrigation of 13** (36.8%)			[10.54]	

(SOURCE CWC, 1996)

* *Productivity estimates for 1950-51 are not given in the source. These are the author's estimates*
Figures in [ ] are marginal contributions of the factors expressed in percentage.

Thus, the major part (63.5%) of the increase in foodgrains production is due to the productivity increase measures. Assuming that most, not all, major and medium irrigation projects are dam-based, the marginal contribution of large dams to increased foodgrains production is less than 10%. This is not insignificant, but not spectacular as is sometimes claimed. Table 2.5 also shows that rainfed farming has responded well to productivity increase measures. This finding goes against the common belief that development of agriculture is possible only if there is some irrigation facility and that HYV seeds or fertilizers cannot be used under rainfed conditions. In reality, the rainfed areas are not devoid of water management measures, although the term used conveys such an impression. (This will be discussed in Chapter 6, in the introduction of options.) The productivity increase measures have benefited both irrigated and rainfed areas.

Substantially change has occurred in the cropping pattern (Table 2.6). The food base of the country has changed increasingly to rice and wheat with the reduction in the importance of millets. The production of other food crops has improved and the oilseed crisis faced by the country has been overcome. It is not possible to distinguish the contribution of different sources of irrigation in bringing about these changes. Large dams certainly contribute their share, as do the tubewells, wells and small irrigation systems. However, the growth of irrigated sugar cane cultivation and some similar changes also indicate that large farmers have cornered higher shares of benefit. Since minor irrigation sources are not used by large farms, the greater part of this increasing inequality might have been contributed by the major and medium irrigation systems. It is probably true that large farmers have benefited disproportionately from large dams.

Table 2.6 Changes in Cropping Pattern between 1952-53 and 1992-93

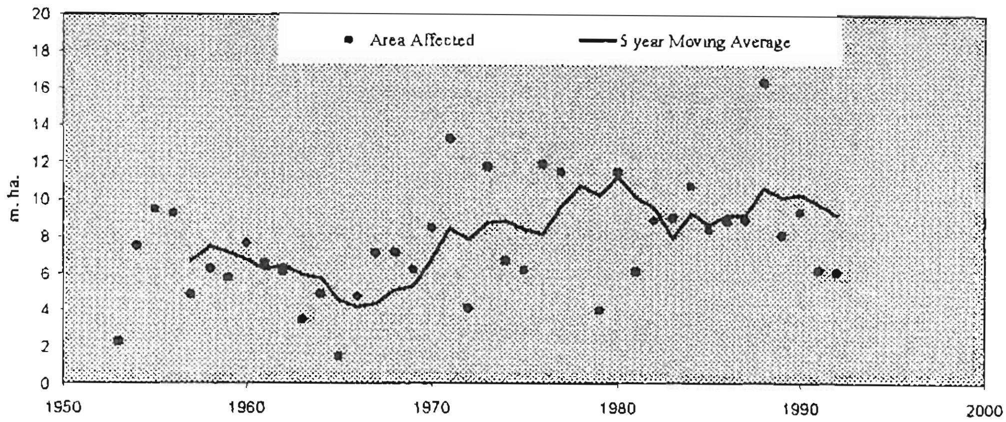
	Addition to cultivated area (m ha)	Allocation of new irrigated area to different crops	% increase inirrigated variety	% irrigatedin 1992-93
Wheat	14.70	39.3	47.1	84.2
Rice	11.87	24.0	15.7	21.5
Maize	2.37	1.8	7.4	48.0
Other Foodgrains	-8.94	-1.0	0.6	8.9
Sugar cane	2.15	5.3	22.0	88.3
Condiments and Spices	1.54	3.1	47.3	50.7
Fruits, Vegetables and Roots	4.99	6.5	38.8	40.5
Other Foodcrops	-0.64	-1.8	13.0	-
Oilseeds	15.67	14.6	23.2	24.1
Cotton	1.47	4.9	26.1	34.6
Fodder crops	2.55	4.8	24.6	24.7
Other non-food crops	0.21	-1.3	-17.9	-
Gross Irrigated Area	47.93	100.0	19.0	-

(SOURCE: Tables 1.4, GOI (1992-93))
Comparable categories are available only since 1952-53.

At the time of Independence, the country had already installed about 500 MW generation capacity in hydropower. This was in the private sector. No further expansion by the private sector was allowed until the policy revision in the last decade The public sector, however, took to hydropower development on a large scale. By now the country has added about 23 019 MW of hydropower generation capacity. In the late 1980s hydropower accounted for more than one-third of the total power generation in the country. However, the progress has slowed down in recent years to an average of 400 MW addition every year during the last decade. The share of hydropower in total power generation has come down to about 25%. The reasons have been discussed in section 1 5

Figure 2.7 shows the area affected by floods in the whole country in different years The five-year moving average shows a slight decrease in the first few years after Independence and a considerable increase since then. However, the contribution of large dams to this decrease needs closer scrutiny because other flood control measures were also adopted. In fact, the evolution of the flood control policy in India has considerable relevance for understanding the actual role played by dams in this respect.

Figure 2.7 Area Affected by Flood



Following the adverse effects of the Damodar Embankment constructed in the 1850s, the engineers in India debated for about a century on the appropriate technique of flood control. In the early 20[th] century there was little dispute about the unsuitability of embankments as a flood control measure In 1938, the National Planning Committee under the Chairmanship of Jawaharlal Nehru stated in its recommendations (cited in Ghosh & Sen Sharma, 1982:93):

> *Indiscriminate construction of flood embankments should be discontinued since they positively restrict the flow of the river and deteriorate its flow regime in contravention to the rights of the rivers to have sufficient space for their accommodating the full discharge*

Storage of water as a solution was first suggested for Mahanadi in 1862 (D'Souza, 1998) and for Damodar in 1863 (DVC, 1958). The colonial government was not prepared to meet the expenses of a flood control project which would not bring any financial returns. But in 1943, after a small flood in Damodar disrupted the transport system for the war operations of the government in Burma, the Governor of Bengal appointed the Damodar Flood Enquiry Committee to suggest suitable remedial measures. By then engineering techniques enabling for large dam construction had been developed The Enquiry Committee recommended a large dam strategy In order to provide financial strength the Committee included generation of electricity as an additional objective Thus began the famous multipurpose project on the model of Tennessee Valley Authority in the United States In 1945 the GOI invited a planning specialist from TVA to draw up a plan (DVC, 1998 60-61). The proposal for the construction of the Hirakud Dam on the Mahanadi, designed exclusively for flood control, was also accepted in 1945. The DVC plan had made the sanctioning of the Hirakud Dam proposal much easier: the Orissa's answer to flood havoc (D'Souza, 1998).

Thereafter, a large dam was rarely constructed primarily for flood control Instead the embankment strategy made a comeback. The reasons for that deserve attention. In 1947 construction of Barahkshetra Dam in Nepal was proposed as the only meaningful option for flood control in the perilous Kosi belt of Bihar (Bhaba, cited in Mishra, 1997:2210). But no move was made toward the construction of the dam because it was felt that there was no demand for the magnitude of power generation and irrigation proposed (Verghese, 1999:139). Then in 1953, being moved by the plight of the people after a severe flood in that region, Nehru insisted on doing something immediately (Mishra, 1997:2211-2). Embankments were the only known technique of flood control that could be implemented within a short time and at low cost. Immediately after this a National Programme of Flood Management was launched in 1954 which again endorsed the embankment technique amongst others In 1954 the length of embankments was around 6 000 kms. Since then 16 199 kms of new embankments have been added, agreeing all the while that embankments are only short-term solutions Government expenditure for flood control has risen from Rs. 130 million in the First Plan to Rs. 16 900 million in the Eighth Plan, a tenfold increase in constant prices.

For flood control, large dams are, therefore, a structural option considered better than embankments but used only sparingly. The very few dams constructed specifically for this purpose permit assessment of the effectiveness of dams as a flood control strategy. In addition, what needs to be investigated is whether the construction of large dams for the purposes of irrigation and power generation is the cause of floods in areas which probably never had one floods before.

Be it Hirakud, DVC or Ukai, there is no dispute that floods have been moderated by these dams though not totally stopped. From technological assessment even moderation is a success since an occasional higher inflow than the planned storage capacity could never be ruled out. But new contingencies have arisen and the strategy of large dams is not at ease to face those. Even though moderated. floods still occur. This point will be discussed in greater detail in Section 6.2 (Performance Improvement Options).

Large parts of the Eastern and North Eastern States are traditionally flood-prone areas. But there is a disquieting perception that the expert of the flood-prone area in the country is increasing. Floods are now occurring outside the old flood-prone areas in the Himalayan ranges, and in western and peninsular India. It is doubful whether deforestation alone is responsible This too will be discussed further in Section 5 2.2.1 (CSE, 1991).

Public water-supply is not a frequently stated objective; many dams have added this objective at a later date. Whatever the original objective, this public water-supply is welcome and is in accordance with the prioritisation of purposes in the National Water Policy. Compiled statistics is not available Stray reports confirm that the drinking water requirements of many towns and mega cities in India are met from the reservoirs of irrigation/multi-purpose schemes existing in nearby areas and even by long distance transfer. In the national scene, 90% of drinking water in the country is supplied from groundwater sources. Also, drinking water problems are increasing over the years

Exact information about the use of dams for the purpose of navigation is not available So far only three out of a proposed 10 national waterways have been announced. These are yet to make the desired impact on the economy. No compiled data are readily available for dam-based storage meeting the industrial need of water. This is an important function, sometimes the primary function. of some dams

Certain benefits are not included among the declared objectives. Inland pisciculture has prospered in the reservoirs. From stray reports available, it seems that this activity is widespread and its output substantial. Also, it supports many fisherman families. Unfortunately, compiled data are not available Under various projects, forests have been developed for soil conservation works both in catchments and on canal banks and as compensatory forestry for the submergence of existing forestland. Some reservoir areas are popular recreational spots.

2.5 Future Outlook

According to the Planning Commission (1999:v.2, p. 483) as much as 92% (1 050 BCM) of the 1 140 BCM total utilisable surface and groundwater resources of the country would be required to be put to use by 2025 AD. This means that almost the whole of the estimated ultimate storage potential of 384 BCM must be completed by 2025. Not only the 75 BCM that are under various stages of construction, but also the 132 BCM still under consideration should be completed. In the hydropower area too, an ambitious perspective has been laid out. According to a projection made by the CEA, total installed capacity at the end of the Eleventh Plan (2007-12) will include a hydropower component of about 74 000 MW which amounts to an addition of 52 000 MW within the next 12-13 years. In the area of flood control, no separate perspective based on dams has been set although dams for both irrigation and hydropower will also serve this purpose. The feasibility of this plan will now be considered.

Table 2.8 Future Potential of Water Resource Development

Region		Storage		Hydroelectricity at 60%LF*		
		Completed and Under Construction	Projects under Consideration	Potential developed and under development	Potential not developed nor under development	Potential not yet explored or cleared
North-eastern		1.53	67.31	3.48	47.83	49.20
Northern		19.92	4.66	36.05	35.83	34.99
Eastern		11.27	2.71	8.53	6.11	5.65
Western		39.38	16.44	17.78	3.58	3.36
Southern		27.92	8.89	34.16	6.65	6.80
TOTAL	%	100.00	100.00	100.00	100.00	100.00
	Actual	249.15 BCM	132.3 BCM	18812.5 MW	65231.5 MW	62428.0 MW

* As on 1 April 2000. Data supplied by CEA.

The north-eastern States, the Brahmaputra-Barak Basin, accounts for 67% of possible storage projects not yet taken up and 48% of unused potential of hydroelectricity. Projects here may effect flood control but there is hardly any scope of irrigation. Another 36% of hydropower potential is in the Himalayan belt of Ganga Basin. This region has plenty of groundwater, and surface storage for irrigation is not a high priority. The future priority in surface water development for irrigation is therefore, confined to peninsular India (Reddy, M.S., 1992). The prospect of exploitation of the internal rivers is not very bright. Due to non-settlement or excessive delay in the settlement process of inter-State river disputes, a large irrigation potential and about 5 to 6% of country's ultimate hydropower potential remains locked (Navalawala, 1999: 36). To exploit the hydel potential located in the Himalayan region, several mega dams are planned, some of which are more than 200m in height. Apart from the fragile ecological nature of the Himalayan region, these dams are also in difficult locations. Tapping these sources is much more costly as compared to thermal power (Planning Commission of India, 1999a: vol. 1, p. 41). Besides, the Brahmaputra River passes through China before entering India. Current water availability may be reduced if in the future, China diverts a substantial part of the Brahmaputra's water for its own needs. Some authorities feel that defence considerations will restrain the process of extension of a series of massive storages that will make a very wide and populous tract of the country vulnerable in the event of international conflicts.

Some authors feel that the estimates of available, utilisable and utilised water resources as well as ultimate irrigation potential must not be taken as sacrosanct (Sengupta, 1993:103-108; Vaidyanathan, 1999:106-8). Apart from other considerations, accurate estimates cannot be made because of natural and potential social uncertainty. By detailed probing a worse scenario may be arrive at or unforeseen possibilities and other feasible plans may be revealed.

The first estimate of total surface runoff, made in 1976, was 1 850 BCM. Since then the figure has been revised upwards several times. The current estimate is 1 869 BCM, but both the database and the estimation method are crude. The Central Water Commission has recently established a hydraulic observation network all over the country. However, it is far short of the standards specified by the World Meteorological Organisation (Reddy, M.S., 1992). The States have their own gauges, but since many rivers are the subject of inter-State disputes, they are unwilling to provide the data on flow measurements (Vaidyanathan, 1999:106). As M.S. Reddy observed (1992), "Inadequate data used in earlier projects is to a great extent responsible for their less than optimum performance, e.g. the reservoirs which do not fill up to their design capacity year after year."

The current estimate of utilisable surface water resources is 690 BCM. The way this estimate has been arrived at can only be described as a guess. The Irrigation Commission (1972) was of the opinion that 35% of the runoff in the whole country could be utilised; K.L. Rao estimated 50% and the National Commission of Agriculture (1976) suggested a figure as high as 56%. The current estimate is 37%

The ratio is not determined by any natural law; it depends on two sets of factors, the state of appropriate technology and water resource management methods. Appropriate technology may enhance utilisation whereas bad management may lead to wastage even from existing facilities. The current estimate of utilisable water, given by the CWC, should be appreciated in the light of these two factors.

A proper estimate of utilisable surface water flows by only those techniques considered by the CWC would require detailed surveys to identify all the possible sites for storage or diversion of river flow. evaluating these sites from the viewpoint of engineering feasibility, and the quantum which could be drawn for use. Instead, the estimates given by the CWC are based on some gross calculations by river basins and sub-basins. Vaidyanathan (1999:107) states that an attempt was made by the CWC during the 1950s, to indicate potential sites, their storage capacities, and utilisation. These reports, running into several volumes, give assessments of technological possibilities of irrigation development for all river basins and sub-basins. They include maps indicating locations of existing and potential storage sites. The reports have not been published, nor does the exercise appear to have been followed up by detailed field surveys and investigation to improve and refine the estimates.

The inclusion of additional techniques will increase the estimate of utilisable flow. One such possibility is inter-basin transfer. The Ministry of Water Resources has prepared a National Perspective Plan and the Government of India has set up a National Water Development Agency for carrying out the necessary surveys and preparations for inter-basin transfer of water. However, no notice is taken of the fact that the estimate would increase if utilisation by many traditional irrigation and water utilisation techniques, which are based on principles different from storage and runoff utilisation, were also included. An amount estimated at 1 650 BCM is shown in the water balance calculations as lost from total precipitation before forming surface runoff. This has been described variously as "local retention" or "soil moisture" This is actually the source of water for the various water utilisation techniques in rainfed agriculture, including *in situ* storage (Sengupta, 1993 106-7). Most watershed management programmes increase utilisation of parts of this source of water

Inclusion of the water management factor will drastically alter the current official estimate of utilisable surface water and ultimate irrigation potential. Vaidyanathan points out that all those measures that are technically feasible are not economically viable. The CWC estimate does not take into account the economics and is only a technical feasibility report. If other non-technical features had played a significant role, a meaningful criterion could have involved such issues andit would have lead to more feasible designs. In many cases, opting for a somewhat smaller size dam might have helped more in the achievement of equity or environmental preservation and would have permitted the projects to proceed smoothly.

"We have created a live storage of 192.7 BCM, but we have no data on the extent of actual utilisation This data is vital for planning future projects in any basin" (Reddy, 1992) The way the ultimate irrigation potential is estimated is absolutely crude; the data are highly sensitive to water management methods. The extent of the area irrigated from a given amount of water depends on a complex set of factors: agroclimatic patterns, the nature of the system, crop patterns and standards of water management There is considerable scope for change in the future, particularly through acceptance of suitable crop patterns and cropping practices.

It is also possible to alter the technical designs to increase the viability of a dam. Some 10 years back. while writing about the Sardar Sarovar project, B.D.Dhawan (1990:33) had suggested, " the problems of displacement of the people, which is now causing great anxiety in many quarters, can be substantially reduced in scale by adjusting the height of the proposed dams on the Narmada".[9] Paranjape and Joy (1995) proposed, along the same lines, some modifications in the official designs of the Sardar Sarovar project. Interestingly, they found that an alternative design retains most of the expected benefits The main feature of the design is to drastically reduce the need for storage behind the dam.

The draft design proposed by Paranjape and Joy (1995) meets the following requirements:

- (i) an FRL of 107 m (as against 138.7 m at present), reducing submergence by almost 70% and displacement by almost 90%
- (ii) full utilisation of Gujarat's share of 9 MAF of Narmada water
- (iii) increase in the share by the drought-prone areas of Kutch, Saurashtra and North Gujarat
- (iv) rehabilitation of the displaced people as part of a development plan for an upstream area of 100 000 ha,
- (v) establishment of permanent vegetative cover on more than 11 m ha in the service area
- (vi) cost not more than the estimate by the World Bank in 1985
- (vii) provision for early delivery of water to Kutch, Saurashtra and North Gujarat

Instead they propose to store Narmada water in dispersed, local surface and groundwater storage and the central system would basically have the role of diverting and conveying exogenous water to these local storages through a series of canals, barrages and lifts.

It may be noted that the suggested design closely resembles that of the existing Tambaparni irrigation system (see Annexure 4)

3. The Framework of Laws, Policies, Institutions and Procedures[10]

Ramaswamy R. Iyer

3.1 Preliminary

This chapter will provide a broad but compendious survey of the legal and institutional structure. setting and ambience within which large dam projects have come into being and functioned in India: the details of actual project experiences will figure in other chapters. The survey will be limited with reference to the purposes of the present review, undertaken for the WCD, of India's experience with large dams. While the chapter has been divided into sections on laws, policy, institutions, etc.. for convenience, there will inevitably be some overlap among the sections.

3.2 Laws

There is no separate law or set of laws in India relating specifically to dam projects. The planning, approval, financing, construction, operation and maintenance of such projects take place within the constitutional and legal framework of the country, and in particular, within the provisions relating to water.

In the quasi-federal structure of the Indian Constitution, with its allocation of legislative competence through three lists (Union, State and Concurrent), entries relating to water figure in both the Union List and the State List. The primary entry relating to water is Entry 17 in the State List:

> *Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power subject to the provisions of Entry 56 of List I*

The legislative competence of the States in relation to water, conferred by Entry 17 in the State List, also implies executive power, and it is this that enables the State Governments to plan and implement dam projects.

Entry 56 of the Union List (to which Entry 17 in the State List has been made subject) runs as follows.

> *Regulation and development of inter-State rivers and river valleys to the extent to which such regulation and development under the control of the Union is declared by Parliament by law to be expedient in the public interest.*

In terms of the constitutional provisions, the Central Government could perhaps have played an important role in relation to inter-State rivers, if it had managed to have the necessary laws passed by Parliament, particularly as most of India's important rivers are inter-State rivers. However, the Central Government has not made (or been able to make) significant use of the enabling provisions of Entry 56. There has been a good deal of discussion on whether water should in fact have been put in the Concurrent List, and whether the Constitution should now be amended to bring this about, but that issue is not relevant in the present context.

An important component of Indian federalism in relation to water resources, though not a constitutional one, is the National Water Resources Council (NWRC), established by the Government of India by a Resolution in 1983. Though the NWRC does not have any statutory backing, its composition ensures its importance and influence. It is headed by the Prime Minister, has the Minister of Water Resources as the Vice-Chairman, and includes all State Chief Ministers and several Union

Ministers as Members; the Union Secretary, Water Resources, is its Secretary. The NWRC provides a forum at which issues of water policy, co-ordination, co-operation, conflict-resolution, and so on can be discussed and answers found. It was the NWRC that approved and adopted the National Water Policy in 1987; that approval and adoption implied a national consensus. However, the NWRC has not been meeting regularly. From 1983 to 1999 it has met only three times: at its first meeting in October 1985 it set up a Group of Ministers to formulate a draft National Water Policy for its consideration; at its second meeting in September 1987 it approved and adopted the National Water Policy; and in 1995, in the context of the Cauvery Dispute, it had its third meeting but no important decision was taken at the meeting.

From the wording of the constitutional provisions, it would appear that the Constitution-makers were essentially thinking of river waters; and while there are references to irrigation, canals, embankments, and water power, there is no explicit evidence of an awareness of traditional community-managed systems of rainwater harvesting or water management, nor of water as a natural resource and a part of the larger environment or the ecological system. (Some of the emerging concerns were incorporated into the Constitution at a later stage. Under the 42nd Amendment of 1976, references to the protection of the environment, forests and wildlife were introduced *via* Articles 48A and 51A, and two entries relating to forests and wildlife were added to the Concurrent List.)

Article 262 of the Constitution provides for the adjudication of inter-State river-water disputes. The legislative competence of a State under Entry 17 of the State List has to be exercised in such a manner so as not to prejudice the interests of other States and create a water dispute within the meaning of Article 262. This has been clearly stated in some of the Tribunals' Awards.

The Inter-State Water Disputes Act 1956 (ISWD Act) passed by the Union Parliament under the provisions of Article 262 is an important law in the context of the planning and construction of dam projects. The concern here is not with the problems experienced in the operation of the adjudication process or the changes that are felt to be needed, but with the bearing that the Act has on dam projects. Not only must the allocation of waters and the restrictions (if any) imposed by the Tribunals Award be kept in mind, but in some cases the Awards have an even more direct relevance for project planning: projects figure in some Tribunal Reports (eg Narmada, Krishna); the Narmada Tribunal's Award specifies certain project features; in some cases the Award itself leads to the formulation or acceleration of projects with a view to making sure of retaining the State's share of the waters (eg planning for Krishna waters by Maharashtra); and there are also new post-Award disputes relating to certain projects (eg the Karnataka/Maharashtra – Andhra Pradesh dispute over the Telugu Ganga Project, the dispute regarding the Alamatti Project between AP and Karnataka, and that between Gujarat and Madhya Pradesh regarding the height of the Sardar Sarovar (Narmada) Dam)

(It must be noted that in the context of the ISWD Act, "inter-State river-waters disputes" means *inter-governmental* disputes. Implicit in this is the assumption that rivers are resources of the state to be dealt with by the government *for* the people. This fails to recognise that the people could have concerns and interests of their own, and that there could be conflicts between these and the aims and purposes of the government. This point has come up in some recent cases.)

The role given to the Central Government in relation to inter-State rivers is reinforced by the use of the provisions of Entry 20 in the Concurrent List, namely, economic and social planning. It is that entry which provides the necessary constitutional basis for the requirement of a Central Government clearance for major and medium irrigation projects (including those not involving inter-State rivers) for inclusion in the national Plan. This has been questioned by some State Governments but the clearance requirement continues to be operative, though some relaxations have been made in the case of "medium" projects which are now subjected only to a summary or "pro forma" check

(In passing, it may be noted that the sanction behind the clearance requirement is the leverage that the Central Government has through the provision of Central Government financial assistance to State

Plans. This is a weak sanction because the Central Plan assistance to States, calculated under what is known as "the Gadgil Formula", which came into operation from the Third Plan, is, with a few exceptions, not project-linked. Prior to the introduction of this system there was in fact a close project linkage, but that is not the case from the Third Plan onwards. Under the circumstances, the Central Government's ability to influence the planning and implementation of State projects has been rather limited. In recent years there has been a change in the situation. There are some special instances of project-linked assistance: for instance, externally aided projects which receive an "additionality" of Central assistance; certain projects considered to be of special national importance; the Accelerated Irrigation Benefits Scheme; power projects receiving funds from certain Central organisations; etc. In such cases, the Central Government may have a greater degree of influence. This, however, begs the question of the extent to which the Central Government's view of project planning is in fact different from that of the States.)

The River Boards Act 1956, passed by Parliament under Entry 56 of the Union List, provides only for the establishment of advisory boards, but no boards even of an advisory kind have been set up under the Act: the Act has remained virtually inoperative. This point will be reverted to later in the discussion on "basin planning"

Other important Central Government enactments having a bearing on dam projects include the Environment Protection Act 1986 and the Forest Conservation Act 1980. Central clearances under these Acts are an essential part of the processes of approval of dam projects for inclusion in a Plan. There is also the Wild Life (Protection) Act 1972 and the Water (Prevention and Control of Pollution) Act 1974. There are other water-related laws, eg legislation relating to groundwater, but they have only an indirect bearing on the subject of the present report.

There are numerous Acts at the State level (Irrigation Acts, Irrigation and Drainage Acts, and other related Acts) – and Rules and Regulations made under these - concerned with irrigation, canals and their maintenance, maintenance of tanks, and so on. There are also Command Area Development Acts in several States. All these Acts have a bearing on the actual *operation* of dam projects. Currently, there is some advocacy of separate legislation to provide a legal underpinning to the programme of Participatory Irrigation Management (PIM) which seeks to transfer the management, at a certain level, of irrigation systems below the outlet to farmers' associations; the Andhra Pradesh Government has passed such an Act (the Andhra Pradesh Farmers Management of Irrigation Act 1997).

There are many legal issues relating to water:
- access to water as a basic human right;
- the asymmetry in law between flowing surface water (over which only use rights and not ownership rights are recognised by Indian law) and groundwater (in respect of which The Indian Easements Act 1882 confers "easement" rights on the owner of the land below which the water lies, subject of course to the right of the state to regulate and control the use of the water).
- the ill-defined water rights of irrigators *vis à vis* the state in an irrigation system,
- the need (argued by some) for some kind of a "National Water Code" providing (*inter alia*) a legal backing to the recognition of water as a scarce and precious resource to be used with care and economy;
- the need (again argued by some) for a formal declaration of water-sharing principles.
- the issue, which has gained prominence in recent years, of the relationship between the people and the state in the matter of water-resource planning; and so on.

These are general issues of water law and policy, and only some of them have a direct bearing on dam projects. However, it is relevant to note that the exploration and development of non-dam approaches to water planning, such as water-harvesting and watershed development, are hampered by the fact that the control and management of water harvested in the state. For instance, in Rajasthan where community efforts under the leadership of an NGO (Tarun Bharat Sangh) resulted in the reappearance of water in wells and streams that had long been dry, a conflict emerged between the civil society that had brought this recovery about and the State Government which claimed legal rights over the water This problem needs to be resolved. (Similar difficulties have also been faced by people who have tried, in the Himalayan region, Kerala and elsewhere, to develop micro-hydel stations on their own.)

Dams are also built for the generation of hydroelectric power. Here the constitutional position is different. Electricity is in the Concurrent List, and both the Central Government and the States can legislate (and consequently exercise executive power) on the subject. While irrigation (and "multi-purpose") projects are undertaken by State Governments, there can be power projects in the Central sector as well. Two Central corporations, National Thermal Power Corporation (NTPC) and the National Hydro Power Corporation (NHPC), have been established for undertaking such projects. The Central Electricity Authority (CEA) is a statutory body established under The Electricity (Supply) Act 1948. Until recently, all power projects required a statutory techno-economic clearance by the CEA, but this has been substantially relaxed in the course of the "Economic Reform" process that has been going on since 1991. For facilitating private sector investments (both Indian and foreign) in the power sector, projects below certain capacity and investment levels have been exempted from the requirement of a clearance by the CEA.

Large dam projects often involve the displacement, resettlement and rehabilitation of people. Taking displacement first, the instrument of displacement[11] is the Land Acquisition Act, dating back to the 19th century, under which private land is acquired by the state for a public purpose. This is an important Act in the context of the implementation of most large projects (including industrial projects), but it has a special importance for large dam projects because of their large land requirements. The actual operation of the Act has been beset with problems in many cases Project planners and managers tend to complain about serious delays and protracted litigation, leading to slippages in project time-schedules and cost escalations; the people whose lands are being acquired tend to complain about inequities and injustices, disparities between cases, delays in compensation payments and corruption (apart from the upheaval always involved in displacement) The grievances of the people are clearly more weighty than the administrative inconveniences that project managers complain of. Though notifications are issued regarding the intention to acquire land, this does not really constitute consultation. The affected people can question the quantum of compensation, but it is very difficult for them to challenge the "public purpose" claimed by the state, or to argue that alternative ways of achieving that public purpose should be considered Until recently, there was no statutory requirement of a public hearing in relation to such projects. Such hearings have now been introduced but have not yet become a well-established procedure. Unfortunately, the "eminent domain" claimed by the state over land and water tends to prevail over the rights of the people It is generally agreed that major changes are necessary to the Land Acquisition Act and related procedures

In regard to both displacement and resettlement/rehabilitation, issues of equity, social justice and human rights arise, between people and the state, between people in the catchment or submergence areas and those in the command area, and between different groups in the command area State Governments have indeed tried to provide project-affected persons with rights in the command area. Mention may be made of the Madhya Pradesh Project Affected Persons Resettlement Act (Pariyojanaon ke Karan Visthapit Vyakti Punahsthapan Adhiniyam) 1985; the Maharashtra Project Affected Persons Rehabilitation Act 1986; and the Karnataka Resettlement of Project Displaced Persons Act 1987 While these Acts are on the statute book and contain some enlightened provisions, it cannot be said that they have been fully put into practice. Similarly, well-intentioned provisions such as the collection of a "betterment levy" from farmers whose lands reap the benefit of irrigation at state expense, or a lower land ceiling for irrigated land as compared with unirrigated land, have remained largely unimplemented.

A digression here from the point of view of the beneficiaries of a project in the command area might not be out of place. Clearly, attempts to provide a share in the benefits of a project to the affected persons run into difficulties because of resistance on the part of those already owning land in the command area They are also "stakeholders", what then can they say on their own behalf? Some may be enlightened and may recognise the rights of the project-affected persons, but by and large, the beneficiaries as a class may say the following: " *We are good farmers. We need irrigation. We happen to be in the command area. Please deliver the irrigation water to us, and we will show you results in the form of increased agricultural production. We shall no doubt prosper, but our prosperity will be identical with the common good of the nation. If in this process the people in the upper catchment or the submergence areas are subjected to hardship, that is a sacrifice they have to make in the larger interests of the country. In any case, we have nothing to do with it; it is for the state to look after the project-affected persons and mitigate their hardship.*" That is not a quotation taken from any document but an attempt to put a particular argument in a nutshell, and it has been deliberately over-simplified. It may seem a caricature of the beneficiaries' position, but arguments on these lines have been heard, though expressed with greater sophistication and subtlety, not only from the beneficiaries but even from the official and other defenders of large dam projects. This is clearly an unacceptable proposition from the point of view of social justice, and it goes against the project-affected persons' right to life and right to equality before the law. (That some people should be willing to make sacrifices for national economic "progress" is the proposition – of questionable morality - that often underlies the calculus of "cost-benefit analyses".)

Apart from special legislation of the kinds mentioned above, the general laws of the country apply. Persons or groups who feel that they have been subjected to hardship or injustice can have recourse to the Fundamental Rights provisions of the Constitution and the writ jurisdiction of the courts, or to the National Human Rights Commission set up under The Protection of Human Rights Act 1993. Members of the Scheduled Castes and Scheduled Tribes could perhaps approach the National Commission for Scheduled Castes and Scheduled Tribes for support, though that institution may have no statutory role to play in this context. The provisions of the Tribal Self-Rule Act 1996, which provides for consultation with tribal communities as a necessary part of project planning, could be invoked. UN conventions such as the ILO Convention 107 (ratified by India) also have a role to play. (Part IV of the Constitution of India, which lays down The Directive Principles of State Policy, is not justiciable, but those principles have to guide governmental actions; some of these principles have a bearing on dam projects.)

When projects are planned on rivers that cross India's borders and come from or go into other countries, the provisions of Article 51 of the Constitution (part of the "Directive Principles"), as well as "international law" in the sense of internationally accepted principles (earlier, the Helsinki Rules which had only the force of consent, and now the Convention on the use of international watercourses adopted by the UN General Assembly and awaiting ratification) have to be borne in mind. India is not a signatory to the latter Convention and is not bound by it, but if the Convention does come into effect upon ratification by the required number of countries, it will acquire a certain moral force which it will be difficult to ignore.

The subject of laws cannot be concluded without a reference to the notorious Official Secrets Act, which creates a veil of secrecy around governmental actions, keeps the people at a distance, makes things as difficult as possible even for individuals and non-governmental organisations (NGOs) with a proven record of service to the people, hampers academic studies, and in general renders all talk of "participatory" or "people-centred" planning meaningless. In cases of inter-State or international disputes, river flows are classified as secret, making constructive work on conflict-resolution very difficult. When certain projects face opposition and controversy on environmental or human (displacement) grounds, the Act is sometimes used to deny information (or even physical access to places) to the investigators. This is a widely recognised evil. There has been a movement for reform and for a "Freedom of Information Act". A Bill in this regard is expected to be introduced in the near future.

Note must be taken here of the creation of case law by the Judiciary. A new dimension has been added to the legal and policy framework by the persistent efforts of the Judiciary to expand the human rights jurisdiction of the courts and extend the scope of judicial review of executive action, and it's the Judiciary's readiness to strike down laws that it considers inconsistent with the spirit of the Constitution. This phenomenon, known as "judicial activism", is not without its critics, but it has been widely welcomed in the country. As a part of this "activism", the Judiciary has been encouraging what is known as "Public Interest Litigation" (PIL). Public-spirited individuals and NGOs have played an important role in these developments. There are critics of PIL too, but it is generally recognised that it has been a valuable innovation.

Finally, reference must be made to the fact that apart from the Union and the States, there is now a third tier in the constitutional structure, created by the 73rd and 74th Amendments, namely, local bodies of governance at the village and city level: the village *panchayats* and the city *nagarpalikas* (municipalities/corporations). The Eleventh and Twelfth Schedules to the Constitution lay down lists of subjects to be devolved to the *panchayats* and *nagarpalikas*. The lists include, *inter alia*, drinking water, water management, watershed development, sanitation, and so on. It seems likely that in future this third tier will come to play an important role in relation to water resource development. However, the processes of decentralisation are still evolving, and the role of the third tier is as yet only incipient. In any case, this *new* development is only of limited significance in a review of *past* experience. (In parenthesis, the point needs to be made that even when fully developed, the third tier of the Constitution, namely the *panchayat* and the *nagarpalika*, will still remain "state" and will not become synonymous with "people". The question of the relationship between the state and the people will continue to be important.)

3.3 Policy Framework

Once again, there is no special or separate policy statement on dam projects, but there is what might be called an implicit policy in favour of such projects. As already mentioned, the constitutional provisions reflect an unconscious assumption that "water" means canals and storages. It is generally taken for granted that given the projected magnitude of population growth and the concomitant needs of food, water and energy, and given the spatial and temporal variations in rainfall, large projects for the storage of river flows and for the transfer of waters from surplus to deficit areas or from one season to another are necessary and desirable. That view, which finds wide acceptance, had its influence on the National Water Policy (1987), and now stands endorsed in the Report of the National Commission on Integrated Water Resources Development Plan, recently submitted to the Government of India (September 1999), in which the stress is on large storage projects which are considered to be the main supply solutions to future needs, though the Report does recognise the importance of local rainwater harvesting and watershed development and devotes a chapter to the subject.

The National Water Policy (1987) (NWP) includes many references to "projects". Some of the observations in the Policy are about matters such as the following:

- bringing available water resources within the category of utilisable water resources;
- planning for a hydrological unit such as a basin or a sub-basin; individual projects to be formulated within the framework of such a plan;
- water to be made available to water-short areas by transfer from other areas;
- projects to be multi-purpose;
- drinking water to be a primary consideration;
- study of impacts on human settlements to be an essential component of project planning, and the preservation of the environment to be a primary consideration;
- the need for an integrated, multi-disciplinary approach to project planning,
- the conjunctive use of groundwater and surface water to be planned from the beginning,
- irrigation options to be considered;
- water use and land use to be integrated;
- water allocation to be done with due regard to equity and social justice

There are also other clauses regarding the utilisation of the created irrigation potential; the participation of farmers in the management of irrigation systems; the conservation of water; flood management; and so on.

Though there is an implicit equation of water resource development with "projects", the references to the environment, "integrated, multi-disciplinary approach", "irrigation options", land use, equity and social justice, etc., show an awareness of the new, emerging concerns. That awareness may now seem incomplete and inadequate; for instance, the priorities for allocation do not include environmental needs or those of the river regime as categories. However, in fairness it must be noted that the NWP was the first exercise of its kind, and that many of these new concerns have been articulated more sharply after it came into being. What is a matter for regret is that 12 years after it was adopted, the NWP (1987) still remains a set of general statements and has not been operationalised.

Following the adoption of the NWP, some State Governments have formulated their own Water Policies (eg the Orissa Water Policy 1994, the Tamil Nadu Water Policy 1994). These take the NWP as the point of departure, reiterate some of its observations in different language, and take some points a bit further. Unfortunately, they too remain largely in the realm of generalities. (Incidentally, both these State documents assume that the Government will be the principal actor; this is explicit in the Orissa document, and implicit in the Tamil Nadu one.) While they do mention certain State-specific concerns, and contain some unexceptionable statements, they are essentially governmental exercises within the conventional framework, and mark no new approaches. In any case, it is too early to say what impact these documents will have.

Leaving aside the question of "alternatives", which the NWP does not really deal with, the principles laid down in the NWP on the subject of projects, if fully complied with, would undoubtedly lead to better project formulation and implementation. The latter are to an extent taken into account in the Guidelines issued by the Central Water Commission for project preparation. Apart from this, successive National Plan documents contain observations on priorities for investment and sectoral policies. The Report of the National Commission on Integrated Water Resources Development Plan (September 1999) also contains observations on the planning, financing, implementation and prioritisation of major projects, which may lead to further policy pronouncements.

An important part of the policy framework relating to major/medium irrigation projects is the approach to the utilisation of the irrigation potential that such projects create. An answer adopted in the 1970s was the Command Area Development Authority (CADA)system under which the state assumed the responsibility not only for creating a reservoir and a canal system, but also for taking the canal water closer to the farms and for "on-farm" development works. Along with this went extension and other activities relating to water management. Over a period of years, experience has shown that the CADA programme has been only a limited success. There is now a move in a different direction, ie the state stepping back and handing over the management of systems below a certain size to farmers' associations, under what is known as "Participatory Irrigation Management" (PIM) to which reference has already been made.

Another important component of the policy framework (as distinguished from the laws referred to earlier) is the set of principles and practices that have been evolving on the subject of the resettlement and rehabilitation of people displaced or otherwise affected by large projects. An effort to codify these in the form of a National Rehabilitation Policy has been in progress for some years, and various drafts have been under consideration by the Government of India. The process does not seem to have reached finality so far. Meanwhile, the principles and practices adopted in particular projects partly by the governments themselves and partly under the influence of NGOs and aid giving agencies constitute a body of precedents on the subject. The basic principle that has come to be generally accepted (which does not necessarily mean that it has been fully or properly implemented in practice) is that project-affected persons should be so resettled and rehabilitated that their living conditions and "quality of life" are at least as good as before, and if possible, better; and further, that a certain minimum level of quality is ensured for all, including those without title to land. How far these principles have been translated into action will be clear from Section 7.4 which deals with the social and equity aspects of dam projects.

There are also other matters (such as agriculture, fisheries, environmental concerns, the welfare of Scheduled Castes and Scheduled Tribes, the welfare of women and children, and so on) which fall within the ambit of different Ministries and agencies. On some of these matters there are formal Policy Statements or Laws (eg the National Policy on the Environment, and the National Forest Policy, apart from the Environment Protection, Forest Conservation and Tribal Self-Rule Acts already mentioned). On others there are sectoral policies, decisions, etc, adopted by the respective Ministries.

A new policy document to be taken note of is "The Policy on Hydropower Development" brought out by the Ministry of Power in August 1998. After a very brief general statement of the familiar case for hydropower projects, the document quickly proceeds to the means of achieving the substantial capacity additions felt to be needed. There is no real policy analysis in the sense of exploration of options and alternatives. Approaches such as those advocated by Dr A.K.N. Reddy and Girish Sant (envisaging a combination of demand management, energy saving, fully utilising capacities already created, extensive decentralised generation, and so on, with minimal recourse to large projects) are not discussed.

On uses other than irrigation and hydroelectric power (eg navigation, industrial use, municipal uses, etc), the appropriate Ministries/Departments (Surface Transport, Industry, Rural Development, Urban Development, etc.), have their policies and concerns. These need to be kept in mind by the planners of water resource projects.

All these (ielaws, policy statements, implicit policies, administrative decisions, case laws, etc) together constitute the policy framework with reference to which projects have to be prepared, approved and implemented.

3.4 Planning System

The Indian planning system and the complexities of plan finance cannot be set forth in detail here. The following should however be noted:

- that there is a system of centralised economic planning (not of the "indicative" kind, but concerned with targets and projects, approving financial outlays, and so on, and virtually performing some of the functions of the Finance Ministry, though the process of "economic reforms" has begun to reduce the relevance of such planning),
- that this system is managed by the Planning Commission, a non-statutory body which derives its influence from the role it plays in the determination of Plan outlay levels, the allocation of outlays for projects and programmes, and Central Plan assistance to the States;
- that the Planning Commission is concerned with planning at both Central and State levels.
- that the planning is for five-year blocks broken down into annual plans to correspond to the annual budgeting;
- that the planning is essentially for the public sector: and
- that all developmental projects must form part of the Plan of the State concerned.

Once a dam project is included in the State Plan in accordance with a procedure that will be described later in this chapter, it is funded out of the provision made in the State budget on the basis of the outlay approved for it in the Plan. It then qualifies for inclusion in the calculation of Central Plan assistance to the State Plan in accordance with the Gadgil Formula referred to earlier

(Note: In addition to Plan assistance transfers from the Central Government to the States, there is also a redistribution of revenues between the Central Government and the States under the recommendations of quinquennial Finance Commissions as mandated by the Constitution, and some "non-plan" forms of Central assistance. These matters have a bearing on the subject of this report in so far as provisions for the operation and maintenance of projects are concerned. The division of governmental budget provisions and expenditures into "plan" and "non-plan" categories is problematic and has been much criticised. Outlays on projects are classified as "plan" and operation and maintenance as "non-plan". There is an over-simplified view that in a situation of a scarcity of resources, plan expenditures merit priority over non-plan expenditures. This view, together with the inherent tendency on the part of the bureaucracy, the technocracy and the politicians in India to be more interested in the construction of new projects than in the efficient running of completed projects, leads to the under-provisioning and neglect of maintenance.)

In recent years there has been some talk of "private sector participation" in large dam projects. So far. this has made only a modest start even in the case of thermal power projects, bura much greater are so in the case of hydropower and irrigation projects. As and when private sector participation becomes a significant reality, a crucial question will be how the human and social aspects, which have presented great difficulties even in public sector projects, will be taken care of.

3.5 Project Planning, Approval, Implementation: Institutions, Procedures, Identification of a Project

Theoretically speaking, there are several possible ways in which projects are identified:

(i) a consideration of the needs of a particular area or region (drinking water, irrigation, water for municipal/industrial uses, hydroelectric power, flood management, etc) could lead to the postulation of a project; or

(ii) from an engineering point of view, a particular location may be identified as a suitable place for the construction of a dam and the creation of a reservoir (or a barrage or a weir, as the case may be); or

(iii) an overall master plan or outline plan for an area (a basin or sub-basin) may envisage a number of projects at various locations.

Instances of all three kinds of projects can be mentioned. For example, what is known as the "Telugu Ganga" Project was initially conceived as an answer to the water needs of Madras city, and therefore can be classified as an example of case (i). Again, many of the projects that have been undertaken over the years have been developed on sites that had been identified long ago, or on sites that were determined in an early exercise of the erstwhile Central Water and Power Commission under which the resources of various basins were assessed and locations for storages indicated, these may therefore seem to fall under case (iii). However, the distinction is in a sense illusory. Once it is assumed that "water resource development" is a matter of an engineering intervention – and this assumption is common to all three cases – topography and geology become important, and suitability from an engineering point of view becomes the determining factor in the identification of projects.

It may be felt that some projects emerge out of the processes of electoral politics and acquire a hold over the popular mind, and that this is one more category that must be added to the three mentioned above. However, the general public and politicians do not invent projects; they pick up an idea that is in the air. That idea must have initially been thought of by a person with some technical background, however tenuous. If so, electroal politics do not constitute a new category.

Basin Planning

Case (iii) mentioned above leads to the question of to what extent "basin planning" has been actually practised in India. As early as 1956, the Union Parliament passed the River Boards Act under Entry 56 in the Union List, but this provides only for advisory boards and not for River Basin Authorities vested with powers of management. In fact, no river boards, even of an advisory kind, have been set up under this Act. The Damodar Valley Corporation (DVC) antedates the Constitution and was modelled on the Tennessee Valley Authority but, while it has served some useful purposes, it has not in fact functioned as a river valley authority. Its functions were whittled down over the years, and the DVC today is mainly a power-generating body, and much of that power is ironically enough thermal power. (Incidentally, the DVC is, administratively, under the Ministry of Power and not under the Ministry of Water Resources.) Similarly, the Bhakra Beas Management Board (also under the Ministry of Power) is a system-management body and not a basin-planning organisation. The Betwa River Board was set up by a separate enactment, but this was only for the specific purpose of overseeing a particular project. The Brahmaputra Board was another board set up under a specific parliamentary enactment. It was vested with powers of execution of projects, but its role has been confined largely to the preparation of a Master Plan and the formulation of a few large projects: it has not, and perhaps could not have, grown into a river basin authority.

There are various organisations set up under Government Resolutions. Some, such as the Bansagar Control Board, were meant to supervise specific projects. The Ganga Flood Control Commission was limited to the preparation of master plans for flood control. The Narmada Control Authority, a body set up under the orders of the Narmada Waters Dispute Tribunal with limited functions relating to cost allocations and the rehabilitation of project-affected persons, was later enlarged to cover the monitoring of environmental aspects, but it is not in the nature of a Narmada Basin Authority (Nor can that description apply to the Narmada Planning Group or the Narmada Valley Development Authority, which are internal organisations of the Gujarat and Madhya Pradesh Governments respectively.) The Krishna Waters Dispute Tribunal envisaged the establishment of a Krishna River Authority, but this was in "Scheme B" which was not part of the Award itself, and was therefore not operative. (The question whether Scheme B should be notified and made operative is now being argued before the Supreme Court in the context of the dispute between Andhra Pradesh and Karnataka over the height of the Alamatti Dam.) Attempts to establish a professional, empowered Cauvery River Authority failed, and instead, a political body for dealing with conflicts relating to the implementation of the Tribunal's Award was set up; this is not a basin planning or management body

There are no river basin authorities or boards in India, of the kind that exist in France or Holland. The National Water Policy 1987 does discuss planning for a hydrological unit such as a basin or sub-basin and about "appropriate organisations" for the purpose, but these (like most of the general statements in the NWP) have not been operationalised Very recently, the National Commission on Integrated Water Resources Development Plan (1999) has recommended River Basin Organisations of a *representative* kind (in the hope that this will prove more acceptable), but its Report has not yet been considered by the Government of India.

Against this background, it may not be unfair to say that planning has, by and large, tended to proceed on the basis of discrete, individual projects That statement may be questioned It could be plausibly argued that "basin planning" of a kind was indeed attempted in several cases for instance, Bhakra Nangal, Sardar Sarovar, Gandhi Sagar, and so on, were not supposed to be "stand alone" projects, but were envisaged as parts of larger systems. There was also (as already mentioned) the basin-wise assessment of resources and identification of storage sites by the CWPC. However, these were instances of "basin planning" only in a limited sense, and even these were not wholly successful "Integrated planning" often means no more than planning a cluster of projects. In the 1980s a multi-disciplinary group in the Central Water Commission prepared a Ganga Basin Master Plan, but for certain reasons it was never made public, and under the circumstances, no comment can be made on its contents The National Water Development Agency has been conducting assessments of basin surpluses and deficits, but these are essentially in the context of "inter-basin transfers", for which the Agency has been identifying possibilities of transfers, storages and links. This is not really "basin planning"

A truly integrated, holistic planning for a basin or a sub-basin would involve *interdisciplinary* planning for the basin or sub-basin, marrying land use and water use, harmonising diverse water uses on the demand side and integrating *all* "development" from local rainwater harvesting and micro-watershed development to "mega" projects (both surface water and groundwater) on the supply side, while at the same time fully internalising environmental, ecological, human and social concerns, and fully associating the people concerned ("stakeholders") at all stages. That kind of basin planning has not really been seriously attempted in India.

Preparation, Examination and Approval of Projects

The basic agency for the preparation of a large dam project is the Irrigation or Water Resources Department of the State Government concerned, which is a department composed largely of engineers. The various non-engineering aspects such as agricultural, environmental, energy, financial, economic, social, etc., are partly dealt with departmentally and partly taken care of through consultations with and comments by the other agencies and departments concerned. In preparing a project, the Guidelines of the Central Water Commission and of the Ministry of Environment and Forests need to be kept in mind (as the project will eventually go to these agencies for examination, as explained below). A Project so prepared goes through the usual approval procedures within the State Government (eg consultation with the Finance, Planning and other Departments concerned, and with the State Planning Board, if any).

After approval at the State Government level, the project goes to the Central Government for approval. As already mentioned, there is no clear constitutional or legal prescription of approval of such State projects by the Central Government. However, the requirement has become established in two ways: first, as a condition for the acceptance of a (major or medium) dam project for inclusion in the National Plan; and secondly, as a requirement of clearances by the Central Ministry of Environment and Forests (MoEF) under the Environment Protection Act and under the Forest Conservation Act. A third dimension is added in respect of inter-State rivers, ie rivers running through more than one State, in which an inter-State aspect has to be attended to by the Central Government

The institutional machinery for the techno-economic clearance of major/medium irrigation or multi-purpose projects at the Central Government is the Advisory Committee on Irrigation and Multi-purpose Projects (popularly though misleadingly known as the Technical Advisory Committee or TAC). This is a Committee set up by the Planning Commission and chaired by the Secretary, Ministry of Water Resources (though it is not a Committee of that Ministry). The TAC is serviced by the Central Water Commission (CWC) which does the detailed techno-economic examination of projects (Incidentally, the CWC is not a statutory body like the CEA.)

The Project sent by the State Government to the CWC, as the Secretariat of the TAC, is examined in the different Directorates of the CWC, and other agencies concerned are consulted. Queries are raised, suggestions are made, changes are proposed, and so on, and when this process is complete, the CWC submits a note to the TAC. Representatives of other concerns (eg agriculture, environment, energy, finance, the welfare of Scheduled Castes and Tribes, women's issues, etc.) are expected to participate in the meetings of the CWC. In the case of inter-State rivers, the relevant inter-State issues are an important part of the examination. At the TAC, the discussion proceeds on the basis of the CWC's note. If the project is found acceptable, the techno-economic clearance of the project by the TAC (ie a judgement that the project is technically sound and economically viable) is communicated to the Planning Commission.

Separately, two clearances by the MoEF (as mentioned above) are also needed, one under the Forest Conservation Act and the other under the Environment Protection Act. (Earlier, the latter was a requirement laid down by policy, but now it is statutory.) For the purposes of these clearances, the MoEF is assisted by two separate committees, namely, the Environmental Appraisal Committee and the Forest Advisory Committee. These have their own procedures after completion of which the two Committeesmake their recommendations to the MoEF. If the recommendations are favourable, the MoEF issues two letters of clearance, one relating to the environmental aspects, and the other relating to clearance under The Forest Conservation Act, with conditions attached, if necessary

After the techno-economic clearance (including inter-State aspects) by the TAC and the clearance by the MoEF from the environmental and forest aspects, the Planning Commission examines the project from the point of view of investment priorities, sectoral planning policies, and provision of funds in the Plan, and issues a letter of acceptance (often referred to as "investment approval"), again with conditions attached, if necessary.

Thereafter, the implementation of the project is the responsibility of the State Government. Save in exceptional cases, the implementation of a dam project is generally a departmental responsibility, carried out through consultancy/construction contracts. Such exceptional cases occur when a public sector agency, corporate or autonomous, is created for the implementation of a Project (eg Tehri, Sardar Sarovar) or the project is entrusted to a public or private sector company (eg projects under implementation by the National Hydropower Corporation (NHPC); the Maheshwar Project in Madhya Pradesh entrusted to a private corporate body).(As mentioned earlier, the idea of private sector participation in such projects has made only limited headway so far.)

Note: The procedure outlined above applies to all major/medium irrigation and multi-purpose projects that come within the purview of the Ministry of Water Resources. Hydroelectric projects proper (ie without a significant irrigation component) are the concern of the Ministry of Power. Further, irrigation and multi-purpose projects are essentially State projects that are submitted to the Central Government only for inclusion in the Plan (apart from certain statutory clearances), whereas in the field of power there are also Central projects for which the administrative ministry is the Ministry of Power. For instance, the Sardar Sarovar Project (Gujarat) and Narmada Sagar Project (Madhya Pradesh) are State-level multi-purpose projects and are the concern of the Ministry of Water Resources. In contrast, the Tehri Hydro-Electric Project, essentially a power project, though it has a minor irrigation component, is a joint project of the Central and UP Governments and is being implemented by a joint corporate body that is under the administrative control of the Ministry of Power. Power projects (including hydroelectric projects) falling within the purview of the Ministry of Power do not go to the TAC but to the CEA for a techno-economic clearance. In such cases, the "hydro" aspects of the projects are examined by a Member (Hydro) in the CEA and by the civil engineering staff supporting that Member. That examination is similar to the CWC's examination for the TAC, and is based on common traditions inherited from the days when there was a joint Central Water and Power Commission. After the techno-economic clearance by the CEA, power projects (whether thermal or hydro) also need clearances by the MoEF under the Environment Protection Act and the Forest Conservation Act, and an approval by the Planning Commission for inclusion in the Plan. However, single purpose hydroelectric projects are few in number; by and large, most dam projects go the TAC route. In any case, dam projects, whether for irrigation or hydroelectric power, involve the same problems of displacement, environmental impacts, etc, and suffer from the same limitations and deficiencies

Investment Criteria

The TAC's basic criterion for the approval of projects has been the BCR (BCR). In the colonial period, irrigation projects were often sanctioned for the purpose of earning revenue, and the criterion for sanction was the rate of financial return to the Government on the investment. With the advent of economic planning in independent India, it was felt that such projects should be judged not on the basis of the revenues accruing to the exchequer but on that of the benefits accruing to the economy. Accordingly, instead of the financial return, the BCR was adopted as the investment criterion and this did not imply a complex and sophisticated socio-economic cost-benefit analysis. "Cost" in this context meant merely the direct cost to be incurred on the project, and "benefit" meant the incremental agricultural production expected as a result of the irrigation provided by the project, and/or the value of the power to be generated. The BCR was calculated for an average year after project completion; discounted cash flow calculations were not undertaken. A BCR of 1.5:1 was considered desirable, but lower standards (1:1 or even less) were considered acceptable for projects in drought-prone areas.

In the case of industrial or commercial projects, a fairly sophisticated techno-economic cost-benefit analysis, which uses concepts such as opportunity costs, shadow prices, etc., and calculates both financial and economic Internal Rates of Return, has been in vogue since the early 1970s. This analysis is carried out by the Projects Appraisal Division (PAD) of the Planning Commission and is submitted to the Public Investments Board (PIB) of the Ministry of Finance, to which all such projects need to go for clearance. The PIB procedure (which applies also to Central Government power projects dealt with by the Ministry of Power) does not apply to major/medium irrigation and multi-purpose projects of State Governments which are submitted to the Central Government for clearance for inclusion in the Plan. These projects, as already mentioned, go to the TAC where the criterion for approval is a rather simple BCR assessment. The BCR as actually operated is an unsatisfactory criterion, and one which is liable to distortion. It is often stated, with some plausibility (though it is difficult to substantiate this), that costs are deliberately understated and benefits overstated in order to arrive at a BCR of 1.5:1. Dissatisfaction with the manner in which irrigation and multi-purpose projects were being dealt with led to the establishment by the Planning Commission of a Committee to go into this matter. The Committee (the Nitin Desai Committee) submitted a report in 1983 making recommendations for an improved appraisal system involving a proper socio-economic cost-benefit analysis leading to the determination of an economic Internal Rate of Return. This recommendation remains unimplemented. The BCR has indeed been replaced by an IRR, but the elements that go into this are the same as before, and there is no real socio-economic cost-benefit analysis. The new IRR is only the old BCR stated in a different way. The National Commission on Integrated Water Resources Development Plan (1999) has investigated this matter and reiterated the need for a move towards the kind of appraisal that the Nitin Desai Committee had recommended.

Partly as a consequence of the abandonment of the financial return criterion, and partly because the pricing of irrigation water in many States is so low and the recovery of tariffs so poor as to make it virtually free, most large dam projects run at a loss insofar as the state exchequer is concerned. This deficit has been well brought out in the Report of the Committee on the Pricing of Irrigation Water (the Vaidyanathan Committee, 1992, Planning Commission). Such a deficit aggravates the shortage of resources of the States and makes the proper maintenance of systems and the provision of a satisfactory service to the people even more difficult This deficit is further compounded by the Plan/Non-Plan distinction and the innate preference for new projects over the maintenance of existing ones, to which reference was made earlier

It needs to be mentioned that projects submitted to the World Bank or any other external aid-giving agency go through a process of detailed examination by that agency There have been criticisms that the donor agencies' concerns and conditions tend to exert an undue influence on, and in some cases distort, internal policies and priorities; that aided projects tend to become "gold-plated" in respect of certain features and heavily capital-intensive; that they receive a priority in budgetary allocations to the detriment of other projects and activities; that the very fact of project-lending builds a bias in favour of "projects" to the disadvantage of alternative approaches; and so on. At the same time, it is perhaps true to say that the questions raised and requirements stipulated during the appraisal and negotiation processes, and the conditions attached to the loan, have in some cases contributed to improvements in project planning as also in environmental and rehabilitation measures.

3.6 Some Weaknesses

Some infirmities of the systems and procedures described above may be noted here

(i) The primary, controlling discipline in project preparation at the State level is engineering Projects are prepared by the Irrigation Department (or to use more recent nomenclature, the Water Resources Department), which is a Department consisting of engineers Other disciplines, concerns and points of view are to some extent brought in through consultations and comments, but there is no *interdisciplinary* planning in the proper sense of the term. At the Central Government, too, the primary project-examining body, ie, the CWC, is a body of engineers. Here again, other concerns and disciplines are involved through consultations and comments, but there is no formal interdisciplinary approach. The CWC has some non-engineering personnel on its staff (at not very senior levels), but the Commission itself has only engineermembers, and it is mainly staffed by officers of the Central Water Engineering Service. Thus, it is a Water Engineering Commission rather than a Water Commission. though it is often referred to as the "Apex" expert body on water resources in the country. A high-level committee to review and restructure the CWC was set up in 1995 and was in the process of discussing the possibility and desirability of making the CWC a multi-disciplinary body and a true Water Commission. For certain reasons the Committee became defunct before it could complete its work. The National Commission on Integrated Water Resources Development Plan (1999) has now recommended that the CWC should be transformed on the lines proposed by the defunct Committee.

(ii) It follows from the above, and from what has been said earlier regarding "basin planning", that there is and can be no integrated, "holistic" planning under these circumstances, despite instructions and exhortations to that effect. For instance, environmental considerations are supposed to be fully "internalised", but this has not begun to happen to a significant extent. The environmental aspect is still largely looked upon as an externally imposed discipline that has to be complied with. An "Environmental Impact Assessment" (EIA) has indeed been a prescribed requirement for all projects for some years and is being complied with, but EIAs are not entirely satisfactory in many cases, as will become clear in the later discussion on the environmental aspects of dam projects. Thus the examination by the MoEF often results in the raising of basic questions, which leads to complaints that the project is being delayed. These complaints indicate a failure to internalise and integrate environmental concerns into project planning from the earliest stages

(iii) One major feature of project planning has been the dominance of irrigation. Even "multi-purpose projects" often have only two components, namely irrigation and hydroelectric power. The integration of other purposes, such as the provision of drinking water, flood moderation, navigation, the maintenance of downstream flows, and so on, has not been a standard feature of project planning. There could be conflicts between two different uses (eg between irrigation/power generation and flood moderation, between irrigation and maintaining minimum flows), but these are not always explicitly recognised and built into project planning.

(iv) The next point, which again is related to the points made above, is that only one unique project is placed before the TAC for approval. The TAC Note of the CWC gives a technical account of the particular project that is submitted for approval, and proceeds to examine it. It follows that project decisions do not represent carefully considered choices from of a number of possible answers to a given need or problem. *Within* the ambit of a project, there may be multiple possibilities at various stages. Some of these are purely technical or engineering choices, and these are likely to be covered in the processes of project preparation and in the TAC Note. However, complex techno-economic, socio-economic and ecological-economic choices are not usually considered. For instance, there is no conscious principle or policy of "*minimum environmental impact*" or "*least displacement*", and choices based on such considerations are unlikely to be presented.

"Alternatives" to a given dam project could include

a) extensive efforts at local water-harvesting and/or watershed development;

b) increasing utilisation of capacities (say, for power generation) already built, in respect of which the "social costs" have already been incurred;
c) adding to the capacity of an existing project (say, a reservoir) through supplementary investments instead of undertaking a new project;
d) obviating the need for supply-side solutions through demand management, increased efficiency of resource-use, resource-conservation, etc; and so on.

Alternatives could also mean a *combination* or *integration* of a large project with smaller projects and with watershed development programmes in a holistic plan for an entire area.

Alternatives in these senses are not usually considered. (The whole question of "options" is discussed in a Chapter 6.)

(v) One of the factors that militate against holistic, integrated planning is the fragmentation and compartmentalisation of responsibilities at the administrative level. The distribution of subjects among different Ministries/Departments whether at the Central Government or in the States (for instance those dealing with water resources, hydropower, agriculture, fisheries, navigation, rural development, urban affairs, environmental matters, and so on) is doubtless inescapable. No one will seriously argue for the grouping of all matters concerning water into one Ministry/Department. However, even within the area of water resources proper there is a compartmentalisation of different components or aspects such as major/medium projects; minor irrigation; command area development; groundwater; watershed development, rainwater harvesting; water management; and so on. Different Divisions/Departments/Agencies tend to deal with these matters with little coordination, and even less integration.

(vi) There is reason to believe that the appraisal and decision-making at the TAC level is not rigorous enough. The basis for this remark is partly that too many projects have sometimes been cleared at one meeting of the TAC, and partly that the post-clearance history of scope changes and modifications is a reflection not only of the quality of project planning but also of that of appraisal and approval. Further, with the kind of investment criterion employed, as already discussed, the appraisal cannot possibly be rigorous.

(vii) Civil society (in the sense of the people concerned, ie, beneficiaries and those who are likely to be adversely affected, and the community in general) plays little or no role in the planning and implementation of such projects. These activities are essentially governmental. The Irrigation Acts vest the management and control of waters in the hands of the State, and project planning and implementation are largely internal activities of the State. As the colonial State had consciously distanced itself from the people, and as that distance did not significantly narrow in the post-colonial era, a tradition of consultation of, and participation by, the people did not develop. (Please see also the references made earlier to the inequities of the Land Acquisition Act, the limited effectiveness of the Rehabilitation Acts that exist in some States, the barriers erected by the Official Secrets Act and the manner in which community initiatives are hampered by the "eminent domain" claimed by the State over water resources.) It is only in recent years that a consciousness of the importance of what has come to be called "stakeholder participation" has begun to emerge. Project-affected persons, with the assistance of some NGOs, have become more conscious of their rights (both their fundamental rights as citizens and their traditional rights of use of river water, forest products and other natural resources). The Government for its part is trying to formulate a National Rehabilitation Policy. Public hearings have now become a statutory of dam projects although how they will evolve in practice still has to be seen.

(viii) In the absence of institutional arrangements for consultation and redressing of grievances, the processes of displacement, resettlement and rehabilitation often generate serious dissatisfactions. When these processes lead to popular resistance or agitation under the leadership of NGOs, the state machinery tends to respond with incomprehension and sometimes force. This has happened in the case of several projects. Traditional bureaucratic procedures do not facilitate a good working relationship between the Government and NGOs. The State in turn tends to charge NGOs with adopting a confrontationist attitude and hampering the activities of the State. However, it is often the State which forces the people and the NGOs onto a path of confrontation through its failures of consultation, delays, reluctance to part with information, and woodenness and unimaginativeness in implementation.

(ix) In the context of the planning and funding processes, four main (interrelated) dysfunctional features relating to major irrigation/multi-purpose projects need to be noted: (a) the thin and sub-optimal spreading of resources over a large number of projects; (b) the time and cost over-runs on many projects; (c) the persistent problem of projects remaining forever incomplete, spilling over several Plan periods, and pre-empting Plan resources for continuance/completion, leaving hardly any funds for new projects; and (iv) the failure in many cases to achieve the projected benefits in full measure. Successive Plan documents have stressed the need for better project planning and implementation and for completing ongoing projects before starting on new ones, but to little avail. From the Sixth Plan onwards, the emphasis has been on "consolidation" and "no new starts", but this has not been effective. These matters have been discussed at some length in the Report of the National Commission on Integrated Water Resources Development Plan (1999).

(x) The monitoring system is weak, and there is no effective mechanism to ensure that the Revised Cost Estimate (RCE) is promptly brought to the TAC/Planning Commission for a fresh appraisal in cases in which sanctioned costs are likely to be, or have been, exceeded. When at last the RCE does come before these bodies, the reappraisal serves little useful purpose, as the option of reviewing and if necessary reversing the investment decision already taken no longer exists. At best only minor changes or adjustments may be possible at that stage. There is also no established system of a post-completion evaluation. Very few projects other than those that receive World Bank assistance, are subjected to such an *ex post facto* reappraisal.

(xi) Where the approval of a project is conditional, there is no effective mechanism for ensuring compliance with the conditions and taking appropriate measures in the event of non-compliance. This is clear enough from the Reports of the Five Member Group on the Sardar Sarovar Project and the Expert Committee on the Environmental and Rehabilitation Aspects of the Tehri Hydroelectric Project. (The *pari passu* condition imposed in these cases has been misinterpreted, and has not really worked, as will be seen in a later chapter.)

References to many of the failings mentioned, couched perhaps in different terms, will be found scattered in various reports and other documents, such as: the successive Five Year Plans, the Report of the Committee on the Pricing of Irrigation Water (the Vaidyanathan Committee), the Reports of the Ninth Plan Working Groups on Major/Medium Irrigation Projects and on Participatory Irrigation Management, the CWC Report on the Organisational and Procedural Change Requirements for improving the performance of irrigation systems, the Reports of certain review committees (the Five Member Group on the Sardar Sarovar Project, the Expert Committee on the Environmental and Rehabilitation Aspects of the Tehri Hydro-Electric Project), the World Bank's sectoral and project completion reports, the recent Report of the National Commission referred to earlier, and in academic writings on the subject. The observations made above will also be found corroborated in the separate chapters on the economic, environmental, social and policy/institutional aspects of large dam projects

4. Financial, Economic and Distributional Analysis of Dams in India

Pranab Banerji

4.1 Introduction

This study, sponsored by the World Commission on Dams (WCD), is a part of the WCD's larger study of India's experience with large dams. The study has focused on the evolution of appraisal procedures and criteria and on the economic, financial and distributional impact of large irrigation and multi-purpose projects. Related issues of planning, decision-making and administration have also been examined to the extent that they have impinged upon selection and performance of projects.

The scope of the study had to be limited due to the constraint of time. All that it analysed was, what economists call, internal costs and benefits. Externalities, which are extremely important in the case of dams, had to be left out for several reasons. An accompanying WCD study has examined some, but not all, of the externalities. To the extent that a few externalities have been internalised over time, they have been included here

The original methodology proposed was to obtain pre-project and post-project data for a comparative study. A large number of questionnaires seeking this type of information were mailed out The response was nil. Moreover field data from six case studies was also not available All that could be used was: (a) the study of official committee reports and documents; (b) a survey of existing literature on the subject and (c) evaluative or related studies obtainable in the short time. Fortunately, the picture that emerged was reasonably consistent and focused.

4.2 Evolution of Appraisal Criteria

At the time of Independence, a profitability criterion was followed for the appraisal of irrigation projects in India. The profit of a given year was the difference between the receipts (direct and indirect) from irrigation projects and the annual costs of the project, comprising working expenses for the year and a simple interest on the capital cost of the project. If this profit, as a%age of capital costs plus interest arrears, was above a specified rate, then only could the project be cleared for investment. This cut-off profitability rate, at the time of Independence, was 6%

The formal shift from the financial to the quasi-economic criterion began in the early 1960s with the setting up of a Committee of Direction (Gadgil Committee) by the Planning Commission in 1961 The Committee recommended the use of annual benefit to annual cost ratio. It also recommended the inclusion of agricultural benefits in project appraisal but left out, for the sake of simplicity of procedure, non-agricultural benefits. More specifically, benefit was to comprise the difference in the value of gross annual production less the cost of cultivation, before and after the introduction of irrigation Annual cost comprised annual interest on capital, depreciation and expenditure on operation and maintenance

The recommendation of the (Gadgil) Committee received official approval in 1964 after being recommended by the "Committee to Suggest Ways and Means of Improving Financial Returns from Irrigation Projects" The recommendation was that the annual benefit to annual cost ratio should be adopted as the criterion for appraising projects and only those projects in which the ratio was at least 1.5 were to be cleared. The definitions of costs and benefits were on the lines suggested by the Gadgil Committee and all valuations were made at market prices.

The shift from financial to quasi-economic criteria was not without problems The Irrigation Commission (1972) noted that the shift "had certain undesirable effects. It minimises the importance

This is a working paper prepared for the World Commission on Dams as part of its information gathering activities The views, conclusions, and recommendations contained in the working paper are not to be taken to represent the views of the Commission of securing an adequate return from investment on irrigation projects." The Commission recommended that the financial return should also be examined. However, it also recommended a lower BCR for drought-prone areas. The recommendation was promptly accepted.

Four years later, the National Commission on Agriculture (1976) endorsed the Irrigation Commission's recommendations of widening the definition of costs to include land development. etc. But while the Irrigation Commission had advised against the adoption of the internal rate of return criterion for project selection, the National Commission on Agriculture recommended its use as it would facilitate the ranking of projects. These recommendations were shelved for the time being.

Four more years passed, the Ministry of Irrigation's Working Group Report on "Guidelines for Preparation of Detailed Project Reports of Irrigation and Multipurpose Projects" (1980) recommended "the constitution of a committee consisting of representatives of all concerned disciplines to make a review of the existing method of calculating the benefit cost ratio and to indicate whether any changes in the present method are necessary . . . " Pending such a review, existing procedures were to be maintained. There was an increase of new projects and expenditures on major and medium projects in the latter half of 1970s as the issue of reforms in the appraisal procedures and criteria was once again postponed and procedures were relaxed.

However, the Planning Commission did set up a review team as suggested by the Working Group and the review team submitted a very comprehensive set of recommendations in 1983 The "Report of the Committee to Review the Existing Criteria for Working Out the Benefit Cost Ratio for Irrigation Projects" (Desai Committee) ought to have been considered a landmark in appraisal procedures and criteria. To put it briefly, it recommended the replacement of the existing quasi-economic methods by comprehensive economic appraisal techniques and the use of the economic rate of return as the appraisal criterion with a cut-off rate of 9% (7% for drought-prone areas). It also made detailed recommendations regarding the items to be included in costs and in benefits and on the steps to derive economic prices for them. Detailed recommendations were made regarding the manner and the sources from which data are to be collected and on the consequent organisational changes necessary

The Desai Committee's recommendations were perhaps too revolutionary for a conservative system The silence with which they were met was deafening. On the other hand, there was increasing pressure on the Central Government for further relaxation in appraisal procedures.

The Central Government resisted further relaxations as it faced pressures both from inside. owing to the emerging fiscal crisis. and from outside as environmental groups and project-affected people became increasingly vociferous. As the fiscal crisis deepened, the number of projects fell drastically from 435 new projects started in the late 1970s (Fifth Plan and Annual Plans) to only 45 new projects started in the Seventh Plan (late 1980s). Expenditures, in real terms (1980-81 prices). were however greater in the Seventh Plan, compared to the Fifth Plan, indicating a shift in priorities to ensure that projects under construction were completed before new projects were sanctioned

There was another reason for rising expenditures in the late 1980s. Faced with an increasingly articulate anti-dam lobby, the government finally began not only to accept some of the recommendations of earlier committees but went further to show its sensitiveness to the arguments environmentalist. The net effect was a widening of the definition of project cost. Thus. by end of the 1980s and early 1990s. some of the social and environmental costs began to be internalised as project costs

Yet the essential structure of project appraisal has hardly changed since 1964. The quasi-economic criteria of annual benefits to annual costs ratio, both evaluated at market prices and comprising many rule-of-the-thumb items, continues even though the internal value of return is also reported and costs now have a broader definition.

In 1991, following an acute balance of payments crisis, the Government of India had to apply for adjustment loans from the IMF, which required, among other things, a reduction in India's fiscal deficit. The implications for the irrigation sector were: (a) subsidies, hidden or open, had to be cut, and (b) resources available for capital expenditures would shrink. Finance, once again, became a central issue. To examine issues relating to subsidies, the "Committee on Pricing of Irrigation Water" (Vaidyanathan Committee) was set up and submitted its report in September 1992. This Committee recommended the re-introduction of a minimum financial return as an essential criterion for sanctioning all investment proposals along with social benefit-cost criteria. The wheel had turned full circle since 1964.

The recovery rate (percentage recovery of working expenses through gross irrigation receipts) fell from 93% in 1976-77 to 46% in 1980-81 and further to a meagre 9% by the end of the 1980s. The irrigation sector had become a huge fiscal liability with annual operational losses exceeding Rs 3 000 crores in 1993-94.

It was inevitable that the possibility of private investment in irrigation would be explored. In 1995, a High Level Committee to study the feasibility of private sector participation in irrigation and multi-purpose projects concluded that such participation is feasible even in surface irrigation and multi-purpose projects and should be introduced on a pilot basis in non-sensitive areas. The Achilles heel of the irrigation power structure - gross financial mismanagement - is beginning to spell the end of a government role in capital investment in irrigation projects. The public investment boom of the 1970s is something of the past.

4.3 Analysis of Performance

Costs: Measurement and Trends

Under the present methodology of project appraisal, "annual cost" which enters as the denominator in the BCR, consists of: (a) interest cost at the rate of 10% on the estimated cost of the project including land development, (b) operation and maintenance costs on a per hectare basis of gross irrigated area or arable command area, whichever is more, (c) depreciation of the project based on the assumed life of the project, eg 1% of the total cost (excluding land development) for every 100 years of life of the project, and (d) maintenance of headworks at 1% of it's the cost of the project. For lift canals, there are additional costs on power consumption and depreciation of rising mains and pumping systems.

Capital Cost

Since items (a) and (c) are %ages of the capital cost of the project, it is necessary to examine the magnitude and trends in capital costs. The usual approaches in the analysis of capital costs have been: (a) to compare actual costs with the estimated costs of projects, and (b) to use planning commission estimates of capital expenditure and potential created in the plans to arrive at capital cost of per hectare of potential created.

a) Project Based Studies

The sharp differences between actual and original estimates of large projects are now fairly well documented both by official and non-official investigations. Official estimates provide the following illustrative evidence:

1973	Report of the Expert Committee on Rise in Costs of Irrigation and Multipurpose Projects	Revised estimates of 64 major projects were, on average, 108% higher than approved estimates. 32 projects showed escalation exceeding 100%.
1978	Estimates Committee (12th Report, 6th Lok	Expenditure exceeded outlay, up to 4th

	Sabha) Ministry of Agriculture and Irrigation (Dept. of Irrigation)	Plan, by 19.4% while physical targets in area irrigated showed a shortfall of 51.4%.
1979	Indian National Committee on Large Dams in India (as adapted in Singh, 1997)	Average cost escalation of 41 dams was 254% with only 6 dams showing escalation of less than 100%.
1983	Public Accounts Committee (141st Report, 7th Lok Sabha)	Cost overruns of 159 projects average 232%. 32 projects show overruns of 500% or more.
1983	Desai Committee Report Annexure 3.1	During Fifth Plan, revised estimates of (all schemes) irrigation projects were 3.2 times the original cost. In the Sixth Plan this figure was 2.7. For new schemes costs increased by about 13% annually

Gulati et al. (1995a) computed the increase in costs at constant (1988-89) prices but also included an annual compounding factor of 5% (for the gestation periods) on actual outlays of 347 projects in 10 states. The period covered was 1963-64 to 1994-95. The average cost of irrigation potential created worked out to be Rs29 000 per hectare for the entire period. Further, the time profile of cost "shows that the highest average cost has been during the decade of the 1980s. and that this cost of cumulative potential creation has been rising throughout the 1980s" (Gulati et al., 1995a:59). According to the authors, the cost figures are likely to be underestimated.

b) Aggregative Studies

The starting point for most aggregative studies is the planning commission data on cost of creation of irrigation potential where the average annual expenditure on major and medium projects during a plan period is divided by the potential created during the plan to obtain the per hectare capital costs. Earlier these data were available only in current prices but now the costs at constant prices also are reported as given in the Table below:

Table 4.1 Cost (in Rs/ha.) of Creation of Irrigation Potential (Major and Medium)

		Current Prices	1980-81 Prices
1st Plan	(1951-56)	1 200	8 620
2nd Plan	(1956-61)	1 810	9 289
3rd Plan	(1961-66)	2 526	10 289
Annual	(1966-69)	2 893	8 313
4th Plan	(1969-74)	4 758	11 060
5th Plan	(1974-78)	6 075	9 074
Annual	(1978-80	10 940	14 111
6th Plan	(1980-85)	21 610	18 771
7th Plan	(1985-90)	50 000	31 475
Annual	(1990-92)	66 570	29 587

The data show sharp escalation in per hectare capital cost, even at constant prices, during the 1980s. Another estimate by Dhawan (1997a), using very different data and methodology, also indicates a sharp escalation in cost (not capital cost but total supply cost) in the 1980s. According to the estimates, the average "supply cost" of irrigation, at 1980-81 prices, rose from Rs488 to Rs613 per hectare, ie by 26% between 1980-81 to 1992-93. Further, marginal costs, ie the incremental cost of additional hectare irrigated, rose even more sharply from Rs.635 to Rs.1709 per hectare at constant prices (a rise of 8% per annum).

Dhawan also works out the marginal capital cost of bringing one new hectare under irrigation through major and medium projects. He uses the National Accounts Statistics data on "consumption of fixed assets", which in 1992-93 were reported as Rs701 per hectare. This is the annual depreciation cost derived from the assumption of 100 years life of the project. The capital cost therefore is 100 times the depreciation charge. "In other words, the capital cost of bringing irrigation to one crop hectare area averaged Rs70 100 Since depreciation is computed on replacement cost basis by the CSO, Rs70 100 per hectare can be validly interpreted as the marginal capital cost of large-scale irrigation in 1992-93. This capital cost is exclusive of the capitalised value of interest charges payable during construction phase" (Dhawan, A-73) The capital cost therefore is at the current price of 1992-93 and may involve some underestimation as interest is not capitalised during the construction period

The steep increase in capital cost in the 1980s is acknowledged by the Planning Commission. The Ninth Plan document reinforces the findings of other studies that inflation is not the major factor in cost escalation. The fact that changes in scope, design and "lump-sum provisions" have led to steep escalation in costs, points to the now well-documented fact of considerable differences between *ex ante* and *ex post* capital costs arising out of inadequate or improper investigation and surveys This fact was pointed out and quantified by the Committee of Experts in 1973 and by various official committees and investigations. Yet the problem remains. One reason why proper analysis of costs is not made is that sometimes the decision to invest is announced by political leaders without any prior study The project report is then an attempt to justify the already committed investment The veil of secrecy helps

Another reason for inadequate analysis costs is that the irrigation sector is showing the classic case of increasing marginal costs as development has proceeded from easier sites to more difficult ones Further, newer cost elements, which earlier were external costs, are now increasingly internalised by project authorities Finally, the prevalent benefit-cost procedures are flawed and work to the disadvantage of project authorities, at least for some items. Since the costs are in financial terms, and do not reflect their economic values, they may be overestimated by about 25% if the standard conversion factors used by international agencies for irrigation project costs in India are followed

Further, 10% interest is shown as "annual cost". The reason is not clear. Why should 10% be the assumed interest cost for the entire life of the project? Presumably, the idea is to compare the benefits of a "representative year" with the annual costs of a "representative year". In a representative year, costs are incurred on operation and maintenance. If the life of the project is 100 years, it is again reasonable to assume that 1% of the capital is used up every year and hence a 1% depreciation cost also makes sense. But 10% interest on the entire capital cost implicitly assumes that 10% interest will be paid for all the 100 years on the entire project cost because the representative year is one of the hundred years. Clearly this is an exorbitant cost of capital. More logically, since 1% of the capital depreciates every year, for a 100 years, the average amount of capital locked-up during the period is only 50% of the capital cost. Hence interest should be charged not on the entire capital cost but on half of it. Or, alternatively, interest could be computed on a declining capital balance if the present method of annual BCR is to be continued.

It would, however, be better to follow the standard procedure of discounting -, at the social discount rate - both costs and benefits as they actually occur. The social discount rate, as Gulati etal argue, should be somewhere around 5% in real terms, ie when the exercise is done at constant (base year) prices. The Desai Committee implicitly recommended a discount rate of 7-9% for irrigation projects. All these arguments point to the fact that the present procedures of appraisal may have unwittingly inflated the cost calculations so that even genuinely beneficial projects may have experienced difficulty in qualifying if the capital costs had been estimated correctly. Underestimation of capital costs became the way out for the system.

Operation and Maintenance (O & M) Costs

Another item entering the concept of "annual cost" is the anticipated expenditure on operation and maintenance. The expenditure on O&M is generally based on a "norm" of required expenditure on a per hectare basis. The costs on this head are relatively small though they too have shown an increasing trend (the norms have increased but not necessarily actual expenditures). The present position, as recommended by the Tenth Finance Commission (1994), is a norm of Rs300 per hectare for the utilised potential and Rs100 per hectare for the unutilised potential, with 30% higher norms for hill states

What is disturbing is that actual expenditures on O&M have been much lower than the norms and even declined during the 1970s. Further, establishment costs as a proportion of O&M expenses rose in the 1980s while that those maintenance and repairs fell sharply. "This has led to the paradoxical situation where, while huge amounts are spent on development of irrigation facilities - to the tune of Rs35 000 per hectare, at 1988-89 prices - available irrigation potential remains unexploited for lack of a small sum of about Rs300 per hectare annually for O&M." (Gulati, Svendsen & Roy Choudhary, 1995:95)

4.4 Benefits: Measurement Issues

The direct benefits can be divided into irrigation and hydropower benefits.

4.4.1 Irrigation Benefits

The present practice is to compute annual benefits from irrigation and compare them with annual costs of irrigation supply. Annual benefits from irrigation are obtained as the difference in the value added of farm produce with and without irrigation.

(i) Yields

Various official committees have commented on the discrepancies between actual yield and yield assumptions in project reports. The Nitin Desai Committee (nd:20-21) made the following observation:

> *Nevertheless the difference (between assumed and actual yields) is so large that it is difficult to accept the project report yield assumptions as being reasonable even as guesses.* (p 20-21)

The Public Accounts Committee of the Parliament (PAC) too highlighted the enormous differences between actual irrigated yields and potential yields as demonstrated under controlled circumstances. Also, the PAC (nd:124) was "surprised to learn that net increase in yield in the command of an irrigation project is not assessed. In the absence of such assessment the committee wonder how actual benefit derived could be ascertained and compared with the project anticipation"

In a study on the productivity of water in ten canal commands, Dhawan (1989:189-89) concludes that the "mean value of output impact of canal irrigation is of the order of 16 quintals of rice equivalents for each crop hectare brought under irrigation, almost twice the magnitude of output level without irrigation. Even when due account is taken of the fact that barely 70% of the created irrigation potential of the ten projects was actually utilised . . . .The output enhancing role of canal irrigation appears impressive, namely, about 10 quintals of rice equivalents for each hectare of irrigation potential brought into existence." The author's estimates show that irrigated area yields are generally 1.5 to 2.5 times the yields in non-irrigated areas for most crops and states.

(ii) Cropping Pattern

Similarly, cCropping patterns predicted in project documents similarly have been normative and rarely realistic.

> *The cropping pattern assumed is generally based on certain normative principles governed by soil type, water availability, etc. A systematic analysis of likely cropping pattern is seldom attempted. Often the proposed cropping pattern includes more or less arbitrary provisions for high value crops like fruits and vegetables, sugar-cane etc. which inflate the estimated benefit*

The combined effect of yield overestimation and over-optimistic cropping pattern projections means that annual benefits will be overestimated. It is therefore important to estimate the extent of actual irrigation benefits so as to obtain reference estimates for benefits from irrigation projects. Dhawan (date page) reports that the value of output per hectare in an irrigated area is about 2.3 times that in a non-irrigated area. This ratio includes the effects of both yield and crop-mix changes. The upper limit for irrigation benefits per hectare is therefore likely to be about 2.5 times the value of output per hectare in a non-irrigated area (on average).

(iii) Irrigated Area

There are also discrepancies between the projected irrigated area and actual irrigated area as pointed out by a number of studies some of which are summarised below:

Table 4.2 Actual Irrigated Area as Percentage of Projected Irrigated Area

Yr.	Report/Study	Projects	Actual Irrigated Area as Percentage of Projected Irrigated Area
1976	Supplementary Report of the Comptroller and Auditor General of India 1975-76.	11 Projects	64.4% (average)
1983	Desai Committee Report	Kosi Hirakud	76% 57%

1989	Dhawan	10 canal Commands	70% (average)
1995	Gulati, Svendsen & Roy Chaudhary	347 projects over 10 states	70% (average)

Further, Planning Commission data show that the gap between the gross area irrigated and the potential created has hovered around 20% in the last ten years or so. However the gross irrigated area includes area irrigated by minor schemes where there is hardly any difference between potential created and utilised as per planning commission data. If a rough adjustment is made for this by subtracting the reported utilisation figures for minor irrigation (planning commission data) from the gross irrigated area (from LUS) a figure is obtained for irrigated area under major and medium (M&M) projects. Comparing this figure with potential created by M&M projects provides a rough idea of the shortfalls in the case of M&M projects. The results show that only 63% of the potential created by M&M projects was utilised during the Seventh Plan. This percentage had fallen to an estimated low of 56% during the Eighth Plan. However, there are problems with the Planning Commission data on minor irrigation and, therefore, it is more likely that irrigated area as a proportion of potential from M&M projects is around 70%.

As regards the reasons for the shortfall in utilisation, the neglect of O&M is perhaps a major cause. In addition, conveyance losses, lack of proper distribution networks, and cropping patterns adopted appear to be particularly significant explanatory factors.

In 1976-77, the Estimates Committee studied a number of projects to identify the causes of under-utilisation of capacity. Its findings were that the principal causes were:
(a) Unrealistic crop pattern envisaged in the original project,
(b) Heavy siltation,
(c) Inadequate extension facilities in command area,
(d) Water-logging in the project command,
(e) Seepages from canals,
(f) Lack of field channels and drainage facilities, and
(g) Inadequate land development.

(iv) Prices

In a proper cost-benefit analysis, valuation of output is an extremely important and complex issue. The annual BCR calculated for irrigation projects bypasses the main issues in valuation and adopts market prices as the basis of valuation for most of agricultural produce. Often, at least for cereals and some other crops, there are two prices - the minimum support price (procurement prices) and the market price. Often a fixed percentage (usually 10%) is valued at the support prices and the remaining is valued at the wholesale market prices prevailing in the major market of the state. In the case of vegetables, fruits etc. there is considerable scope for over-valuation as the prices of these products are not readily available. But even in the case of cereals, inflated prices are not unknown.

In addition to gross value of crops, benefits include, as per the prevalent procedure, the value of fodder and dung on the basis of a standardised norm. The Desai Committee suggested changes in the procedure as crop residues vary not only between crops but according to variety and dung receipts depend on the extent of mechanisation. It therefore suggested that by-products should be assessed from actual data obtainable from cost of cultivation studies.

Cost of Cultivation

Cost of cultivation studies can also provide valuable data that can be used to obtain the net value of agricultural produce, ie gross value <u>minus</u> cost of cultivation. "The present method for assessing the costs of cultivation", the Estimates Committee (19...77) observed, "seems to rest on a very unreliable database. Many of the calculations seem to be based on thumb rules rather than direct estimates. With growing importance of material inputs in agriculture it is necessary that the cost of cultivation be analysed more thoroughly".

The discussion on benefits shows that there is enough evidence to show that: (a) the actual area irrigated by major and medium projects falls well short of the projected area and the discrepancy may be increasing, (b) actual yield figures are often well below anticipated yields, (c) there is divergence between assumed cropping patterns and actual one, and (d) there is some evidence of over optimistic price assumptions. The effect of these is that actual benefits from irrigation, as measured in market prices, are considerably lower than the anticipated/projected direct benefits from irrigation.

Comparing Benefits with Costs

The impact of these factors on actual BCRs and internal rates of return is obvious: the actual ratios and rates have not only been lower than the projected rates and ratios but they have also reached levels which show that direct agricultural benefits fall short of costs. Unfortunately, the number of studies showing this are few.

Early studies by the Planning Commission were essentially aimed at comparing the financial criterion with a quasi-economic criterion. They showed that though many of the projects were unable to satisfy the prevailing financial criterion, they yielded annual benefits in excess of annual costs. In the early years, the costs (excluding external costs which were not counted) were low. The situation seems to have changed later. In a painstaking attempt, Saha (1993) reworked the data given in eight project reports in the light of actual rates and ratios and, using the discounted cash flow approach, found that the net present values (NPV) of six of the eight projects were negative. A similar negative NPV and a BCR below unity are reported by Singh (1994) for the Western Gandak Canal Project. Even World Bank-assisted irrigation projects have shown that the post-project economic rates of return (ERR) are often well below the rates estimated at the appraisal stage (Thakkar, 1999:18). The ERRs of 8 projects after completion (Thakkar, 1999) also show that the ERRs of as many as six projects were below 9% – the cut-off rate recommended by the Desai Committee for the selection of irrigation projects.

It can be seen that the few evaluation studies that are available (few other studies exist) have followed different methods. It may be desirable to calculate the BCR before and after the project using the same (CWC) method. However, such studies, to the best of the author's knowledge, have not been made. Since each study requires a fresh estimation of costs and benefits as actually occurring, it is a task beyond the means of individual researchers to produce within a short time. The author has however tried to obtain indicative results from (interim) evaluation studies conducted for 12 command area development projects. Using the data given in these studies, the annual benefit to annual cost ratio as per the prevalent practice has been worked out. The results relate to with and without estimated command area development benefits and costs. The results show that, according to the original project proposals (without CAD), the BCR (based on data of evaluation studies) are less than the cut-off rate of 1.5 in 8 of the 10 projects (relevant data for 2 projects were not available). If CAD is included, then 6 of the 11 projects fail to reach the qualifying ratio of 1.5. The author's earlier analysis of higher actual costs and low post-project benefits appear to be confirmed in the majority of cases.

The studies so far reported looked at individual projects. It is also necessary to attempt an answer to the question whether or not the benefits from large scale canal irrigation clearly outweigh the direct costs of providing the irrigation. Dhawan (1997b) has tried to answer this question by making a number of adjustments to data given in the National Accounts Statistics. His findings show that, on a per hectare basis, benefits exceeded costs by substantial amounts even when both were computed at constant prices. The picture, however, is different if using a marginal analysis which Dhawan does not attempt. In the early 1990s, according to Dhawan's estimates, the capital cost of M&M projects per hectare was Rs70 100. Following the existing procedure of annual costs calculation, the author obtains costs approximating about Rs8 000 per hectare in 1992-93, at current prices. The benefits from irrigation at current prices in the same year, reported by Dhawan, are Rs7 132 per hectare Therefore, according to the existing criteria, M&M projects on an average are not viable in terms of irrigation benefits alone. If adjustments are made for the fact that interest should be charged on the average capital held then, of course, the projects are viable. However, the correct procedure is to use the DCF technique to find the net present value of projects. A rough calculation of Rs70 100 capital cost per hectare in year one and benefits of Rs6 800 every year (adjusting Rs300 for O & M charges), accruing after a lag of 11 years and continuing for 100 years, all discounted at 10% rate, gave an NPV figure which is negative, but the IRR was slightly over 9%. These calculations are very rough and ready and on a per hectare basis using data given by Dhawan, with all their limitations. Yet the conclusion seems to be uncomfortably true: by the early 1990s, major and medium projects may have become unviable if irrigation benefits alone are considered. On the margin, the benefits from bringing one hectare of land under irrigation through M&M projects falls short of the direct costs involved.

The real impact of large dams, as far as irrigation benefits are concerned, is therefore almost entirely distributional. The benefits are reaped by farmers and others in the command areas and the costs are borne by society at large, the taxpayers and the project-affected people. There is possibly no net gain to the economy from major and medium irrigation projects.

4.4.2 Hydropower

Among the non-irrigation benefits, the largest benefits come from hydropower. In the economic appraisal for hydropower for the Sardar Sarovar project the following (economic) costs and benefits are reported in the SPIESR study (Alagh et al. 1995), which also quotes the World Bank estimates.

Table 4.3 **Hydropower Cost & Benefits (Rs. Million)**

	SPIESR	WB
Cost	15 408	14 266
Benefits	260 203	149 974

The enormous benefits, compared to cost, are the result of the high price of power which, in the SPIESR study, is put at Rs1 83 per KWH and Rs3.07 per KWH for non-peaking and peaking power respectively In fact, so high are the reported benefits from hydropower that these alone cover the reported cost of the entire project (including canal costs) in both the WB and SPIESR estimates It must also be pointed out that the WB and SPIESR studies follow different approaches in obtaining the shadow (economic) prices for hydropower. Further, it may be noticed that costs are very low The project is to have an installed capacity of 1 450 MW, therefore the cost per MW of capacity creation is extremely low Part of this is due to the under-reporting of capital cost and part is the result of apportioning of costs where the major costs are apportioned to irrigation. Further, external costs are excluded

Since hydropower appears to be a major benefit in multi-purpose river valley projects, it needs a closer examination. At the time of Independence, the installed capacity for hydropower generation was 508 MW or 37% of the total capacity in the power sector. The first two decades after independence saw a rapid expansion, with the installed capacity increasing nearly tenfold and the share of hydropower to total capacity rising to nearly 46%. The growth of capacity thereafter was slow, increasing from about 7 000 MW in 1973-74 to nearly 21 000 MW in 1994-95, with the share in total falling from 42% to 26%. The figures for generation are similar, with hydropower generation increasing from 2 194.5 GWH (1947) to 28 971.8 GWH (1973-74) and then to 82 712 GWH (1994-95) During this period, the share of hydropower to total generation fell from 54% to 24%

The valuation of hydropower, which is necessary to arrive at benefit figures, is a tricky business as the cost of power generation differs considerably between hydropower and gas-based power, and because of inter-state and inter-use differences in tariffs and subsidies. However, it is possible to calculate some rough and ready estimates, one of which is attempted here based on cost data reported in the DVC (Damodar Valley Corporation) Annual Report. The 1997-98 Annual Report estimates the cost per KWH of hydel and thermal (next expensive alternative) as 70.97 paise and 120.38 paise respectively for 1995-96.

The net economic benefit from one additional unit of hydel is therefore (roughly) the difference in costs, ie 49.41 paise or Rs0.49 per KWH. Multiplying this figure with actual hydel generation in 1994-95 gives Rs4 052.89 crores of annual benefit. This figure, though only indicative, is not a very small amount. In fact, it works out that hydropower (annual) benefit could be in the range of one-third to one-fourth of irrigation benefits if Dhawan's figures of per hectare benefits are multiplied by the gross irrigated area from major and medium projects to obtain gross benefits from irrigation.

It is also desirable to look at the benefits in terms of rate of return on capital. However, such an exercise is not possible in the absence of data on the total capital invested for hydropower development. Moreover, even if some data were available, the method of apportioning of costs would, in all likelihood, significantly lower the capital costs of hydropower generation. To take an example, the capital cost of installing one MW capacity in the Tehri Project (StageI) (projected estimates) comes to about Rs3 crores (1993 prices) which is comparable to capital costs of other power projects despite the well-known fact that the capital cost of dams and related capital costs are enormous. Similarly for the Nathpa Jhakri Hydroelectric Power Project, the capacity of 1 500 MW was expected to cost (at 1993 prices) Rs4 338 crores only. The implication of this apportionment is discussed in the financial section (Section 4.6). Here, it can be mentioned in passing that: (a) recent years have seen considerable increase in capital costs, and (b) the projected costs are invariably far below the actual/revised estimates. The projected cost of the 3X115 MW Salal Hydroelectric Project was only Rs55.15 crores (1970 prices) or only Rs0 16 crore per MW But by 1978, the year the project was transferred to NHPC and separate finances were no longer reported, the cost had escalated to Rs229 33 crore. Similarly, for the Kopili Hydroelectric Project the completion time was 23 years with the cost escalating from Rs57 crore (1975) to Rs243.82 crore (1998) Sharp cost escalation has already been reported for the Nathpa Jhakri Hydroelectric Power Project and the Tehri Dam and Hydropower Project (Stage I). There is therefore some evidence to believe that capital costs in hydropower projects, as in irrigation projects, suffer from the same malady of under-reporting at the project stage and, after clearance, are gradually stepped up. It is also not clear whether the interest cost arising out of the delay in execution is capitalised or not. Although the 1992 Planning Commission Guidelines do recommend this, it is unlikely that the practice was followed earlier There is therefore reason to believe that the cost estimates, as per project reports, are likely to be considerably lower than actual costs even if external costs are not included.

But power has emerged as a central area of concern for policy makers in India At the commencement of the Eighth Plan, the country faced a peaking shortage of 19% (9 000MW) and an energy shortage of 8% (22.5 billion KWH). The Electric Power Survey and the Rakesh Mohan Committee have forecasted an increase in shortages unless urgent steps are taken to rectify the situation A likely result of this is that it is extremely probably that there will be an effort to increase installed capacity for hydropower. The hydroelectric potential has already been increased to 600 billion KWH as against the earlier assessment of 472 billion KWH

Efforts are being made to increase hydropower capacity. But owing to scarcity of large investible funds with the Central and State governments, which are required for large river valley projects, it is unlikely that much headway will be made in this direction unless external funding is tapped. Eighth Plan experience tells the story:

Table 4.4 Hydropower Targets and Achievement (MW) (Eighth Plan 1992-97)

Sectors	Target	Achievement	% shortfall
Central	3 286	1 465	55
State	5 860	794.7	86
Private	162	168	-
Total	9 282	2 427.7	74

As the involvement of private sector is small, the onus for development of hydropower capacity lies really with the government, as the table indicates. Although electricity is in the concurrent list, the large investment required for hydropower development is not easily available from state governments. The Central Government's role has therefore increased in this sector, beginning with the launching of centrally sponsored power projects in the early 1970s and the subsequent incorporation of the National Hydropower Corporation (NHPC) in the mid-1970s. The organisational structure followed for hydropower development has relied on the setting up of corporate structures. . which have the responsibility of developing and managing large hydropower projects (with share capital contributed by the Central Government and concerned States. Besides the Damodar Valley Corporation and the Bhakra Beas Management Board, which came into being before 1970, recent years have witnessed the incorporation of NHPC, North Eastern Electric Power Corporation (NEEPCO), the Tehri Hydro Development Corporation and the Nathpa Jhakri Power Corporation. These bodies do not have the financial muscle for the development of hydropower capacity. Given the high capital cost, long gestation period and the environmental and social costs, hydropower development is not the preferred option for power generation compared to other sources.

4.5 Project Preparation

The analysis so far shows that there are considerable differences between estimations at the time of appraisal and actual cost. Costs are systematically underestimated and benefits exaggerated so that the requisite BCR is shown to have been arrived at. Further, during actual implementation, there are considerable delays, enormous escalation in costs and changes in design and scope of projects. Benefits, on the other hand, fall well below anticipated figures as actual irrigated area and achieved yields fall below projected levels. Against this background, it is important to enquire into the planning and implementation processes in order to seek reasons for this inaccurate state of affairs.

The first steps in the preparation of project reports are identification and investigation. The identification of projects should follow from an assessment of water resources by the State and the plan for phased development of such resources. Regarding the existence of such assessments and plans, the PAC (1983,53) had the following to report.

> *One of the strategies priorities of the Sixth Five Year Plan in the irrigation sector is preparation of State-wise Master Plans and completion of all investigations by 1989-90. Not a single State has, however, been able to prepare such a plan pending completion of investigations needed therefor. The Committee trust that the State Governments would realise the desirability and the urgency of preparing such plans in the interest of orderly and phased development of the precious water resources.*

In the absence of a plan and even of requisite detailed information regarding water resources in the State till as late as the Sixth Plan, it is a mystery how project identification was done. Clearly, some ad-hoc approach must have ruled in the absence of a technical approach. In the author's discussions with officials of irrigation departments, he was informed that sometimes decisions are taken and announced at the political level without even a preliminary technical survey.

Another factor which seems to have influenced the identification of projects is inter-state competition for developing irrigation projects. Although rivers are often inter-state, irrigation has been a state subject. Rivalries, therefore, have not been unusual. As far back as 1964, the "Committee to Suggest

Ways and Means of Improving Financial Returns from Irrigation Projects" put the following question to State governments: "Will it be possible to concentrate on the continuing schemes and to start only a minimum of new schemes to complete them on a priority basis?" The answer of one state (Mysore) was absolutely frank: "Not agreed. Most of the rivers in the State are inter-state. Some major projects on them are already under construction in neighbouring states. So, possible projects on them in Mysore, if not started early, will be objected to on the ground of 'perspective rights'. Again a large part of the State is arid requiring irrigation facilities urgently." (PAC, 1983:53)

A perusal of committee reports shows that State governments have guarded their rights zealously. The Irrigation Commission (1972) had recommended the setting up of an "Indian Service of Engineers", but the PAC (1983:58) was informed: "The matter has been under consideration since August 1961. It will take some more time for a final decision to be taken . . . . [and] to obtain the view of some of the State Governments whose reactions are still awaited" Clearly, the states did not want the Central Government be involved "... . . so far as the association with the Central Water Commission is concerned, the State Government has been quite averse to associating the with Central Water Commission. ... . . . Perhaps, are afraid that there may be certain inter-state aspects which will become known to the Central Government and their projects might be delayed." (PAC, 1983:59)

Given the inherent tendencies towards competitive construction of projects, phases of easy availability of finance saw spurts in the launching of new projects. The Gadgil formula, which operated during the Fourth and Fifth plans, allotted 10% of plan funds to States on the basis of major continuing irrigation and power projects. In addition, non-plan assistance, assistance under advance action and additional central assistance for command area development (a centrally sponsored scheme from 1975-76) were also provided to States during the period. In addition, World Bank finance also began to flow in. New Project reports were the key to obtaining all this finance. As is well known, success in the bureaucracy is generally measured by the officer's (department's) abilities to get finances. It is no wonder then that the Fourth and Fifth Plans saw a major spurt in the initiation of new projects

This is how new projects have been identified in addition to the common-sense approach of providing irrigation to dry and drought-prone areas. Large projects required detailed project reports for their inclusion as new plan projects. The machinery for investigation was wanting in many respects. In the early years of planning, i.e. up to mid-1960s, large projects were undertaken with little prior investigation:

> *Although investigations were carried out for fixing dam sites, and for dam or barrage foundations, detailed investigations on the canal system were carried out later and in most cases, the estimates framed were based on preliminary investigations and cost studies of one or two small branches or distributaries. A per acre cost was adopted for working out the total cost of the canal system. Also, provision for drainage etc. was made on an ad-hoc basis. It was only in the course of construction of main dams and barrages that further detailed investigations were carried out for the canal systems, railway crossings, cross drainage structures etc. (PAC, 1983 p 31)*

In 1973, the Naegamwala Committee identified inadequate investigations as a principal cause of cost and time overruns. The Committee recommended that projects costing over Rs 30 crore should be treated more strictly regarding detailed investigations and preparation of project reports, and that the outlay on these could be up to 5% of the anticipated project cost. In 1983, the PAC was again recommending that "this suggestion be pursued vigorously with State Governments"

The Estimates Committee also found that the State governments were not adhering to CWC guidelines which caused delays in sanctions. Project reports were incomplete in many crucial ways. Further, the survey staff were not competent. Proper training was lacking, though improvements in this were reported in later years. Further, there were no incentives to conduct surveys in distant and difficult locations which had virtually no amenities. The quality of project reports therefore was generally extremely unsatisfactory.

But project reports were the key to acquiring finance. The requisite BCR was necessary to clear over a number of initial hurdles – the CWC, Central Electricity Authority (for hydropower projects) and the Technical Advisory Committee – so that the projects could be sanctioned by the relevant working group and then included by the Planning Commission. The argument was that if the allotment for the irrigation sector was large, more new projects would come in. Alternatives were rarely, if at all, examined. The requisite BCR was therefore a necessary condition for inclusion, subject to the availability of finances for the irrigation sector.

No examination of alternatives, from an economic appraisal viewpoint, is done for projects. The BCR, as the Desai Committee found, is restricted to the final version of the project which is the only one submitted for approval. Technical and economic analyses are separate and the latter is generally an addendum to the final technical version. Optimisation of technical parameters within a techno-economic framework was suggested by the Desai Committee. Also, the use of a sensitivity analysis to estimate the effects of changes in assumptions was recommended by the committee.

The disturbing picture that emerges is that the appraisal procedure and criterion seem to have been reduced to so many bureaucratic requirements which needed to be shown to have been fulfilled in order to obtain finance and permission for execution. And the requirements were somehow fulfilled on paper.

4.6 Financial Performance

"The Supplementary Report of C & AG for the year 1975-76 had pointed out that just before Independence, ie 1945-46, the net gain to the Exchequer from irrigation schemes after meeting working expenses, interest charges and deducting loss on unproductive works was Rs7.92 crores, ie a return of 5.3% on the investment of Rs149 crores. Just after Independence, irrigation works in the country as a whole yielded a net annual profit of over Rs.1 crore after meeting the cost of maintenance and interest charges. In the subsequent periods, the irrigation and multi-purpose projects incurred losses." (PAC, 1983:130)

Before Independence irrigation systems were divided into "productive" and "unproductive works" for the purposes of finance and accounting. Prior to the great famine of 1877-78, all works were "productive" in the sense that they yielded profits after meeting the interest charges and O&M costs. After the famine, the category of "productive" or "unproductive" works was introduced mainly as a protection for vulnerable agriculture in drought-prone areas. Profit was not the intended criterion.

Post-Independence India embarked on an ambitious development of the irrigation sector. Although the financial criterion for project approval remained on paper till 1964, considerable lattitude was allowed in practice. Irrigation development became a part of plan resources in the States sector with finances coming from (a) State revenue surpluses, (b) State loans from the public and (c) Central loans and grants. In the first three Plans some weightage in the allocation of Central funds was given to States with large irrigation schemes. In the Fourth Plan 10% of the plan funds was earmarked for meeting the financial needs of major projects in states. As the capital outlays increased, the financial losses from public irrigation works mounted. The losses in 1955-56 were Rs4.84 crore. The figure increased to Rs14.48 crore in 1960-61 and then to Rs56.91 crore at the end of the Third Plan.

Concerned with the rapidly deteriorating state of irrigation finances, the Government of India set up a "Committee to Suggest Ways and Means of Improving Financial Returns from Irrigation Projects" in 1964. In 1972, the Irrigation Commission expressed concern over the financial situation and also made recommendations for irrigation projects, as a whole, to "give an annual income at least equal to their annual cost of operation". In 1976, the National Commission an Agriculture noted that losses had risen to Rs141 crore in 1971-72. This Commission too, like the Irrigation Commission, recommended that "at the time of considering a new project for sanction, its financial return should also be carefully examined". Further recommendations of the National Commission also related to revision of water rates. By the end of the 1970s the deteriorating financial position of the irrigation sector was beginning to have an impact on capital outlays. Simultaneously, the earlier urgency of increasing food production had eased. The irrigation sector began to feel seriously the constraint of finances for capital expenditures. The Estimates Committee of 1977-78 was principally concerned with the inadequacy of resources for completing even ongoing projects. The Committee recommended an enhancement of irrigation outlay as a%age of total plan outlay and special treatment/provision for States with large incomplete projects. But these recommendations were not enough. The real help, which the Estimates Committee had just begun to understand, had begun to flow in from the World Bank.

The Estimates Committee (1977-78:72-73) noted that "up to the end of the Fourth Plan, the assistance from the World Bank as rendered or committed for major and medium irrigation projects amounted to 112.9 million dollars for six projects". . . . The trend in assistance was clearly on the rise. "In all, 23 projects are stated to have been identified for credit assistance from the Bank. Of these, the Bank has evinced interest to consider providing assistance to twelve projects." Based on information in the Ministry's annual reports and on data provided by Singh (1997),a list has been compiled of externally funded projects in the late 1970s and 1980s . The list is not exhaustive as annual reports of a few years could not be readily obtained due to paucity of time. Nevertheless, the available list shows that the World Bank funded about 46 irrigation projects with the total assistance amounting to nearly $5 000 million In addition, hydropower projects were also financed taking the total assistance to nearly $7 800 million. There is little doubt that the spurt in the number of new major and medium projects taken up in the Fifth Plan was the result of World Bank funding. External funding appears to have tapered off in the late 1980s.

The easy availability of external finance put into the background the issue of financial reforms in the irrigation sector Paradoxically, as losses in the sector mounted, the allocations and the number of new projects increased. In 1975-76, the losses were Rs146 crore which rose to Rs403 crore in 1980-81 (PAC, 1983:130). The PAC (1983) also enquired into the question of losses The evidence placed before the PAC makes sad reading:

> *The trend in irrigation losses has been a matter of serious concern. . . successive Five Year Plans have stressed the need for adopting suitable measures for reducing progressively the losses on irrigation works and ultimately eliminating these altogether The successive Finance Commissions have also gone into the question of irrigation losses and have made several suggestions from time to time for implementation by States The Irrigation Commission (1972) also examined this matter in detail and suggested a number of steps to improve financial return on investment for irrigation projects. The Committee on Taxation of Agricultural Wealth and Income (Raj Committee) also recommended that water supplied by public irrigation projects should be priced like any other input so as to cover the cost. . Planning Commission and Ministry of Irrigation have been taking up this question with the State Governments in many forms like the National Development Council meetings, annual plan discussion, State Ministers Conference, Regional Conferences etc. . . The National Development Council also recognised that the financial results of . . . irrigation works needed urgent improvement for orderly implementation of the Sixth Plan.*

To this long list of futile attempts needs to be added the "Committee to Suggest Ways and Means of Improving Financial Returns from Irrigation Projects" (1964), the "National Commission on Agriculture" (1976), the "Public Accounts Committee" (1983), National Water Policy (1987) and the "Committee on Pricing of Irrigation Water" (1992). According to CWC data, losses from Irrigation and Multipurpose River Valley Projects rose from Rs424 crore in 1980-81 to Rs945 crore (1985-86) and then to Rs3 124 crore in 1993-94

As the Vaidyanathan Committee (1992) pointed out, the CWC figures underestimate the actual losses on account of four factors. Firstly, the interest (and depreciation) shown are with regard to commercial projects (a vestige of the earlier productive irrigation category). The interest does not include interest on capital expenditures on the non-commercial (protective) projects and on command area development. Secondly, the rate of interest shown is a book adjustment based on rates indicated by the State government and not based on actual rates. To correct this, the Vaidyanathan Committee used the "average interest rate paid on the outstanding public debt of each state". Thirdly, interest during construction is not capitalised. Finally, "gross receipts" or incomes from irrigation projects include a number of items which are not part of irrigation income and can account for up to one-fifth of "gross receipts". Quick but incomplete estimates made by the Committee for the year 1986-87 showed that losses were in the region of Rs1 526 crore compared to the CWC estimate of Rs1 379 crore; nearly 11% more in a single year.

The immediate causes for the mounting losses, as emerge from various reports, are (a) rising costs (b) static water rates, and (c) shortfalls in area irrigated and delays in completion. Of these, the issue of water rates has emerged as the most important in recent years.

Water Rates

Despite repeated exhortations by numerous official committees, water rates have remained remarkably unchanged:

> *Revision of water rates has been infrequent, hesitant and very much less than the increase in costs. For instance, water rates in Tamil Nadu were last revised 30 years back. In Punjab, Kerala, Haryana, Jammu and Kashmir and Himachal Pradesh, there has been no change in rates since the mid-seventies Several [states] announced revisions during 1981-86, but in some cases the implementation of the revised rates was held up by the Governments. . The rate increases were themselves rather modest and no state has accepted, much less implemented, the Irrigation Commission's recommendation for reviewing and adjusting rates every 5 years. . During this period, the prices of agricultural produce have roughly doubled and overall yields of irrigated crops were also rising*
>
> (Vaidyanathan Committee, 1992 37-38).

Not only were the rates not revised even to account for inflation, they were fixed at ridiculously low levels. The Vaidyanathan Committee noted that "In no state", does the gross receipt by way of water charges per hectare account for more than 3% of the gross productivity per hectare of irrigated area." Further, even this meagre amount was not collected and the arrears in collection had been allowed to accumulate. There was also no rational basis for the fixing of rates; the water-intensive crops actually paid less per unit of water and the correlation between gross receipts and productivity across States was absent. Cost coverage, of course, was not a consideration at all.

Cost Escalation

The other proximate factors cited as causes for the losses, are escalation in costs, shortfalls in area irrigated, and delays in completion of projects. These are primarily the result of faulty planning - from the project to the national levels - and tardy implementation The "Expert Committee on Rise in Costs of Irrigation and Multi-Purpose Projects" (Naegamwala Committee, 1973) and the Planning Commission's Working Group for the Sixth Plan (1980) identified ten factors causing cost escalation and time overruns. Of these, eight are clearly attributable to faulty planning:

- proliferation of projects resulting in thin spreading of resources;
- lack of thorough investigations before starting work;
- delays in taking decision.

- non-availability of essential inputs;
- change in scope of projects during implementation;
- lack of construction planning and monitoring organisations in states;
- lack of detailed plans and estimates for the distribution systems and structures thereon; and
- failure to update estimates and inform governments of the rise in cost of projects.

The PAC (1983:51) noted that the problem of proliferation had escalated since 1969:

> *. . . until 1969 major projects were added at a steady rate, averaging 4-5 projects per year. However, since then there has been a spurt in the number of new projects. As many as 119 major projects and 479 medium projects have been taken up since the commencement of the Fourth Plan till the end of 1979-80. . . . The Committee have been given to understand that "with the severe droughts in the late sixties and early seventies there were immense and persistent demands for undertaking new projects. It also became a national policy to exploit our water resources and provide the basic infrastructure of irrigation as early as possible." The Committee need hardly point out that long gestation projects need very thorough and detailed investigations. In any case, drought conditions call for quick result-yielding schemes which are possible only through the development of minor irrigation facilities. The Committee, therefore, consider it to be a negation of planning for the Planning Commission to sanction a large number of major schemes without making sure of the availability of funds, the technical personnel and essential inputs like cement, steel, coal etc. to enable completion of the projects within the time schedule laid down and within the approved estimates.*

According to the PAC, therefore, the escalation in costs is attributable almost entirely to faulty planning. The combined effect of the politics of water rates and the administration of project planning and implementation is that the irrigation sector has made staggering losses since Independence. According to Gulati et al (1995) during the period 1951-90 "more than Rs600 billion (at 1988-89 prices) have been spent towards creating a huge canal network through major and medium irrigation schemes. The direct financial recovery from the irrigation schemes is less than Rs3 billion at 1988-89 prices."

The enormous losses in the irrigation sector have serious implications for the financial viability of hydropower. As already noted, the cost per unit of hydropower is low because only a small part of the capital cost of multi-purpose projects are apportioned to hydropower. Hydropower therefore generally shows a profit if power rates are at reasonable levels. But this is only notional. The bulk of the costs are apportioned to irrigation from which benefits are only notional; actual financial returns are negligible. Therefore, if the combined financial viability of the project is studied, the gains from power are unlikely to compensate for losses from irrigation unless hydropower generation is extremely large.

4.7 Distributional Aspects

Distributional Weights

The philosophy underlying usual benefit-cost analysis is that those who benefit from the project should be able (hypothetically) to compensate the losses of those adversely affected, and there should still be some net benefits over. In short, benefits from the project must exceed costs. However, this presumes that all benefits and losses, irrespective of whom they accrue to, are given equal weightage: the rich and the poor are treated alike. To correct this, distributional weights are sometimes assigned so that the benefits to the poorer are given more weighting.

In India, economic appraisal of projects has not followed this practice. In the case of irrigation projects, neither the earlier financial criterion nor the subsequent quasi-economic criterion raises the question of distribution. None of the official committees, except the Desai Committee (1983), has made any recommendation regarding the incorporation of distributional issues in project appraisal procedures. The Desai Committee recommended the inclusion of distributional effects for project appraisal but it was not, however, in favour of the use of distributional weights. According to the Committee (1983:11): "the analysis of distribution of surplus income should be used to estimate (a) the number of small and marginal farmers who would benefit and (b) the proportion of benefits which will accrue to them. As a part of benefit-cost analysis this factor can be taken into account by taking credit for the savings in subsidy." Similarly, employment benefits should also be taken into account with due care. The Committee (1993:96) also stressed that the issue of rehabilitation requires special attention:

> *It is essential that the loss of income and property as also amnesty suffered by displaced persons should be quantified as thoroughly as the gain in income of beneficiary households. The database for such calculations has to be obtained from land holdings data and, if necessary, a socio-economic survey. The estimates of loss must also include an adequate solatium for the psychic consequence of displacement. The provision for compensation included in the project can be set off against this estimated loss".*

The recommendations of the Desai Committee, as mentioned earlier, have been ignored. Surprisingly, distributional analysis of irrigation projects in India has rarely been undertaken even by individual researchers. To the best of the author's knowledge, only two cost-benefit studies have incorporated distributional analysis using income weights. The first is an unpublished doctoral thesis by M.N. Murty on the Nagarjuna Sagar Project. The other is an evaluative study of the Western Gandak Canal Project by Singh (1994) of the financial, economic and social (using distributional weights) net benefits from the project (barrage and canals). The financial analysis yields a negative NPV of Rs4.52 crores. The economic analysis (using economic prices) also yields a negative NPV of Rs0 72 crores However, when regional income distributional weights are used, the NPV becomes significantly positive. Since the project under study is a barrage it is not really a representative case for this study, but it indicates that there is no a priori reason to expect that the inclusion of distributional analysis will invariably lower the net benefits.

Subsidies

Another way of looking at the question of "who gains and who loses" is to examine the financial performance of projects. (This has been attempted in the earlier section.) The operational losses from public irrigation projects are, in fact, implicit subsidies which the State governments provide to the beneficiary farmers. These subsidies are large and have continuously increased. A study by Srivastava and Sen (1997) for the year 1993-94 estimated that, among the State government subsidies, irrigation subsidies were the largest (Rs12 421 crore) and accounted for 24% of all subsidies. Education subsidies came second, accounting for 20% of total subsidies, followed by power subsidies (11 4%). On a per capita basis, irrigation subsides for the same year ranged from Rs33 in West Bengal to Rs300 in Goa with Maharashtra, Haryana, Gujrat and Karnataka (all well-off states) showing per capita irrigation subsidies exceeding Rs225. Since the beneficiaries of public irrigation are only a section of the farmers, not the entire state population, per beneficiary subsidies will be fairly high.

The inequity involved in such large-scale subsidisation of beneficiaries has often drawn sharp reactions from various committees. The Irrigation Commission (1972:264-5) was perhaps the most explicit

> *There is a view that irrigation projects should be undertaken not as much for the purpose of earning revenue but as a measure of social welfare and that the irrigation rates should be kept low. This approach would be valid if the benefits from irrigation projects were more or less evenly distributed over the entire farming community But this is not the case as the main beneficiaries are only a section of the cultivators in the command area It would be highly*

inequitable to call upon dry-farmers and the general tax-payers to pay for benefits enjoyed by irrigators.

In a similar vein, the PAC (1983:136) saw "no reason why the big landowners who are the principal beneficiaries of the irrigation facilities, should continue to be subsidised any longer though it may be justified in the case of small and marginal farmers and share croppers". It must be mentioned that the subsidies relate only to operational losses, the capital expenditures are not covered. Since capital expenditure involves long-term borrowing, and since irrigation projects yield almost no income, inter-generational distributional issues also become an important consideration as the tax burdens over future generations are likely to be heavier and/or future development expenditures are likely to be curtailed.

Regional Distribution

Our analysis of the regional distribution of benefits shows that the benefits from large irrigation and multi-purpose projects have been confined mainly to the Northern and Southern regions with the Western region coming third. The Eastern and North Eastern regions have reaped very little benefit

The Southern region (comprising 4 states) alone accounts for 45% of the hydropower installed capacity in the country (excluding the central sector) and 25% of gross irrigated area. The northern states, on the other hand, account for about half of the irrigated area and nearly 29% of the installed hydel capacity. In contrast, the combined share of eastern and north-eastern states in hydropower capacity is only 10% and that in irrigated area only 6.5%. Statewise, the maximum share in hydropower benefits have been received by Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra, Punjab, Kerala and Uttar Pradesh (in that order) The maximum shares in irrigation benefits have accrued to Uttar Pradesh, Punjab, Andhra Pradesh, Rajasthan and Madhya Pradesh In short, the states in the northern and southern regions account for 75% of both hydropower and irrigation benefits Clearly, the regional distribution of benefits from large irrigation and multi-purpose projects has been highly inequitable.

Intra-Project Distribution

The issues relating to intra-project distribution of costs and benefits have been widely commented upon and also form a major part of an accompanying WCD study (Singh, 2000) Hence the issues are mentioned here only in passing.

Dams, by their very nature, lead to submergence and displacement in the catchment area, which is hilly, and the irrigation benefits flow to the command area. The burden of costs and benefits therefore falls on different sets of people (often geographically separated). One expects, and this is confirmed by Singh's (2000) study, that the costs fall disproportionately on tribal people The benefits accrue to farmers, usually the bigger or more dominant ones, who are able to influence, in many cases, the actual distribution of water. Land ownership data sometimes show that larger landowners benefit This could also be the result of the fact that land holdings in unirrigated areas are usually larger Once irrigation is provided the benefits accrue to these larger farms. Further, since Punjab, West Uttar Pradesh and Rajasthan are some of the states benefiting more, and since the average size of holdings in these regions is larger than in eastern India, a positive correlation between size and irrigation may be evident.

Another intra-project issue is the unequal distribution of benefits between the upper, middle and tail reaches of canals. A quick study, conducted by the author, based on evaluation studies of five projects (results presented below) only reconfirms what is already known, both (net) area irrigated and cropping intensities are much lower in the tail reaches.

Finally, the problem of project-affected people has become a central one. Unfortunately, wide differences exist regarding the number of persons displaced by large irrigation and multi-purpose projects. The estimates range from 2 million to 40 million. What is, however, less contentious is that the compensation paid has hardly covered even a small part of the costs borne by the displaced in an overwhelming majority of projects as indicated by, among others, Thukral (1992) and Singh (2000). A large number of people have undoubtedly been impoverished by costly projects with doubtful net benefits.

4.8 Lessons

In this brief study, an attempt has been made to trace the evolution of appraisal procedures and criteria that are employed by government authorities to analyse and decide upon large projects. The behaviour of actual costs and benefits has also been traced and compared with anticipated costs and benefits using both project-level and aggregative studies. Only direct costs and benefits have been studied.

The study brings out the enormous lethargy and resistance to change in the irrigation sector. It took seventeen years after Independence for a shift from financial appraisal to quasi-economic appraisal procedures to take place. The procedures established in 1964 continued almost without change till about 1990, by which time the cost definition was widened and IRR calculation was added. But even now, despite the Desai Committee recommendations in 1983, the shift to full economic appraisal has not materialised.

This amazing resistance to change did not persist because the existing procedures were helpful to project-clearance. Undoubtedly, they were easy for computation. But, as pointed out, the accounting fallacy of 10% interest on the <u>entire</u> project cost actually makes it difficult for projects to qualify. Yet there was no change because appraisal exercises were not taken seriously. The problem was tackled through data misrepresentation - costs were grossly underestimated and benefits overestimated. The actual costs showed that the project data were, by and large, fictitious. The entire appraisal process developed into a huge systematic exercise in self-deception.

One reason for this mistaken practice is that the benefit-cost analysis has never been used as a tool for assessing alternatives and therefore never been central to the planning process. The only use of the BCR is for accepting or rejecting a project. Since the development of water resources has been a State subject and outlay on irrigation is provided in the State sector, the real onus of proper appraisal lies with the States. Each State investigates, constructs and operates its irrigation projects. The BCR enters only as a central government imposed criterion which must be <u>shown</u> to have been fulfilled to obtain central clearance and plan finance. It is not surprising therefore that sometimes projects are announced and even started without an appraisal and thereafter the project report undertakes the tortuous exercise of benefit-cost justification. Capital costs are underestimated by at least half the actual costs and projected benefits are nearly double that of actual benefits.

While this has been the dominant story since 1964, the last twelve years may have witnessed a change towards more realistic benefit assessments and the inclusion of many cost elements which were previously ignored. The reason for this is that, due to financial difficulties faced by the Central Government and the States, the number of new projects has declined, facilitating better appraisal. Pressure from enlightened public opinion has also reinforced the need for greater realism in project preparation. Transparency and debates are therefore good for all parties concerned.

Harder budget constraints have also meant that the overwhelming domination of political and bureaucratic concerns over economic and financial considerations is no longer possible. The recovery ratio, which fell from over 90% to less than 10%, has shown the utter lack of financial management in this large sector. Water rates have been ridiculously low and have borne no relation to either benefits or operational costs. Pricing of water has been mismanaged as a result of populist politics. Thus not only huge capital expenditures with doubtful benefits but even operational expenditures in the water resource sector have depended on subsidies and taxpayers' money. Unwittingly, it has been a huge but costly distributional exercise. Many in the sector and also the beneficiaries profited from the easy budgetary position. Now the adjustments are proving difficult as old habits die hard. The position is now so pathetic that even maintenance expenditures have been shown as capital expenditures, for which plan funds are available, for renovation and modernisation of systems.

In short, the absence of accountability and transparency has harmed the long-term interests of irrigation development in India. It is necessary to open up the entire appraisal procedures and criteria as well as the financial accountability systems to public debate so as to enable the development of a more enlightened and professional decision-making and management system. Such a system will examine alternatives so that scarce public resources are put to the most beneficial uses.

5. Environmental and Social Impacts of Large Dams: the Indian Experience (Summary Report)

Shekhar Singh, Raman Mehta, Vishaish Uppal, Asmita Kabra, Bansuri Taneja, Prabhakar Rao

Preface

This is the summary of the report, with the same title, produced by the Indian Institute of Public Administration for the World Commission on Dams. The main report includes various tables that have been left out in the summary. Also, the main report contains annexes with the detailed data- base used for the report. Though the annexes have not been included in the summary, references to the annexes have been retained in the text in order to indicate the supporting data that are available in the main report.

In writing this report we have received assistance and encouragement from many people. Though it might not be possible to name all of them here, we would like to acknowledge our debt to the Bombay Environmental Action Group, specifically Mr Shyam Chainani, who very kindly made available to us the relevant information which we required. We would also like to thank Dr N C. Saxena, Secretary, Planning Commission, for allowing us access to the data at the Planning Commission. We would also like to thank Mr A.D. Mohile and Mr M. Gopalakrishnan of the Central Water Commission for making available to us various documents of the CWC and for sending us detailed comments on our earlier draft

We are particularly grateful to Mr L.C. Jain Mr Himanshu Thakkar, Ms Medha Patkar, Mr Bharat Dogra, Mr Harsh Mander, Ms Enakshi Thukral for many very useful comments on our earlier drafts Many other people have sent their comments or otherwise helped us in this work and we are very grateful to all of them even if it is not possible to list all of them here

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5.1 Introduction

5.1.1 Objectives

The main objectives of this case study are to identify the environmental and social impacts of large dams and to assess, for the Indian situation, the prevalence of such impacts. It is also an objective of this case study to determine which of these impacts were anticipated and taken into consideration while assessing the feasibility of the dams and, for adverse impacts, to determine what steps were taken to avoid or minimise these and to what effect. On the basis of these results and along with findings regarding other aspects of large dams, the overall objective is to assess the development effectiveness of large dams. The detailed terms of reference are contained in Annex 1.

5.1.2 Conceptual Framework

Dams have both intended and unintended impacts which can be positive or negative.It is unlikely to find intended negative impacts, though positive impacts can be both intended and unintended.

This is a working paper prepared for the World Commission on Dams as part of its information gathering activities. The views, conclusions and recommendations contained in the working paper are not to be taken to represent the views of the Commission

Each of these types of impacts can be:

- Inevitable;
- Reducible;
- Avoidable.

Many possible impacts can be anticipated prior to assessing the viability and best use of a dam, and taken into consideration while making such an assessment. The avoidance, reduction or mitigation of the adverse impacts can also be planned in advance of the dam and the costs of such measures added to the other costs of the dam, for the purpose of determining its economic viability. During and after construction, there can be a monitoring system that regularly and periodically monitors the various environmental and social impacts, determines whether they are by and large as anticipated, and whether the measures for preventing, reducing or mitigating the adverse impacts are effective. Where there are adverse impacts that were not anticipated or where the various measures for handling such impacts are not effective, corrective action can be taken.

5.1.2.1 Environmental Impacts

Environmental impacts of large dams occur at different times and locations. A distinction can be made between impacts that occur:

- upstream of the dam and reservoir;
- at the site of the dam and reservoir;
- in the command/rehabilitation sites and along the canals;
- along and adjacent to the power transmission lines, and
- downstream of the dam and reservoir/

Similarly, a distinction can be made between impacts that occur

- prior to the construction of the dam, at the investigation and planning stage;
- during the construction of the dam and related infrastructure;
- after the construction of the dam, during its operation;
- during and after the decommissioning of the dam/

A tabular representation of possible environmental impacts is given in Annex 1.II.

As already mentioned, most such impacts can be anticipated. However, new impacts are still being discovered and improved methodologies and instruments are being developed which better measure even known impacts. Therefore, in the past, not all the impacts that are known today could have been anticipated, and certainly not measured with the accuracy with which they can be today

Many environmental impacts only become obvious over time, sometimes after many years, and therefore many more impacts of dams which are already constructed and even studied will become known much later. Such impact studies must be redone every ten years or so based on current knowledge and skills. Such an approach raises the level of environmental and social standards that dams must meet and also takes into consideration the enhanced capabilities and technologies that become available to meet such standards.

5.1.2.2 Social Impacts

Very often, economic impacts are understood to be *ipso facto* social impacts.It is assumed that if people become economically better off then they automatically become socially better off However, for the purposes of this case study, a much wider and independent understanding of social impacts is used It is not assumed that if people benefit economically they also necessarily benefit socially.. economic benefits can also have social costs. For example, better incomes can (and have) lead to the consumption of liquor or drugs, to the abandonment of original spouses (mainly wives) in preference for new ones who can be attracted by the raised economic status, or to changes in lifestyles and eating habits that are detrimental to health. There are also cases where families were made economically better off but their social fabric was destroyed when they were relocated in alien surroundings or in a fragmented manner.

The converse is also possible and people might become socially better off even while becoming economically worse off.

For these and many other reasons, it is important to independently assess social impacts without necessarily correlating them with economic costs or benefits.

Social impacts are understood to be those impacts that affect the physical. psychological and emotional well-being of a community or group, positively or negatively. They include (though are not limited to) all those elements that impact on the following aspects of a group or community:

- physical health and nutritional status;
- mental health;
- livelihood and incomes;
- aspirations;
- vocational or professional choices;
- access to preferred food varieties,
- access to nature and natural resources;
- access to preferred natural surrounds and climate;
- access to infrastructure and development;
- opportunity to live preferred lifestyles;
- cultural and religious beliefs, practices and interactions;
- sense of collective and individual security;
- opportunity for entertainment and leisure activities;
- customary values;
- dignity and self respect;
- state of social justice and equity within the group and in relation to the larger society.

Social impacts can also be distinguished geographically and temporally, similar to environmental impacts The various possible social impacts of large dams are tabulated in Annex 1.III

Issues relating to social justice and equity require special and separate analysis, as they are far more complex than the other issues. The indicators for improved social justice and equity are often not direct, for even where matters seem to have improved overall in an absolute sense, relative values could have been adversely affected. The promotion of social justice and equity are also an explicit and overriding objective of all development processes in India, as they should be, considering the existing social and economic inequities in India.

Issues of equity become relevant for at least five levels. Equity can be affected by:

1. The manner in which some people are made to pay the costs of the project while others obtain the benefits, or the manner in which the costs and benefits of the dam are distributed in society (intra generation class-benefit analysis)
2. The manner in which the costs of the dam are distributed among those adversely affected by the project, and mitigative measures applied (class benefit analysis among project-affected people)
3. The manner in which the benefits of the dam are distributed among the beneficiaries of the project (class benefit analysis among project beneficiaries).
4. The manner in which the costs and benefits are distributed among various generations of human beings (inter-generation equity).
5. The manner in which the costs and benefits are distributed among species (inter-species equity)

Specifically, these imply the following questions:

1 Whether the dam promotes overall equity by benefiting the poor and weak in preference to, or at the cost of, the rich and powerful? In other words, is the social and economic gap between those who benefit and those who pay greater or less, because of the dam? Clearly, only where the costs are paid by the rich and powerful, and the benefits go to the poor and weak, would this be so
2. Among those who pay the costs (the project-affected people), are these costs equitably distributed, with those who have more, paying more, and those who have less, paying less?
3. Are these costs at least equally distributed, with all levels paying the same or do the poorer and weaker pay more?
4. Similarly, are the benefits also equitably, or at least equally, distributed among the project beneficiaries (PBs)?
5. Is human society overall more equitable or less so because of dams?
6 Does the dam represent a sustainable form of development so that the rights of future generations of human beings to nature and natural resources, and to economic resources, are not compromised?
7. Do dams promote or adversely affect the rights of other living creatures in relation to human beings?

5.1.3 Methodology

This study has been seriously handicapped by the lack of data on the environmental and social impacts of large dams. Part of the reason for this lack of data seems to be that, till 1978, there was no formal requirement to conduct an environmental impact assessment or to assess the social impacts of the project. Consequently, this was not done and no data were collected. Even after 1978, though environmental impact assessments were carried out for all large dams, most of the data collected are no longer available Much of the data that still exist are not in the public domain Accessing data that are held by government agencies was not always easy and in some cases proved impossible. Similarly, data held by international agencies like the World Bank was also not available, despite repeated attempts Another constraint was the paucity of time. The time available (two months) for preparing the draft report was, by any standards, inadequate.

There is an understandable demand that if large dams are to be judged to have impacts (positive or negative) then comprehensive data must be provided in support of such a judgement. However, such comprehensive data do not exist in India for most environmental or social impacts What, then, is the solution to this dilemma. It could be argued that if there are no data regarding any particular impact then it must be assumed that such an impact does not occur. But this is a misleading assumption, for it cannot be assumed that such data do not exist, all that is known is that no effort has been made to collect the data It is also a dangerous assumption for, if accepted, it would discourage the collection of data about adverse impacts. The agency most likely and able to collect such data is the agency that manages the dam and it rarely, if ever, would like to highlight the adverse impacts

Nevertheless, the activities that are involved in the construction and operation of large dams are known. Large dams create reservoirs and submerge land, displace people, alter the flow of rivers, divert water through canals and tunnels, distribute water to agricultural fields, industry, and rural and urban habitations, involve earth work, and masonry and concrete constructions, etc The environmental and social impacts of such activities have been studied in projects abroad and in a few projects in India Also, there is fair scientific understanding about the sorts of environmental and social impacts these types of activities have. For example, there is a good idea of the role that vegetative cover plays in regulating silt and water flows. It is also known to some extent what happens to the species and ecosystems that comprise various forest types when their habitat is submergedThere is some knowledge of what happens when a river is converted into a lake and the impact this has on water quality, on fauna and flora and especially on various species of fish

Something is known about the role of variable river flows in a river ecosystem and about the ecological impact of reduced or enhanced nutrient flows.

Similarly, there is some idea of the sorts of impacts that occur when human communities, especially tribal and other rural communities, are displaced from their traditional homes, especially where such displacement is forced. There is also some understanding of the patterns of resource distribution in society and what happens when a low return resource (like un-irrigated land) is transformed into a high return one.

From this general understanding, it is certainly possible to obtain a broad idea of what the environmental and social impacts of large dams, in general, are likely to be, or were in the past. From a study of the documentation available on Indian projects, it can also be determined which of these impacts were studied, anticipated, assessed, and provided for in which of the projects. Based on the detailed studies available for a few of the Indian dams and on the experience of dams in other countries, it is also possible to identify the required processes and parameters of assessment

To collect the data and experiences available, a list of the relevant issues was developed and finalised after discussions with various knowledgeable people. Out of this list, a proforma was developed (see Annex) and, based on this proforma, information was gathered from available documents. It was decided to collect information on as many dams as possible but, as it was not known in advance for which of the dams information would become available, it was not possible to develop any sort of representative sample. Therefore, though 220 dams (see Annex) were studied for their social and environmental impacts, 67 of them in some detail (Annex), it cannot be claimed that these form a scientifically determined representative sample. Also, though there was no screening of the dams to be studied - and all those for which data became available were studied, time permitting - the sample can also not be considered a totally random one. The fact that data were available for some dams and not for others might itself indicate that the dams for which data were available were the better studied or better planned ones.

As documents and data were collected from wherever they were available, it also cannot be claimed that all the relevant documents pertaining to a particular dam became available and, consequently, were studied, or that similar amounts of data were available for each of the dams studied.

As it became obvious that concern for environmental and social issues has improved as time has passed, it was thought important to study the assessment processes of some of the more recent large dams This conclusion led to the decision to include in the study some ongoing projects. Specifically, three of the ongoing projects, namely the Tehri, Indira (Narmada) Sagar and Sardar Sarovar projects, were looked at in detail. As these are among the latest projects and also perhaps those with the greatest amount of public scrutiny, they could best bring out the strengths and weaknesses in our planning and implementation of large dams in India. Also, because one of the authors, Shekhar Singh, has been a member of various official committees related to each of these projects, current and detailed data were available. Of course, these projects only illustrate the experience of planning, assessment and initiation of projects. It is too early to say what their impacts will be after completion, if they are ever completed

The constraints within which this case study was developed also did not permit any reconciliation of contrary or even contradictory data. Basic factual information regarding the dimensions of the dam, area submerged, forests submerged, people displaced, area irrigated, etc. was taken, wherever available, from official government documents. However, even the various government documents did not always agree with one other. For example, the data on rates of sedimentation given by the Central Board of Irrigation and Power in its publication (CPIB, 1995a) differed widely from the data supplied by the Central Water Commission in its response to this report [CWC 2000]. Both these also differed again from data in another CWC report (CWC, 1982/91). Sometimes such differences were owing to varying definitions or varying timeframes, occasionally they were owing to departments and agencies interpreting and presenting data which promoted their own interests best. Robert Wade (1976a, 1437) observes that in some cases the extent of the area irrigated was under-reported by the revenue department that had the responsibility of collecting water charges. On the other hand, the irrigation department, which had the responsibility of ensuring that irrigation benefits reach the largest number of people possible, gave figures that were considerably higher.

There were also inconsistencies between figures in government documents and those available from non-governmental agencies, especially regarding sensitive information like the number of people displaced, forests submerged or even the extent of the effective command. Wherever irreconcilable discrepancies emerged, the case study has tended to take the more conservative estimate in order to maintain the credibility of the database.

Apart from the information gathered for specific dams, general reports and studies were also examinedand a broad understanding of dams in India, in terms of their environmental and social impacts, was developed. The case study reflects this dual approach in that, based on general studies, broad findings are presented, which are supported by examples and statistics emerging from the study of specific dams.

A letter was also sent to over 700 NGOs and concerned citizens, along with an outline of the case study, with a request to submit information and data. Various individuals and organisations responded with useful information.

A draft summary of the section on environment and social impacts of large dams was then circulated to over 200 people, including NGO representatives, professionals, experts and government functionaries. Subsequently, two one-day meetings (of stakeholders) were organised in Chennai (1 March 2000) and in New Delhi (3 March 2000). These meetings were attended by nearly 150 stakeholders from the community and from the government. All the State Governments and the Central Ministries and Departments concerned were invited to send representatives. Most of the Central Government agencies were represented. The Central Water Commission also, subsequently, sent a detailed comment on the draft chapter. Many other experts and stakeholders also submitted their comments, in writing, and these have all been taken into consideration while finalising the chapter

5.2 Environmental Impacts

Dams usually fulfil one or more of three objectives: providing water for irrigation, generating electricity, and preventing floods. Some dams have the objective of providing water for industry or for domestic consumption. In no case is environmental protection an objective of dams. Therefore, environmental impacts of dams must all be seen as unintended impacts.

As already mentioned, the impact of dams on the environment varies geographically and temporally. Based on a general study and specific assessments of over two hundred dams, the detailed findings are given below

It must be kept in mind that evidence of what happened after a dam was completed is very scant because, barring a few aspects in a few dams, no retrospective assessment has been done. The names of the dams assessed and tables detailing their status regarding the various environmental parameters are given as Annexes.

In addition to examining reports and documents dealing with the 200 dams studied, other material covering a number of dams or specific aspects of dams was also examined. Based on all this, certain findings have emerged, which are reported below

5.2.1 Beneficial Environmental Impacts

Dams are not intended to produce beneficial environmental impacts. However, they do often benefit the environment in one or more ways, which are described below.

5.2.1.1 Findings

Beneficial Impacts Upstream of the Dam

i. Beneficial Impacts of Catchment Area Treatment

For most recent projects, the environmental clearance conditions include the treatment of the catchment. Where this treatment is adequately undertaken and results in the regeneration of natural forests and other ecosystems in the catchment area, there are significant benefits to the environment Such benefits were not included in the BCR of any of the projects studied.

Beneficial Impacts at the Dam/Reservoir

ii. Beneficial Impacts of the Reservoir

The creation of a reservoir provides a habitat to wetland species, especially water birds. The reservoir can also be a source of water to the animals and plants in the adjoining areas and, where such areas have become unnaturally dry, this can be a significant environmental benefit. These benefits were not included in the cost benefit analysis for any of the projects studied.

Over 50 national parks and sanctuaries, which encompass or are adjacent to human reservoirs, were identified during this study.

Beneficial Impacts Downstream of the Dam

iii. Beneficial Impacts of the Provision of Water

The provision of water to urban and rural areas for domestic and municipal use can significantly help improve the living environment. The increase in water supply resulting from a dam can help reduce the incidence of diseases like skin infections, trachoma and others related to inadequate personal hygiene (Ramalingaswamy 1980, as quoted in Verghese, 1990).

For areas that have been made arid because of human factors, the provision of water by dams can enhance environmental restoration and can improve environmental productivity These impacts have also not been included in any of the cost benefit assessments studied.

iv. Beneficial Impacts of Floods

The construction of a dam can help control artificial floods of human origin, thereby preventing environmental damage However, in general, flood control cannot be seen as a significant environmental benefit.

It is occasionally argued that flood control is an environmental objective of dam building for, by controlling floods, dams protect or even "improve" the environment. However, it is an established fact that natural flooding is a part of essential environmental processes. The flood plains are annually enriched by the soil deposited by receding flood-waters and in many areas, for example the flood plains of Assam, agricultural productivity was dependent on the natural flood cycles. Natural floods also perform various ecological functions in a river and its basin. they bring down nutrients and flush river courses, they provide the extra water required by many species of fish to breed, and they restrain salt water ingress at the mouth of the river.

Non-natural or floods of human origin, in contrast, are a major threat to the environment and to the safety of people and property.Such floods result from deforestation and destruction of vegetation in the watersheds, from artificial barriers, like dams, constructed on rivers. Verghese (1990:121) comments on thus: "It is man-made interventions in the regime of these rivers, obstruction of the natural drainage, invasion of the flood plain as a result of development and runaway population growth that has turned an otherwise often benign phenomenon into a dreadful visitation." The most effective and sustainable way of preventing such floods would be to address the basic cause

Flood control also becomes an objective where the land use in natural flood plains is changed in such a way that of the frequency and intensity of natural floods has to be inhibited. While such an objective might have an economic rationale, it can certainly not be justified on environmental grounds.

5.2.2 Adverse Environmental Impacts

Dams also have many adverse environmental impacts. Some of the major ones are described below

5.2.2.1 Findings

Impacts Prior to Construction at the Site of the Dam, Reservoir, Canals, Transmission Lines and in the Rehabilitation Sites

The main impact that has been observed before construction has been the premature cutting of trees in areas that are to be submerged or have to be deforested. Often the trees are felled long before they need to be or before the actual submergence. Consequently, the area is denied the ecological functions of trees even before this becomes inevitable.

Though, occasionally, especially in the last few years, there has been a stipulation that trees are not to be cut below 2 to 4m of Full Reservoir Level (FRL), there still appears to be no stipulation that the trees should not be cut prematurely. There have been complaints from various projects, including Tehri, Narmada Sagar and Sardar Sarovar, that tree felling was done long before it was necessary However, it is not known how prevalent this practice is. This is a totally preventable adverse impact of dams.

Impacts Upstream of the Dam : During and After Construction

i Impacts of the Dam on the Catchment Area

Impacts on the Forests and Vegetative Cover

The state of the catchment is very important for maximising the benefits and minimising the adverse impacts of dams. The degradation of the catchment results in greater silt flows into the reservoir, thereby reducing the life of the dam and also posing a threat to the safety of the dam and to the equipment and machinery installed in the dam. Degraded catchments also result in erratic water flows resulting not only in dry season shortages but also a serious threat of excess water during heavy rainfalls and cloudbursts, again threatening the safety of the dam The degradation of the catchments also adversely affects the biodiversity of the forests upstream and their ecological functions

The construction of a dam can itself contribute to the degradation of its catchments. In the past, the labour force that worked on the dam was not provided with cooking fuel. Consequently, in numerous projects, during the many years it took to construct a dam, the labour force was forced to collect firewood from the neighbouring forests, thereby degrading the catchments (GOR, 1995b). It was also recorded that labourers resorted to tree felling for firewood and to provide a their livelihood during the lean season when construction activity was at a standstill (CWC, 1991).

Most recent projects stipulate that wood or other types of fuel will be supplied to the workers. In recent years the MoEF, for almost all the projects that it has cleared, has also stipulated this (TNEB. nd; Shah. nd; WAPCOS, 1994; CWC, 1991). In many recent projects, despite there being a clear guideline that wood for fuel must be supplied to labourers at the construction site, even and despite this provision being a part of the contract signed with the contractor, satisfactory implementation has not been reported (CWC, 1994b; CWC, 1995).

Forest degradation also occurs owing to improved access, both during and after dam construction. After the construction of the dam, where forests and other vegetation are submerged by the reservoir, the pressures on the remaining forests, mostly in the catchment, increase significantly. For example, an environmental impact study of the Narmada Sagar Project, undertaken for the Narmada Planning Agency of Madhya Pradesh Government, records that, "Apart from the affected population itself, people on the periphery of the submerged area also meet some of their requirements like timber, fuel, bamboo, fibres, etc; and MFP from the submerged area. Neighbouring forests will, thus, come under greater pressure after filling of the reservoir." (EPCO, 1984:70)

Also, where catchments are degraded owing to the construction of a dam, the access to biomass by the surrounding people, is adversely affected. These people often further degrade the catchment or excert pressure on other areas that in turn become degraded.

The construction of roads and other infrastructure, and the increase in activities put an additional strain on the catchment. Unfortunately, the impact of these activities on the forests was not assessed at the planning stage of any of the dams surveyed. But such impacts have been reported from many projects (CBIP, 1995; GOR, 1995b)and from various dams (CWC, 1991; WII, 1994). See Annexs for further details.

All the adverse impacts of a dam on the forest and vegetative cover in the catchment are preventable Most were not anticipated and, till recently, little attempt was made to prevent them

Impacts of mining/quarrying for construction materials

The soil, stones and sand required for the construction of dams and canals are often mined and quarried from around the actual site. Such extraction can also have adverse environmental impacts, especially by aggravating dust pollution, disturbing wildlife and destroying vegetation. The scars and pits from such mining and quarrying (sometimes called borrow pits) remain as ecological sores and can also have an adverse impact on the dams and canals.

These impacts were not assessed as part of the planning of any of the projects studied. In at least one recent project, Indira (Narmada) Sagar (ISP, 1998), the project authorities have been asked not to allow any mining or quarrying, in the catchment area, for construction material for the dam The effect of this activity on the catchment is also rarely documented. In some instances, e g. Subarnarekha (CWC, 1991) and Malana (WAPCOS, 1994), Rajghat (Shah, K.B., nd) and Upper Indrawati (CWC, 1991) restoration of construction sites had been recommended. In another case, Almatti, the project authorities stated that they had a plan for the restoration and beautification of the construction area (CWC, 1993a). However, in the case of the Subarnarekha, the official evaluation report states that this restoration was not carried out (CWC 1991).

In its Annual Report for 1992-93, the Environmental Monitoring Committee of the Central Water Commission states that "In the majority of cases no action is being taken by the project authorities for restoration of construction areas, with the plea that borrow pits are generally situated in the submergence area of the reservoir and as such, do not need any restoration. This does not appear to be a fact ..." (CWC, 1994B:11).

Again, these are impacts that can be prevented by ensuring that such mining or quarrying is done in an environmentally friendly manner and not close enough to the dam to have a direct impact on it. Where this is unavoidable, the mined area should be restored prior to submergence

ii. Impacts of the Catchment on the Dam

Siltation of the Reservoir

Siltation of the reservoir poses many threats to the dam: it not only shortens the life of the dam but also threatens its safety and the safety of the turbines, other machinery and structures. According to the Ministry of Irrigation (as it was then known): "The effects of reservoir sedimentation are felt in many ways: through the direct loss of water storage capacity in the reservoir itself, through increased evaporation losses in the reservoir pool, through increased transpiration losses in delta areas, and through the economy of a region depending upon the reservoir" (GOI, 1985:-152).

A World Bank Technical Paper on Reservoir Sedimentation states various adverse impacts of sedimentation.

> *By raising the bed level of the channel upstream of the reservoir limit, backwater deposits create problems of flooding, waterlogging and non-beneficial use of water by phreatophytes. The physical impact of in-reservoir deposits is to reduce the volume of storage available for water*
>
> *As the sediment deposits approach the dam, they are released, to an extent, with the flow passing through outlet works and power turbines. Here, the sediment has another harmful effect. It abrades the structures it passes through*
>
> (Mahmood, nd.,2)

Siltation of reservoirs has been recognised as a major problem in India. The Central Board for Irrigation and Power (CBIP) (1977:2) has the following to say:

> *The annual rate of siltation from a unit reservoir has been 2 to 3 times more than what was assumed at the time of the project design.*
>
> *These measurements have shown that sediment has deposited not only in the dead storage space, but has also encroached on the live storage. Till now it was believed that all the silt would be deposited in the dead storage space, and recent measurements have exploded this belief. The encroachment on live storage capacity has affected the function of the reservoir*

The rate of silt flow is calculated in all the recent dams, as a part of the project report for each. In many cases, independent studies had also been carried out to determine what the rate of siltation would be. Anticipated and observed siltation rates were available for 24 dams. For most of these dams, the actual rates were found to be higher than predicted. (See Table 5.B and Annex 2 III for details.)

For the Ukai reservoir, the survey report states that "The rate of silting is higher than that assumed. The silt index of 1.49 ham/100km^2/year was adopted in the project report ... the rate of silting during the two surveys is 6.26 and 8.07 ham/100km^2/year respectively" (CBIP, 1995a). Similarly, for the Kadana project, the assumed siltation rate at the time of design was 1.3 ham/100km^2/year. The actual rates observed were 6.57 and 4.60 ham/100km^2/year in the two years surveyed (CBIP, 1995a

Inordinate levels of sedimentation were also recorded for the Krishnarajasagar Dam in Karnataka, which was completed in 1932 and, as late as 1992, catchment area treatment was recommended (CBIP, 1992). For the Malaprabha reservoir, the first sedimentation survey was conducted from 1979 to 1981 and the second from 1987-1991. The results of surveys done between 1981 and 1991 indicated an annual sediment deposition rate of 7.86 M m^3, against an assumed rate of 0.94 M m^3. ie 8.36 times as much. If this rate continues, the entire dead storage will be filled up in another 20 years and the capacity up to FSL in about 33 years. Thus the total life of the reservoir will be only about 50-60 years against the planned life of 100 - 2 000 years (CCPA, 1995:2).

In the case of Loktak, the lake was silting up owing to the destruction of vegetation cover in the catchment as well as adverse land use practices. In order to mitigate the problem, dredging of the lake was being done. The monitoring committee felt that dredging was not enough, moreover. the silt removed from the lake was flowing back into it CWC:1993a). For the Bhadar (Rajkot) Project. according to the official consultants, "In the original project the sedimentation rate had been taken to be equivalent to 1.31 ha m/100km^2/year. This was very low and the reservoir sedimentation survey in 1974 indicated a rate of about 13.5 ha m/100km^2/year . . . Based on the average figure for the period 1966 to 1986, the Consultants have recommended a sediment load of 7.6 ha m/100km^2/year " (CCPA. 1996" xxix)

In the Mayurakshi Dam, in West Bengal, the official consultants found after a survey that the actual sedimentation rate was 1358 m^3 /year/sq km as opposed to the assumed rate of 380 m^3/year/sq km. R.S. Varshney, Chief Engineer, Ganga Valley Hydroelectric Projects, UP, states that "Maneri Dam on the Bhagirathi is 39m high and it is already silted up to crest level. A similar fate is expected for the proposed Shrinagar Dam (85m high) on the Alakhnanda." (CPIB, 1995:68)

Below is a table recording the assumed and observed rates of siltation of some of the dams. following data

Table 5.1 Sedimentation Data of Selected Reservoirs

	Sedimentation Data of Selected Reservoirs								
Sr. No.	Reservoirs	Impoundment year	Annual rate of silting in ham/100km^2. CPIB data (CPIB 1995a)			Annual rate of silting in ham/100km^2. CWC data (CWC 82/91; courtesy R. Rangachari)			
			Assumed	Observed	3 as % of 2	Assumed	Observed	6 as % of 5	7 as % of 4
		1	2	3	4	5	6	7	8
1	Beas unit II	1974	4.29	14.30	333.33%	4.29[1]	27.85[2]	649 18%	315.85%
2	Bhakra	1959	4.29	6.00	139.86%	4 29	5.66	131 89%	-7 97%
3	Dantiwada	1965	3.61	5.14	142.38%				
4	Ghod	1966	3.61	15.40	426.59%				
5	Hirakud	1956	2.52	3.57	141.67%	2.50	6.62	264.72%	123.05%
6	Kangsabati	1965	3.27	3.76	114.98%				
8	Machkund	1956	3.90	2.57	65.90%				
9	Maithon	1956	1.62#	13.10	808.64%	9.05	10.25[3]	113.23%	-695 42%
10	Matatila	1958	1 43	4.30	300.70%	1.33	6.00	451.13%	150.43%
11	Mayurakshi	1955	3.61	16.56	458.73%	3.75	16.83	448.69%	-10.03%
12	Nizamsagar	1931	0.29#	6.65	2293.10 %	2.38	4 89[4]	205 46%	-2087 64%
13	Panchet	1956	2.47#	10.00	404.86%	6.67	5.88[5]	88 11%	-316 75%
14	Ramganga	1974	4 29	18.20	424 24%	4.25	22.94	539 76%	115 52%
15	Shivajisagar	1961	6.67*	15.24	228.49%	6.67	7.71[6]	115.59%	-112 89%
16	Tawa	1974	3.61	6.38	176 73%				
17	Tungabhadra	1953	4.29	6.54	152.45%	4.29	6.48	151.05%	-1 40%

18	Ukai	1972	1.49	8.00	536.91%	1.49	7.16	480.54%	-56.38%
19	Kadana	1977	1.30	4.60	353.85%	1.30	3.92	301.38%	-52 46%

(SOURCE: CBIP, 1995a. * Source GOI 1985. # Note the marked difference in even the assumed rates between the two sources,)

[1] In CWC 2000 the assumed rate is given as 25.29 ha. M/100km^2/year
[2] In CWC 2000 the observed rate is given as 21.11 ha. M/100km^2/year
[3] In CWC 2000 the observed rate is given as 10.75 ha. M/100km^2/year
[4] In CWC 2000 the observed rate is given as 3.78 ha. M/100km^2/year
[5] In CWC 2000 the observed rate is given as 5.12 ha. M/100km^2/year
[6] In CWC 2000 the observed rate is given as 8.10 ha. M/100km^2/year

Though efforts were made to assess the probable rate of siltation for many of the dams, the levels anticipated were not always accurate, as can be seen from the above table.

Water Availability

Degraded catchments lead to erratic water flows. Though for all recent dams the available water flows have to be studied as a part of the project preparation, there are very few assessments of whether the anticipated flows have actually materialised. Studies on water availability could be found for only 6 of the 67 dams studied. Of these, 5 stated that the amount of water actually available was lower than that envisaged at the time of planning. For only one project: Hasdeo-Bango, (REDECON, 1996a) did the water flow meet expectations.

The Malaprabha project, for example, was planned to have a 75% dependable yield of 1338 M m^3 On the basis of 21 years of reservoir inflow data from 1972-73 to 1992-93, and 13 years of observation at Kochi Weir downstream, the yield works out to 878 M m^3, which is 34.35% short of the planned 75% dependable yield. According to the official consultants, CC Patel and Associates, "Such a major reduction in 75% dependable yield calls for a critical review of the project." [CCPA, 1995 2).

The Bhadar (Rajkot) Project was designed to have a 75% dependable flow of 161 60 M m^3 However, according to the 1996 study of the official consultants, the flow is actually 93.79 Mm^3 (CCPA, 1996 xxviii)

According to the official consultants, the actual inflows in the Barna Dam were 11% lower than those estimated at the time of project formulation [REDECON, 1996 2.1.10).

Overestimation of water flows means that the benefits derived from dams are curtailed Further, adverse impacts on downstream areas are greater, as these areas obtain less water because irrigation needs are met first.

Admittedly, water flows can perhaps never be measured with absolute certainty, especially since rainfall and snow melt patterns and the quality of the catchment are everchanging factors. Consequently, it is all the more necessary to take a conservative view of water availability so that only the minimum assured project benefits are projected. Given these data, it does not seem that this principle is being followed.

iii. Catchment Area Treatment

One common prescription for preventing the negative impacts of dams on the catchment and of degraded catchments on dams is the carrying out of catchment area treatment (CAT) In the last twenty years or so, since the requirement for obtaining an environmental clearance for dams has been in place, almost all dam projects have been required to carry out CAT.

If properly done, the treatment of catchments created by projects, and at project expense, can be seen as a significant positive impact on the environment. This is because, ideally, the catchments would be improved and treated to a point which would not only counteract the negative impacts of the dam but also improve the soil, water and vegetative profile.

The efficacy of CAT as an inhibitor of soil erosion is not without controversy. Verghese, for example, states that:

> *It would be as well to dispose of some other myths here. It is widely believed that deforestation causes floods by reducing infiltration and augmenting runoff. . . . Infiltration is a slow process and vegetation [does] augment percolation by extending the residence time of each raindrop that falls to the ground. But only to a point. . . . Once the soil is saturated, all excess water must runoff as rejected discharge or be lost to evaporation. . . . Forests do increase residence time by intercepting rainfall and letting it down gradually, by absorbing it in humus and leaf litter and in facilitating infiltration through the root structure which too acts as a passage and sponge. But once the sponge is full, its retention capacity is exhausted.*
>
> *What forests do is to reduce erosion and consequent sedimentation. This is best done by leaf litter and undergrowth covering the forest floor.*
>
> (Verghese ibid - 149)

However, Verghese does not seem to succeed in "disposing the myth" that CAT inhibits silt flow and regulates water runoff. All he seems to establish is that the capacity of a forest to do this is not infinite and that the litter and undergrowth plays a very important role in this. These, of course, are not disputed: in fact, it would be pointless if the forest stopped all silt and water from flowing down to the river. The important point is that a forested and well littered catchment is necessary for maintaining natural levels of water and silt flow.

Catchment Area Treatment proposals were a part of the plans for nine out of the 67 projects that were studied (Bhakra Nangal, Champamati, Chandil, Kollimalai, Loktak, Malana, Ramganga, Srinagar, Upper Kolab). In addition, for three projects (Bhakra Nangal, Champamati, Chandil) other mitigative measures were planned (GOM, 1992; Goodland, 1987; GOO, 1988; Annex 2.II)

Some of the other problems observed with respect to large dams in India are described below.

- **Inappropriate treatment:** The major objective of CAT is to inhibit the runoff of water and silt and thereby not only improving the local environment but also minimising adverse impacts on the dam. This would imply that CAT ought to involve extensive plantation and regeneration of vegetative cover. However, most often the treatment is restricted to the planting of trees and those of a few species, some of which are either exotic or unsuitable for CAT, like Cheer pine (Tehri, 1997). Also, there is no effort to reduce or divert those pressures, especially the ones unrelated to the dam, that have, in the first place, led to the degradation of the catchment. Also, as there is little or no effort in making the local communities partners in CAT, the sustainability of the treatment is doomed to failure and the catchments, even when treated, rapidly deteriorate to their earlier levels. In their annual report for 1992-93, the Environmental Monitoring Committee of the Central Water Commission state of catchment area treatment that, " Sufficient emphasis is not generally being laid on integrated soil and water conservation along with proper watershed management techniques are essential to maintain the health of the catchment areas of the reservoirs for their sustainable beneficial use " [sic] (CWC 1994:12)

- **Delayed treatment:** If the dam is to be allowed to have its full life and the reservoir is to be prevented from silting up prematurely, the catchment treatment must become effective prior to any impoundment taking place. Unfortunately, this almost never happens. Current experience shows that CAT was not completed for many of the large dams even after impoundment had taken place. In fact, as CAT involves extensive afforestation, for which pits are dug, the actual flow of silt into the river increases rather than decreases while CAT work is in progress. This means that if impoundment takes place before CAT is completed (and allowed to stabilise for at least two years), the silting of the reservoir occurs even faster in the initial years than it would have been without CAT (NCAenv, n.d.).

- **Treatment of inadequate area:** In the last ten years or so there has been a hesitation on the part of project authorities to treat the entire catchment or, as prescribed, the entire area which is determined to be of very high or high erodibility. This debate started around three of India's largest dam projects, namely Sardar Sarovar, Indira (Narmada) Sagar and Tehri [Tehri, 1997; NCAenv n.d.) The project authorities took a stand that they would treat only the "directly draining" catchments as a part of the project and in accordance with the project construction schedule.

  A "directly draining" catchment has been described as one that drains directly into the reservoir or, in other words, is adjacent to the reservoir. This has meant that a large proportion of the catchment remains untreated, at least as a part of the project and in time for the project to benefit from its treatment The distinction between "directly" and "indirectly" draining catchments or watersheds remains an illogical one from the point of view of the impact of the catchment on the dam. After all, by definition, a catchment is an area from which water and silt flow into the dam, either directly into the reservoir or indirectly into the river, which then conveys them to the reservoir. There is, therefore, no reason to neglect the indirect and focus on the direct Besides, the "indirectly" draining catchment is invariably much larger than the "directly" draining one and, as such, has the greater impact.

  Of course, the question of who should pay for CAT of the entire catchment needs to be resolved Where the catchment is very large and subjected to many pressures unrelated to the dam, it might not be correct to add the cost of treating the catchment onto the project cost However, from whatever head the money comes from, CAT has to be done, and done in time and in a manner such that the adverse impacts of the catchment on the dam and on the environment are minimised These aspects are essential for safeguarding the huge investments being made by the society in building large dams.

- **Problems of ownership:** Not all of the catchment is forest or government land and much of it is agricultural land which is privately owned. Here, treatment cannot be done and certainly not maintained unless the owners of the land agree and find it in their interests to do so CAT schemes are, however, usually insensitive to this aspect and therefore the progress of CAT in private lands is even worse than in government and forest lands. In a recent project (Sipu in Gujarat), while an allocation has been made for CAT, problems in acquiring the land for treatment have resulted in there being no progress. Reportedly, the land identified for CAT is in private hands (CWC, 1994). In another case (Bawanthadi in Maharashtra and Gujarat), an integrated CAT has not yet been prepared owing to multiple ownership and lack of co-ordination between the different departments of two different states (CWC, 1995).

iv Impacts of Backwater Build-up

When a free flowing river meets the relatively static reservoir, there is a build-up of back-pressure and a resultant backwater, which can damage or destroy the upstream ecology and property Backwaters can also build up from the deposit of sediments and silt upstream of the reservoir as "backwater deposits".

The build-up of backwaters cannot be totally prevented, if a reservoir is to be created. However, the build-up can be minimised by controlling siltation and its impacts lessened by anticipating the extent and preventing loss of property or land. Unfortunately, assessment of possible backwater impacts was missing from most of the projects studied.

Impacts at Dam/ Reservoir Site

i. Dust Pollution

Construction activities almost always significantly raise the levels of dust in the atmosphere. Such dust not only negatively affects the forests and other vegetation in the region, it also pollutes the river and other water bodies. There is also a significant impact on the health of the people living and working in the region. Impact of dust pollution during construction has not been assessed in any of the dams surveyed. It has been acknowledged in only three instances: Rajghat (Shah n.d.), Middle Vaitarana (Badrinath et al., 1991) and Tehri (Tehri, 1997). In Ramganga, air and noise pollution was reported to be tremendous; dust pollution increased the occurrence of TB (CBIP, 1995).

Though dust pollution during construction cannot be totally prevented, it can be minimised in many ways as can the impact on human health and on the fauna and flora.

ii. Impacts on Aquatic Ecosystems and Biodiversity

Construction activities, including the diversion of the river through a tunnel, cause major disturbances and have adverse impacts on the aquatic ecosystem. In many cases, vulnerable species, with either limited distribution or low tolerance, become extinct even before the dam is completed. However, in most projects, the study of aquatic biodiversity has been limited to the study of fish, and then only the commercially important species. Only in some of the recent high profile projects like the Tehri Project (Tehri, 1997) and Uri (UHPP, 1989) has there been an attempt to study the impact of the dam construction activities on the aquatic ecosystem and biodiversity as a whole. The results of these studies indicate that there are significant adverse impacts on the aquatic ecosystems and biodiversity at and around the construction site

Even after the construction of the dam, there can be various adverse impacts of the dam on aquatic ecosystems. The blocking of a river and the formation of a lake significantly alters the ecological conditions of the river: there are changes in pressure, temperature, oxygen levels and even in the chemical and physical characteristics of the water. Besides, by interrupting the flow of water, ecological continuity is broken, especially for those species of fish whose passage up river to their breeding grounds is blocked by the dam However, many other species are also affected, though not always so dramatically.

According to a World Bank Technical Paper, "On the upstream side, the thermal regime of the flow is changed so that the impounded water may become anaerobic or it may become hostile to the wildlife previously supported by the river " (Mahmood, n.d.:2)

Though the adverse impacts on the aquatic biodiversity cannot be totally prevented, they can be reduced. Besides, as these are very significant impacts, they should form a part of the assessment process of a project. Unfortunately, they have remained largely unanticipated costs

iii. Impact on Terrestrial Fauna and Flora

The disturbance caused by the construction activities, such as noise and movement, building of roads, extraction of stone and soil, construction of buildings, etc. also negatively impact on the fauna and flora at the dam site. Such disturbance has also not been studied in any of the projects surveyed. For the Tehri Project (Tehri, 1997), the report on the impact of the dam on fauna only mentions incidentally the extensive damage resulting from ongoing construction activities.

As impoundment starts, the dam's reservoirs invariably submerge large tracts of forests and other ecosystems, including grasslands and wetlands. Efforts are sometimes made to "compensate" for this loss by attempting to recreate such ecosystems elsewhere. However, it is not possible to "recreate" natural ecosystems; a plantation perhaps but never a natural forest or grassland.

The most obvious impact of reservoirs on terrestrial ecosystems is the submergence of forests. Of the 221 projects examined for this aspect, information was available for 60 dams (Annex 3.VI). Of these 60 dams, in 21 cases forest land formed the majority (over 50%) of the land submerged

According to various sources, that, up till 1980, only 500 000 ha of forests were lost to dams. This loss pertains to 2 178 large dams (completed up till 1980), 1 877 dams (completed or from 1981 to the present under construction; for another 236 dams the date of completion is not known) (CBIP, n.d (b)).

From available data regarding forest submergence for 60 dams, the average forest area submerged per dam works out to approximately 4 879 ha. Therefore, the 1 877 dams built between 1980 and 2000 would be likely to submerge 9 157 883 ha (roughly 9.1 ha) of forests. A CWC study (CWC, 2000:43) of 116 projects (details not available) found that the average forest submergence per project was 2 400 ha. Assuming this figure to be correct, the total submergence between 1980 and 2000 would be 4 504 800 ha (roughly 4.5m ha). This is certainly a very large loss of forests, especially considering the record of compensatory afforestation, described later, and the fact that against the stipulated 33% of forest cover required as a minimum, India has only about 24% of forest land and only about 11% of closed forests at present.

The adverse impacts of forest loss have been anticipated only since 1980 The most common mitigative measure prescribed is compensatory afforestation.

However, available evidence indicates that "compensatory" afforestation is difficult to implement. and in some cases has still not been effected many years after completion of the project In fact, the practice of insisting on compensatory afforestation started only in 1986, six years after the Forest Conservation Act (FCA), at the behest of the Prime Minister (GOI, 1986) The FCA prohibited transfer of forest land for non-forest use without the clearance of the Government of India (GOI) As diversion of forest land for dams was considered a non-forest use, clearance had to be sought from the GOI and, as a condition of clearance, it was specified that an equal amount of non-forest land must be afforested and legally declared forest land. Where non-forest land was not available, the GOI could permit the afforestation of twice the area of degraded forest land, as a special case

The rationale of such a stipulation seems to be that if a particular forest type is depleted in a particular region, because of the dam, it must be "compensated" for by creating the same type of forest in the same region. Also, where legally designated forest land has been de-notified, an equivalent amount of non-forest land must be notified as forest land, so that the total stock of forest land in the country, which is already much below the required 33%, is not further reduced

However, in 1998, the GOI amended these conditions and now, for certain categories of projects including all Central Government projects, the States have the freedom of regenerating twice the amount of degraded forest land, even where non-forest land can become available Though this might meet the condition of "compensating" for the forests lost, it cannot compensate for the depletion in the stock of forest land. Also, as forest land is easy to come by, especially degraded land, the earlier hesitation of State governments to convert forest land to non-forest use because of the difficulty in finding non-forest land for compensatory afforestation, has disappeared. Considering that the submergence of forests between 1980 and 2000 was between 4.5 and 9 1 m ha (see above), if all or most of the compensatory afforestation is done in existing forest lands, the country stands to lose, in 20 years, between 6.2 and 12.6% of its forest lands just to dams.

There are, however, many other problems with the current scheme. Firstly, it is impossible to replace a natural forest by a plantation.Though there is formal "compensation" for the forests lost, in terms of forest area, the actual ecological and biodiversity losses resulting from the destruction of natural forests cannot be compensated for.

Secondly, in many cases compensatory afforestation is effected in areas and ecosystems far removed and different from those that it is meant to compensate for. For example, the forests being submerged under the Tehri Project, in the hilly terrain of Tehri Garhwal, have been "compensated" for by plantations in the distant districts of Jhansi and Lalitpur, in the plains. Similarly, the forest submerged and being submerged under the Sardar Sarovar Project has been "compensated" for by plantations in the distant grasslands of Kutch.

Thirdly, the record of state governments in actually carrying out compensatory afforestation has been very poor. According to the MoEF, the performance of the State government in raising compensatory afforestation has not been very satisfactory: Up till 1997, only 46% of the area stipulated had been afforested (Enviro, 1998:-14).

Apart from forests, the reservoir and the dam also affect other ecosystems and various fauna and flora species. Unfortunately, till recently, there had been little effort to assess the impact on flora and fauna and on non-forest ecosystems.

Of the 67 dams studied, information on the impact on flora and fauna was available in 22 cases Of these 22, 10 stated that there had been no adverse impact on the flora and fauna, primarily because there was no "valuable wildlife" in the submergence area. In 12 cases it was stated that important forestland will be destroyed and important species or ecosystems will suffer damage. In another 2 dams (Bisalpur, Hasdeo Bango), the creation of wetlands was seen as enhancing the biodiversity (See Annex 2.V for details.)

Even where studies that have been conducted on the impact on fauna and flora they have been inadequate on many counts. For one, there is a tendency to consider only large mammals as "wildlife", despite the fact that the Wildlife (Protection) Act of 1972 includes all wild fauna and flora in the definition of "wildlife". Also, the emphasis has been on "valuable" species, which often means the more prominent or visible species However, some of the less visible species might actually be even more important to conserve. There is also a tendency to focus only on endangered species which can result in other species also becoming endangered over time Besides, the endangered status is usually applied to species that are nationally or globally endangered, only a proper survey can determine which species are locally endangered and, therefore, require protection. Whereas some species have been studied, however unsatisfactorily, there is almost no study of the cumulative impact of a dam on the ecosystem.

Some of the mitigative measures that were recommended and implemented included the creation of bridges for the movement of elephants (Dalma - Subernarekha Project) and the creation of sanctuaries (Sardar Sarovar)

In some cases, the mitigative measures suggested are totally inappropriate In many projects it is stated that there would be no impact on wildlife as they would migrate to neighbouring forests. For example, a study done on the impact of the Indira (Narmada) Sagar project on wildlife, by EPCO (1984:7476) in Madhya Pradesh, suggested that the wildlife would either voluntarily migrate into neighbouring forests when impoundment took place or be driven there by squads of specially trained staff Similarly, on the Tehri Project maintained that the fish would migrate and establish themselves upstream of the dam. For the Rajghat Project, it was suggested that "The National Park at Shivpuri is also not far off. It is thus felt that there is ample scope for migration of the wild life to the adjoining forests and there would be no difficulty on this account" (Shah, n.d.,-15). Verghese (1990.217) also suggests that "Forest corridors need to be provided to enable wildlife to migrate to other areas so that loss or diminution of habitat has little or no adverse effect. In other circumstances it may be necessary to remove animals, especially rare and endangered species, to parks and sanctuaries, or to relocate them if possible, maybe in areas of compensatory afforestation." The CWC (1992:18) also states that "wild life could be shifted and rehabilitated. Birds will migrate on their own".

Clearly, such thinking is flawed. Firstly, the areas to which these animals will hopefully move will have their own complement of wildlife and cannot be considered "vacant habitats". Secondly, wildlife, even wild animals, do not move down corridors of forests as the flood waters advance. They are not aware of such corridors and what lies beyond. They are rightly wary of leaving their own territory, and become panic stricken when the waters roll in. Besides, some animals are nocturnal, others roam during the day, others live underground or in trees and in caves. And wildlife includes plants. Also, the task of "removing" all the wild animals to other habitats, even if such were available, is a gigantic one entailing phenomenal costs that would render most dams non-viable from the start

In none of the dams studied were there any efforts to monitor the status of wildlife after the construction of the dam, to assess the impact of the mitigative strategies or to check the veracity of the estimates of impact done prior to construction.

The adverse impacts on terrestrial wildlife and biodiversity cannot be prevented. Therefore, they need to be calculated and taken into consideration while assessing the project. In most of the dams surveyed, there had been no real effort to assess the impact on wildlife. For many of the recent dams, studies have been undertaken on wildlife but most of them are little more than lists of some of the species found in the submergence zone, especially the large and "rare" ones. Most of these studies certify that nothing "valuable" will be lost or give, as described earlier, impractical suggestions on how to minimise the loss (Tehri, 1997; NCAenv, n.d.).

v Impacts on Cultivated Biodiversity

Reservoirs also submerge productive agricultural land in the valley. This not only has a social and economic cost but also adversely affects cultivated biodiversity and a host of birds, insects, mammals and reptiles that have adapted to agricultural ecosystems. In many cases, traditional crop varieties and methods of cultivation have disappeared because of the submergence of agricultural lands This is another aspect that has not been assessed, as a part of project evaluation, in any of the projects studied.

vi Impacts on Grazing Land (Rangelands)

Lands grazed by livestock and wild animals alike are also often submerged by reservoirs. This, again, leads not only to economic losses, but also to the loss of natural and domesticated biodiversity Where preferred habitats of wild animals are submerged, there is an inevitable reduction of their populations Also, the users of these habitats shift to the other remaining grasslands, thereby overgrazing and degrading them. Grassland species of plants and animals also suffer especially as there is no "compensatory" creation of grasslands. Iimpacts on grasslands have not been assessed by any of the projects studied.

Though the impacts on rangelands cannot be prevented, by creating alternate rangelands in appropriate locations at least some of the adverse impacts could be minimised.

vii Impacts on Rim Stability

The creation of an artificial reservoir often results in the gradual or rapid erosion of its rims Destabilisation of the rim not only poses a threat to the reservoir ecology but can also threaten the safety of the dam. The sudden collapse of the reservoir sides can create a wave that can over-top a dam and result in disaster.

The impacts on rim stability cannot be prevented but, in some cases, can be minimised if proper measures are taken. In other cases, the threat posed by a possible collapse of the rim can be such that the very viability of the dam can be questioned. Only the recent dams have commissioned studies on rim stability (NCAenv, n.d.; Naidu, 1994).

viii. Impacts on Human Health

For reservoirs in the tropical regions of the world, especially those that are situated below 1 000m elevation, there is a significant threat of vector breeding. Mosquitoes, which are carriers of malaria, filaria, dengue and other diseases breed in small pools of water created at the edge of the reservoir owing to the rising and falling of the waterlevel of the reservoir. In some areas, snails, which are carriers of schistosomiasis, are also found to proliferate as a result of dams.

The World Bank identifies sexually transmitted diseases (STDs) and HIV, hepatitis B & C, malaria, schistosomiasis, and Japanese encephalitis as diseases the incidence of which is increased by dams (WB, 1997:-4). Schistosomiasis is currently not prevalent in India and the CWC reports that "In India, only about three or four focii of schistosomiasis snails have been observed." (CWC, 1992:17). However, the fact that these snails are present in India and in some of the neighbouring countries means that there is an ever present danger of their spreading in India also, if a proper check is not maintained.

Increase in the breeding of disease vectors has been anticipated in many instances;. this aspect was part of the project study in 13 out of the 67 dams studied. In three instances it was stated that increased vector breeding was unlikely because of the montane location of these projects: Tipaimukh (GOI, 1995), Srinagar (Goodland, 1987) and Uri (UHPP, 1989). However, in other projects, for example Sriramsagar and Ukai, the incidence of malaria reportedly increased (Annex 2.VI). Raichur district in Karnataka became highly endemic for malaria after the construction of Tungabhadra Dam and its canal network (ERRC, 1996). In the Sirhind Feeder Canal Command Area, there is a "menacing increase in mosquitoes." (Dhesi, 1996:E.2).

The correlation between the spread of vector borne diseases like malaria and irrigation projects has been well studied and established (see, for example, Sharma, 1991).

Primary Health Centres are generally recommended as remedial measures, though in one case it was stated that local farmers would be trained to control the occurrence of malarial vectors. Further, flourosis was also noticed in Nagarjunasagar (Jauhari, n.d.). *Genu valgum*, a crippling bone disease associated with skeletal fluorosis, developed in young people, especially males: 75% of the cases were in the age group 10-20 years. An increased incidence of hepatitis was recorded in the case of Tawa (Choudhauri, n.d.) In the case of the Hasdeo-Bango reservoir, the increase in incidence of malaria could not be controlled by conventional measures (CWC, 1991). In the monitoring reports of the Gandhi Medical College, Bhopal, a significant rise in morbidity was recorded for the Narmada Project in post-impoundment areas as compared to pre-impoundment areas (ISP, 1998).

The growth of malaria, especially since the 1970s, and the contributory role of irrigation projects is most alarming. According to Verghese (1990:239), "The resurgence of malaria in India appeared to coincide with the green revolution as the new hybrid varieties demanded more intensive irrigation. This in turn augmented and enlarged the area of breeding sites along the entire canal network. These mosquitoes could be vectors of malaria, filariasis or Japanese encephalitis." He goes on to quote V P Sharma, who says: "In many areas of the country it was, and still is, observed that the construction of canals brings malaria to healthy areas." (Verghese, 1990:239).

The setting up of primary health centres and the spraying of pesticides are the two most common responses to the threat to human health. Unfortunately, the first is a curative rather than a preventive measure while the effectiveness of pesticides is doubtful. Besides, the application of chemical pesticides results in health hazards, which themselves need to be assessed and tackled.

The new agricultural practices, many of which are consequence of the irrigation waters brought in by dams, also promote the use of chemical pesticides and fertilisers, which have well recorded and significant adverse impacts on the environment and on human health. However, though the benefits of the anticipated increases in agricultural productivity are taken as a benefit of dams, the resultant costs of pesticides and fertilisers on the environment are very rarely computed or even studied.

It is unlikely that adverse health impacts can be totally prevented in dam projects. However, through proper efforts, they can be lessened. Unfortunately, in none of the projects studied was there a realistic assessment of health impacts. Many of the studies did not assess these impacts at all and the few that did kept making the unrealistic assumptions that the application of pesticides and the provision of primary health centres would resolve the problem.

ix. Impacts on the Water Quality

As already mentioned, the creation of a lake significantly changes the quality of water: the oxygen content may be reduced resulting in the release of gases like methane and sulphuretted hydrogen. There may also be thermal stratification, with the cold water trapped underneath. Soils and stones containing naturally occurring mercury and other minerals may contaminate the water, which in turn may affect fish and finally human beings. There have been cases in the USA where people and animals have suffered mercury poisoning in this way. Also, water falling over spillways can force air bubbles into the water, which may sometimes be absorbed into fish tissue, ultimately killing the fish. Stretches of stagnant water may encourage the growth of weeds and exotic plants (WWF, 1999:-15)

There is also a build-up of concentrations of pollutants that come into the lake through the atmosphere or through watercourses flowing into the reservoir. There is also significant non-point pollution from human settlements and activities around the rim and in the immediate catchments. Whereas much of this would have flowed down the river, the dam prevents this and causes a build-up of concentrations of pollutants

A form of contamination that is peculiar to reservoirs is mineral contamination from underground contaminants. Because of the weight of the reservoir, water is forced through cracks and faults in the reservoir bed, to a great depth. Such hydraulic continuity sometimes brings water into contact with mineral substances, such as arsenic, and results in the water in the reservoir becoming contaminated

For the available data, water quality has often been analysed only from the point of view of potability and suitability for irrigation. Analysis of the water quality of the Middle Vaitarana Dam stated that sedimentation and siltation adversely affected the water in the reservoir (Badrinath et al., 1991). The nutrient status of the reservoir has not been studied generally, though for the Teesta Stage III project, it is stated that the reservoir will remain oligotrophic (NEERI, 1991).

Water quality was studied for 11 dams: 5 reported no change, 2 reported better water quality, and 4 stated that the water quality became worse. (See Annex 2.VI for details.)Considering that changes in water quality are inevitable, both upstream and downstream of the dam, clearly more detailed studies are required.

Adverse impacts on water quality cannot be prevented but some aspects can be controlled. As these are significant impacts, they must be taken into consideration, as they almost never were, during the preliminary assessing the project.

x. Impacts of Reservoir Induced Seismicity

The weight of the reservoir, by itself or in conjunction with other reservoirs in the region, can create the sorts of pressures that result in an earthquake. The weight of the reservoir can also force water down cracks and faults till it catalyses an earthquake. The occurrence of reservoir induced seismicity (RIS) is now a well accepted fact (Le Moigne et al., 1990).

Verghese (1990:234) states that: "..... Bhatsa Dam, near Bombay experienced an earthquake of 4.5 while minor tremors have been felt in the region of Hirakud, Nagarjunsagar, Ukai, Idduki and Mula dams (Srivastava). However, there was consternation when an earthquake of a magnitude of 6.5 shook Koyna in 1967, killing 117 people and causing some damage to the dam in an area regarded as seismically quiescent". However, it is generally believed that RIS can cause only moderate earthquakes of up to 3 or 3.5 M and that often the dam acts only as a trigger to larger earthquakes.

Reservoir induced seismicity was studied in nine of the 67 dams surveyed and was predicted in six of these. (See Annex 2.VII for details.) It is interesting to note that 17 of the 75 cases of RIS reported world-wide have been reported from India (Singh, 1990).

Though RIS cannot be prevented, the damage it causes can be minimised by strengthening all dam structures and also by strengthening other structures and buildings, old or new, in the region. The cost of this should be assessed as a part of the project cost, but it rarely is.

xi. Impacts on Microclimate

The existence of a reservoir and the resultant changes in temperature and humidity can adversely affect the fauna and flora of the region, which might be naturally adapted to a warmer and drier climate. This aspect has also not been examined at any of the dams studied. In one case it was reported that vegetation around the reservoir was affected and altered because of changes in the reservoir level. Groundwater levels around the reservoir were recorded to have risen in this instance and in the case of Tawa it was stated that trees around the reservoir were dying because of a stagnant water table (Choudhaury, n.d.).

A common result of dams and irrigation canals is the infestation of weeds from microclimatic changes. This problem is mentioned in some of the projects, for example, in the case of Loktak, the increase of water hyacinth and other aquatic weeds in formidable quantities is creating many problems such as reducing the live storage of the lake. Integrated watershed development, combined with removal of water hyacinth and other aquatic weeds through manual harvesting and biological processes, is necessary to improve the environment of the lake (CWC, 1993a). Weed infestation has also been reported from other projects: Malaprabha (CCPA, 1995) and Hasdeo Bango (Redecon, 1996a).

Negative impacts on microclimate can also not be prevented but the environmental impacts they have should be assessed while formulating and appraising the project.

At the Canal/ Command

i. Impacts of Waterlogging and Salinity

Waterlogging

Canals themselves can directly contribute to waterlogging. If not properly lined, or maintained, significant amounts of water can seep out of canals and inundate the surrounding lands around (GOI, 1989,XI-3). Also, when subsidiary canals are not well maintained, when the releases of water are not properly monitored, or when drainage is not assured, waterlogging results. There is an unfortunate tendency among engineers to pay less attention to subsidiary canals, which aggravate waterlogging problems (Verghese, 1990:93).

Waterlogging not only reduces the anticipated agricultural benefits from irrigation projects but sometimes reduces the benefits to levels below even those before irrigation was introduced. A well-known and documented case is that of the Tawa Dam in Madhya Pradesh. According to the Comptroller and Auditor General (CAG) of India:

The table given below shows the comparative position of the yields per acre under various crops after irrigation during 1977-78 and 1978-79 and the yields prior to introduction of irrigation (1971-72) in Hoshangabad district, as per the Agricultural Statistics compiled by the Commissioner, Land Records.

Table 5.2 Average Crop yields per acre after irrigation

Crop	Before irrigation	Average yields per acre after irrigation (in quintals)	
		1977-78	1978-79
1. Paddy	4.00	2.98	3.83
2. Jowar	2.82	3.64	2.74
3. Maize	4.81	4.07	4.01
4. Wheat	3.14	3.30	3.06
5 Gram	2.43	1.96	2.08

It will be noticed that the yields per acre after irrigation have actually declined.

According to the scientific and technical opinion now available, because of the soil and weather conditions in the command area of the Tawa project, agricultural operations in both kharif and rabi seasons with the help of irrigation could not have been productive, on the contrary, irrigation could be even harmful. There was also resistance on the part of cultivators to a change in their habits and the cropping pattern they have been used to. Thus, it would appear that the project was ill-conceived and the benefits that were presumed would be available could not have been realised".

(CAG, 1979-80)

Waterlogging can also be one of the causes of salinity and provide a conducive habitat for vector breeding. It destroys natural vegetation and damages houses, buildings and roads.

In some of the recent dams an attempt has been made to study this aspect: two such examples are the Narmada (Indira) Sagar Project (NSP) and the Sardar Sarovar (SSP) projects. A report by Kalpavriksh (KV, 1988) on the Narmada dams has the following to say:

A similar situation could arise in the NSP and SSP commands. A study on the waterlogging potential of NSP, done by the Indian Institute of Science (IISc), Bangalore, and sponsored by the Narmada Planning Agency, notes that a very large part (perhaps about 40%) of the command area will become water-logged given the surface/ground water use pattern proposed in the original design of the project (Sridharan and Vedula, 1985). This report has suggested a different surface-groundwater use ratio, viz. predominantly 70:30 instead of 80:20 as now proposed, to avoid waterlogging. This would necessitate the sinking in of a tube well every 6.3 ha. with a 3 bhp motor to prevent water logging. The cost of doing this has been computed at Rs.54 crores (Narmada Valley Development Authority, 1986:II), but it is not clear if this cost has now been included in the cost-benefit ratio (it had not been in the original ratio). One estimate puts the power requirement for the wells at 45 MW which is one-third of the firm power generation of NSP!

(Alvares and Billorey, 1987)

Even the IISc study, critical as it is, does not take into consideration the reservoir of the SSP which will intrude into or border the NSP Command area over a long stretch. If the reservoir is taken into consideration, the problem of water logging could become much more severe *and the sinking of additional wells would not solve the problem as the wells, in effect, would be attempting to drain the reservoir. This scenario has not been studied.*

For SSP, the project authorities claim that lining of canals, conjunctive use of groundwater, and a much more limited supply of water per unit of land than given in previous irrigation projects, will greatly reduce the possibility of waterlogging (NPG. 1983). However, of the huge command area of over 18 lakh ha, only a small portion of 4.7 lakh ha. – the Narmada-Mahi Doab – has actually been studied for drainage and potential waterlogging (CCPL. 1982). The remaining over 13 lakh hectares has not yet been studied. Much of this is semi-arid land which is known to be prone to salinisation problems. This is because the hot climate causes rapid evaporation of irrigation water from the surface of fields, leaving an encrustation of salts behind. Besides, it is also known that the sub-surface water in this region is saline and, therefore, salinisation could be aggravated even further

(KV, 1988)

Waterlogging is studied in 23 of the 67 dams for which data were examined. However, its occurrence has been recorded in only 11 cases. In some instances, more than half of the proposed command area has been subject to waterlogging. Of these 23 dams, 6 dams had predicted that there would be no waterlogging. However, in 2 dams, waterlogging has occurred despite it not being predicted

Waterlogging can be prevented by lining and properly maintaining the canals, and by regulating water use and cropping patterns. In some cases either it is impossible to prevent waterlogging or the costs of prevention are so high that they make the project economically non-viable. In fact, the Central Water Commission, in the Theme Paper on Water and Environment (1992:3)says: "Provision of drainage is expensive and many water resources projects may not be economically viable if this component is added to the cost of new projects. The issue needs to be resolved quickly"

There have been various estimates of the extent of waterlogging in different command areas. Two such estimates are given in Table 5.3 and Table 5.4

Table 5.3 **Waterlogged Areas in Different Irrigation Command Areas of India**

S.No.	Irrigation command area	Area (million ha.)
1.	Ukai-Kakarpar Project, Gujarat	0.008
2	Male Prabha Project, Karnataka	0.001
3	Gandak Project, Bihar	0.400
4.	Ram Ganga Project, U.P	0.350
5	Rajasthan Canal Project, Rajasthan	0.170
6	Sri Ram Sagar Project	0.080
7	Hirakund Project, Orissa	0.060
8.	Kosi Project, Bihar	0.120
9	Nagarjun Sagar Project, A.P.	0.110
10.	Chambal Project, M.P.	0.030
11.	Tungabhadra Project, Karnataka	0.010
	Total	1.339

(SOURCE Rao, 1984.)

Table 5.4 Extent of Waterlogging in Selected Irrigation Projects in India

S.No.	Irrigation Project	State	Water-logged area	Percentage-Waterlogged area - X100 Potential
1.	Sriram Sagar	Andhra Pradesh	60.00	47.62
2.	Tungabhadra	Andhra Pradesh	4.65	1.27
3.	Gandak	Bihar & Uttar Pradesh	211.01	21.11
4.	Ukai-Kakrapar	Gujarat	16.25	4.32
5.	Mahi-Kadana	Gujarat	82.00	16.81
6.	Malaprabha	Karnataka	1.05	0.99
7.	Chambal	Madhya Pradesh & Rajasthan	98.70	20.31
8.	Tawa	Madhya Pradesh	-	-
9.	Rajasthan Canal	Rajasthan	43.10	7.98
10.	Sarda Sahayak	Uttar Pradesh	303.00	28.34
11.	Ram Ganga	Uttar Pradesh	195.00	38 99
	Total		1014.76	

(SOURCE: Joshi & Agnihotri, 1984:528-536.)

This, then, remains one of the major hidden costs of many of the dams in India.

Salinity

Of 67 dams surveyed, the possibility of salinity had been studied in 7 dams (Bisalpur, Dharoi, Gandhi Sagar, Hasdeo Bango, Isapur, Kadana and Polavaram). The occurrence of salinity was reported in 5 dams (Dharoi, Gandhi Sagar, Hasdeo Bango, Isapur and Kadana) Mitigation Plans were also prepared for 5 dams (Bisalpur, Gandhi Sagar, Hasdeo Bango, Isapur and Kadana) (See Annex 2.XV for details)

For the Chimmoni dam, the Environmental Monitoring Committee recommended that a monitoring mechanism be set up to study soil salinity levels in the command area at regular intervals (Trissur Kole Land Area) (CWC, 1993a).

Extensive salinity and waterlogging were also reported from the Chambal Project in Rajasthan by the official consultants (WAPCOS, 1996b). Similarly, the official consultants for Dharoi Project, in Gujarat, report heavy waterlogging and salinity (KICONS, 1996:E-14).

The loss of productivity due to soil salinity is another undervalued cost.

ii Impacts on Terrestrial Biodiversity

Like dams, canals also have significant impacts on terrestrial biodiversity A large amount of forest land is diverted into canals For example, 1 359 ha of forests were diverted for the Srisailam Right Bank Canal Similarly, 273.12 ha were diverted for the Sriram Sagar canal and 118 577 ha for the Barnarpur Left Bank Canal (MP) (CWC, 1996). For the Surya Canal (UP), 1 250 ha of forests, 8 000 ha of agricultural land and 3 250 ha of grazing land were diverted (Afroz & Singh, 1987|. Apart from destroying natural ecosystems and impacting on species of fauna and flora, the canals very often cut across the migratory routes of animals and also divide up their habitats. There are many examples of this, including the recent one, in which the range of the wild ass in Gujarat will be adversely affected by the construction of the Sardar Sarovar canals (NCAenv, n.d.). In none of the projects that were studied was the aspect of migratory animals assessed. Consequently, the costs of such an impact were not taken into consideration while assessing any of the projects studied.

iii. Impacts on Natural Drainage

The construction activities associated with canals also interfere with natural drainage across a slope and thereby lead to waterlogging on the up slope side of the canal, where the water collects, and aridity on the down slope side. However, none of the projects studied assessed the impact of this aspect.

Even after they are constructed, canals interfere with natural drainage and thereby lead to water-logging, on the one hand, and aridity on the other. In none of the dams studied was cognisance taken of this fact.

iv. Impacts on Vector Breeding

As in reservoirs, canals also provide a habitat for the breeding of vectors. The areas that become waterlogged because of canals are also good habitats for disease carrying vectors. In none of the dams studied was cognisance taken of this fact.

At or Adjacent to Power Lines

i. Dust Pollution

The construction of power lines results in a certain amount of dust pollution. This has also not been studied in any of the projects surveyed.

ii Impacts on terrestrial biodiversity

Very often corridors have to be cut through forests and other natural ecosystems to accommodate power lines. This activity adversely affects the terrestrial ecosystems. These corridors also have to be maintained in order to allow repair and upgrading work on power lines so that the impact of these corridors is often long-term.

According to one estimate, the right of way required for power lines varies in width from seven metres in the case of 11 kv lines to 15 metres for 33 kv, 18 meters for 66 kv, 22 metres for 110 kv, 35 metres for 220 kv and 52 metres for 400 kv (Verghese, 1990–199). In the Uri Project, for example, 98.54 ha of forest land were cleared for transmission lines in J&K.

The impact of power lines on forests, in terms of the forestland required, is now assessed but the impacts on biodiversity have not been assessed in any of the projects surveyed.

iii. Impacts of Radiation

Power lines, especially high tension lines, are known to produce high levels of radiation which may affect ecosystems and human beings. High tension power lines can also be sources of fire and hazardous to birds and other animals. These aspects have also not been looked at in any of the dams studied.

Impacts Downstream

Despite popular belief that the major environmental impacts of dams are upstream of the dam, the downstream adverse impacts of dams are often even greater. Historically, these have been relatively ignored

i Impacts on aquatic ecosystem and biodiversity downstream

Even during construction there are many downstream impacts. Construction activities cause much pollution of the river and send down huge amounts of silt and mud. The diversion of the water through a tunnel also leads to adverse ecological impacts. The dumping of excavated and construction material in such a way that it contaminates the environment is another problem, for example, in the Subarnarekha Project (CWC, 1991) and in the Indira (Narmada) Sagar Project. The construction of four dams as a part of the Upper Indrawati project would reportedly result in a vast dry area downstream as no water would not be released downstream but would be channelled to the Hati River, a tributary of Mahanadi (OKM, n.d.). As a result of the Uri project, five endemic species of fish and some molluscs will also be affected as no water will pass through the barrage during dry spells (UHPP, 1989).

The interference that dams cause to the natural flow of a river causes significant downstream impacts. By interfering with river flows, dams adversely affect downstream flora and fauna. There is a popular misconception that as most dams supplement dry season flows and only partially curtail rainy season flows, their impact downstream is negligible or even, sometimes, positive. However, in actual fact, riverine ecology needs the heavy rainy season flows, for example, to enable many fish species to breed. By curtailing rainy season flow, the dam inhibits the ability of the ecosystem to regenerate itself.

According to a World Bank Technical Paper (Mahmood, n.d.:2): "On the downstream side, the flow tends to pick up the sediment load from the stream bed leading to retrogression of channel bed and water level, erosion of banks, elimination of nutrients carried by the fine sediments, deterioration of channel morphology, increase in the hydraulic resistance of flow, elimination of oxbow lakes and reduction of wildlife food supply."

Heavy rainy season flow also acts as a flush for the riverbed and mouth, clearing them of accumulated silt, garbage and stale water. The absence of such a flow creates significant problems down stream and decreases the capacity of the riverbed to accommodate peak flows, leading to larger floods in the case of cloudbursts or sudden releases of water

In many irrigation projects, a significant amount of water is diverted from the river by canals. This results in significant shortfalls in the natural flow and in the net flow of water in the river with attendant serious ecological implications.

In "run-of-the-river" projects with diversion tunnels, often a stretch of the river downstream of the dam, to the point where the diversion tunnel feeds back into the river, becomes dry. This has adverse impacts on riverine ecology and breaks the ecological continuity of the river's ecosystems

A large proportion of the nutrients that flow down the river and form an essential part of the food-chain of the river's ecosystem, become trapped by the dam, thereby starving the ecosystem. This also has significant deleterious effects.

The reduction of river flows can also result in the collapse of riverbanks, leading not only to erosion but also to muddying of the river. This collapse leads to a filling up of riverbeds, making the rivers more prone to flooding, and also to the river becoming insufficiently oxygenated and relatively opaque and impervious to sunlight. All these also negatively affect aquatic fauna and flora.

The fact that, in hydroelectric projects, the water has to pass through turbines also results in significant fish and other faunal mortality and trauma. In some projects screens are provided that filter out fish, but this in turn denies them passage to the lower reaches of the river.

The inability of certain species of fish to travel upstream, which they must do in order to breed, has already been mentioned. The recent tendency to set up breeding centres for such fish might ensure the continued existence of these fish downstream but does not compensate for the ecological roles these fish species played in the riverine ecosystem upstream of the dam.

Impacts on the river ecosystem downstream were studied in 5 of the 67 dams surveyed. In all these 5 dams it was predicted that there would be adverse downstream impacts. There is further indication that in at least four further studies confirmed that there were adverse downstream impacts. (See Annex 2.IX to 2.XII for details.)

These impacts cannot be avoided but they must be recognised and minimised. Besides, as these are among the severest of the impacts of a dam, they must be taken into consideration during the prior assessment of the dam.

ii. Impacts on Downstream Fish

The disturbance and pollution of the river, during the construction phase, has impacts on the fish downstream. This was, however, not studied in any of the dams surveyed.

Post-construction effects, as already described, have many adverse impacts on downstream fish and can also have a negative impact on coastal and sea fish. The two mitigative measures that are occasionally planned are the construction of fish ladders for species that migrate upstream to breed, like the *mahseer*, or the artificial breeding and introduction of fish species downstream

Though this has been recognised as a problem for most dams, there are very few studies that assess the impact on downstream fish after the dam has been operationalised, except for commercially valuable species. Of the dams studied, only five had studied the impact on fish after the commissioning of the dam. In one of these (Isapur) it was stated that fish populations downstream of the reservoir would increase. (See Annex 2.IX for details.)

This impact cannot be avoided but can be reduced. The cost of reduction and the cost of the residual impacts must be computed and included into the CB ratio of a dam. This is very rarely done

iii. Impacts of activities related to the rehabilitation of project-affected persons

Often sites for rehabilitating the project-affected persons are carved out of forest or other ecologically valuable areas, which obviously leads to the degradation of these areas. Also, shifting large human populations to new locations, often results in serious adverse impacts on the neighbouring environment. This is especially so if adequate resources have not been planned for and made available to meet the need for water, land, wood, fuel and livestock fodder of these populations. Forests and other natural resources are also sometimes degraded because lack of other livelihood options force the project-affected people to earn their living by extracting firewood and fodder at an unsustainable rate

There are many examples of these impacts: for Chandil Dam, forest land was to be diverted for resettlement (WB, n.d.), in Nagarjuna Sagar 14 000 ha of reserved forest was denotified for rehabilitation (Jauhari, n.d. & Rao, 1979)]. In the case of Sriram Sagar, compensatory afforestation was reported to be less than that diverted for rehabilitation (Kothari, 1994a). Forest land was also diverted for rehabilitating project-affected peoples of the Sardar Sarovar Project (NCAenv, n.d.)

Almost no attention has been paid to these impacts

iv Impacts of water availability downstream

The variation and reduction in waterflow in the river as a result of the diversion of water to canals also adversely affect water availability downstream, both from surface sources and because of inadequate re-charging of groundwater. There are also huge water losses from the canals and the reservoir In

Malaprabha, for example, "Conveyence losses in both lined and unlined systems are generally 300% of those assumed. In MLBC, in lined reaches, losses are as high as 7.48 and 20.24 cumecs/ M m^2 against assumed loss of 0.61 cumec/ M m^2" (CCPA, 1995:5). Similarly, in the Hasdeo Bango Project. "Seepage losses in the conveyance system are 2 to 3 times more than the designed conveyance losses." (REDECON, 1996a:56).

Though in some of the recent projects this aspect has been studied, its impact tends to be underestimated. Very few assessments were available of what actually happens after the dam becomes operational.

v. Impacts on water pollution levels downstream, especially owing to reduced river flow

River pollution may occur downstream, during construction, for one or more of the following reasons

- waste water from excavations;
- the construction and removal of coffer dams;
- wash water from concrete and aggregate plants;
- oil leakage and waste disposal;
- sewage and storm water;
- hot water effluents;
- soil erosion during reservoir clearing.

Even after construction, reduction and variation in the flow of the river can also result in the increase of concentrations of pollutants downstream, as less water is available for diluting the pollutants

In none of the dams surveyed were downstream pollution impacts assessed prior to the appraisal of the project. In a few cases, studies were conducted after the construction of the dam. In one case, regulation of the flow downstream is stated to have had a positive impact on the water quality (Gandhisagar) (WAPCOS, 1996b), but in another case, it is mentioned that the lower volume of water downstream resulted in a greater concentration of pollutants. In Hasdeo Bango there is a negative impact on water quality owing to an increase in fluoride content (CWC, 1991). There is also thermal pollution of the canal water by neighbouring industries and power stations (REDECON, 1996a 111) The only other study of water quality dealt with the potability and usefulness for irrigation of the water in the command area: Malaprabha (CCPA, 1995).

Downstream pollution can be reduced by proper management and the cost of reduction and the cost of the residual impacts must be taken into consideration when a project is being assessed This also remains an unanticipated impact.

vi Possible salt-water ingress

Where the quantity and force of water reaching the river mouth and, through it, the sea, is reduced, there is a danger of salt-water ingress. Such ingress can not only destroy the riverine and terrestrial ecosystems but can also contaminate groundwater resources.

The phenomenon of salt-water ingress, though not studied in any project formulations, was noted in post-construction analyses for one dam (Ukai). A project for the prevention of saline ingress was been initiated in Gujarat in 1976, to deal with 160 km of the Saurashtra coast subject to saline ingress (CWC, 1996).

This is an inevitable impact for dams located near the sea or where the total water flow below the dam remains very low compared to the natural flow. Though this impact can be reduced, it cannot be totally eliminated. However, its costs are never taken into consideration during dam appraisal

vii. Impacts on coastal and marine ecology

Changed water and silt flows also have an impact on coastal and marine ecology. In certain areas, the first monsoon floods are essential to open the sand barriers that seal coastal backwaters from the sea during the dry season. This enables a flushing of the backwaters and a mixing of fresh and saline water, which is essential for the breeding of many freshwater and marine fish and crustaceans. The changes in river regime resulting from the dam disrupt this ecological function and inhibit the reproductive cycle of these species. Also, the depleted flow of nutrients results in insufficiency of food for various marine species.

In other cases, reduced flows can lead to the erosion of estuaries and coasts.

This impact is also inevitable, though it can be somewhat reduced. Costs of mitigation are never taken into consideration while appraising a project.

viii Impacts of sudden release of water or of dam failure

The construction of dams is done in stages, sometimes with the help of a coffer dam. Water begins to be impounded long before the dam is completed. If for any reason there is a sudden release of water or dam failure at this stage, it can have disastrous results. A case was reported from Western Sikkim, where the coffer dam of the Rangit Hydropower Project was washed away owing to flash floods, while the dam was being constructed (Economic Times, 1995b).. This possibility is not assessed or provided for in any of the dams surveyed.

Even after construction, owing to degraded catchments, excessive rainfall or overfilling of reservoirs, it may become necessary to make sudden releases of water from the reservoir in order to protect the dam structure Such sudden releases can be disastrous for the people living downstream, for their crops and for the downstream ecosystems

Such releases have occurred twice from the famous Bhakra Dam, in the late 1970s and again in 1988 (Economic Times, 1995a).

A recent case was that of the Rihand Dam. In 1997, huge amounts of water were suddenly released and flooded 175 villages in the Rewa district of Madhya Pradesh as well as the town of Rewa, killing 14 people and causing damage estimated at Rs 200 crores (Indian Express, 1997b)

The failure of the dam, where the structure collapses and allows the reservoir to partially or totally drain out, is a catastrophe for downstream ecosystems and human populations There are many causes of dam failure: faulty design or construction; use of sub-standard materials, over-topping owing to surplus water; deliberate sabotage or bombing, and severe earthquakes. In some cases, the dam structure might remain intact but the neighbouring hillsides crumble, which has the same effect as the dam collapsing.

The Manchu Dam II is a case in point

> *"The initial design flood capacity of the spillway was 200 000 cusecs based on an estimated PMF of 191 000 cusecs. However in August 1979 the dam was overtopped by a flood of 460 000 cusecs. As a result of this a complete review of the hydrology lead to a revised PMF estimated at around 739 000 cusecs, which was nearly four times the original design flood Even as this revised design was about to be built a still greater flood occurred which required the PMF to be raised still further to around 933,000 cusecs. This is a five fold increase on the original design flood in just 20 years.*

(Le Moigne, 1990 71)

According to Dr YK Murthy (Le Moigne, 1990:62], a study of 131 dams funded by the World Bank in India revealed the following facts:

1.	Spillway capacity not satisfying Indian Standard Code	20
2.	Freeboard not conforming to Indian Standard Code	25
3.	Seismic factor not taken into account in the design of the dam (mostly old dams)	15
4.	Non-study of Emergency Reservoir Operation Plans	90
5.	Distress manifestations reported	36

Dr Murthy goes on to report that, according to the CWC data, an increasing number of dams are showing distress. In Maharashtra State alone, distress in 46 dams has been reported.

An assessment of dam failures reveals that foundation seepage and overtopping are the two most common reasons for dam failure. (See Table 5.5).

Recently, fears have been expressed that the Tehri Dam is not safe. If the Tehri Dam should collapse, according to the MoEF (PMs briefing note), the impact would be as set out in Table 5 5

Table 5.5 **Arrival Time for Surge**

Place	Distance D/S of Dam (km)	Arrival Time for Surge (Hrs)	Depth (m)
Dam	**0**	**Approximate time of emptying of Reservoir**	
Rishikesh	80	0.63	260.00
Hardwar	104	0.80	232.00
Bijnor	179	4.45	17.72
Meerut	214	7.25	9.85
Hapur	246.5	9.50	8.78
Buland Shahar	286.5	12.00	8.50

As can be seen from Table 5.5 above, in less than an hour and a half, the water would hit Rishikesh and Hardwar and wipe out these two cities. This is certain because the height of the water would be 260 metres and 232 metres respectively. In order to assess how this can be minimised and to what extent, a disaster management plan is essential. This plan would also prescribe the communications and personnel networks that would need to be in position and the costs involved. These costs would have to be calculated as a part of the cost benefit analysis of the project.

There have been many dam failures across the world in the last 140 years. Some of them are listed in Table 5.6

Table 5.6 **Recorded Dam Failures since 1860 that have Killed More than 10 People**

Dam	Country	Type	Height (m)	Year completed	Year failed	Cause of failure	People killed	Cost of damage
Dale Dyke (Bradfield)	England	E	29	1858	1864	SF	250[1]	£0.5 m
Irubaike	Japan	E	28	1633	1868	OT	>1 000[2]	
Mill River	MA, USA	E	13	1865	1874	SF	143	>$1m
El Habra†	Algeria	R	36		1881	OT	209	
Valparaiso	Chile	E	17		1888	SF	>100	
South Fork (Johnstown)	PA, USA	E	22	1853	1889	OT	2 209	
Walnut Grove	AZ, USA	R	34	1888	1890	OT	150	
Bouzey	France	G	15	1881	1895	SF	150[1]	
Austin	PA, USA	G	15	1909	1911	SF	80	
Lower Otay	CA, USA	R	40	1897	1916	OT	30	
Bila Desna	Czechoslovakia	E	17	1915	1916	SF	65	
Tigra	India	G	24	1917	1917	OT	>1 000[2]	
Gleno	Italy	M, G	44	1923	1923	SF	600	
Eigiau/Coedty §	Wales	G/E	11	1908/19	1925	PI/OT	16	
St Francis	CA, USA	A	62	1926	1928	SF	450	
Alla Sella Zerbino	Italy	G	12	1923	1935	OT	> 100	
Vega de Terra (Ribadelago)	Spain	B	34	1957	1959	SF	145	
Malpasset (Fréjus)	France	A	61	1954	1959	F	421	
Orós	Brazil	E	54	const	1960	OT	c.1 000	
Babii Yar	Ukraine	E			1961	OT	145	
Panshet/Khadakwasla §	India	E/R	54/42	const/1879	1961	SF, OT/OT	> 1 000[2]	
Hyokiri	S.Korea							

Dam	Country	Type	Height (m)	Year completed	Year failed	Cause of failure	People killed	Cost of damage
Kuala Lumpur	Malaysia							
Vaiont	Italy	A	26	1960	1963	OT	2.600	
Quebrada la Chappa	Colombia							
Swift	MT, USA							
Zgorigrad (Vratza)	Bulgaria	Ta	1			OT	> 96	
Nanaksagar	India	E	1	1962	1967	SF/OT	c.100	
Sempor	Indonesia	R	5	const	1967	SF/OT	c.200	
Frias	Argentina	R	1	1940	1970	OT	> 42	
Buffalo Creek	WV, USA	Ta	3	const	1972	OT	125	$30-50m[1]
Canyon Lake	SD, USA	E		1938	1972	OT	237*	$60m
Baniqao, Shimantan, 60 others	China	E		late 1950s	1975	OT	≤ 230 000[4]	
Teton	ID, USA	E	9	1976	1976	SF	11-14	$0.4-1bn
Laurel Run	PA. USA				1977		39[3]	$20-45m[2]
Kelly Barnes (Toccoa Falls)	GA, USA	E	1	1899	1977	SF	39[3]	
Machhu II	India	E	2	1972	1979	OT	> 2 000	$15m crops
Gopinatham	India			1980	1981	OT	47[5]	
Taus	Sapin	R	7	1980	1982	OT	> 20[6]	
Stava	Italy	Ta		1960s	1985		269[7]	
Kantalai	Sri Lanka	R	1	1952	1986	PI	82[8]	
Sargazon	Tadjikistan		2	1980	1987		> 19[9]	
Belci	Romania	E	1	1962	1991	OT	c.48[10]	
Gouhou	China	R	7	1987	1993	PI	342[11]	$18m
Tirlyan	Russia	E	1	<1987	1994	OT	19-37[12]	Rs40bn
Virginia No.15	S.Africa	Ta	4		1994		39[13]	$15m
Lake Blackshear Project/Flint River Dam	GA, USA	E	< 1		1994	OT	15[14]	
N/A	Philippines	N/A	N/	N/A	1995	N/A	c 30[15]	

(SOURCES: Various, as quoted in Jauhari, 1999|).

Notes : *Dam types:* E=Earthfill; R=Rockfill; G=Gravity; M=Multi-arch; B=Buttress. A=Arch. Ta=Tailings; *Cause of failure* OT=overtopping; PI=piping. SF=structural failure. F=geological/foundation weakness; * unable to distinguish dam break fatalities with those caused by 'natural' flood; † El Habra first failed in 1872 without loss of life. It was then rebuilt, failed again in 1881, rebuilt again, then failed again in 1927 (without fatalities) and was then abandoned; § The flood from the collapse of the first dam breached the second dam downstreams.

The impact of dam failure on downstream areas has not been studied in any of the dams under review Critical assessments of the Hirakud Dam, though, do point out that the dam developed cracks even before it was completed (Subakar, n.d.). The Nizamsagar Dam is designed for a lower peak outflow than the magnitude of the maximum expected flood (GOAP, 1965). In Gandhisagar (Gupta, 1998), it has been stated that peak flows could be higher than anticipated and could, therefore, put the dam at risk.

In 1995, the Central Water Commission made a list of 33 Indian dams which have structural and hydrological defects. In the same year the World Bank reportedly categorised 25 Indian dams as unsafe (Indian Express, 1995)

For example, the Bhadar (Rajkot) Project has been judged as unsafe by the official consultants. According to them "the spillway has been constructed for a design flood of 5660 cumecs . . . in 1979, the CDO of Gujarat revised the design flood in consultation with the CWC and accordingly the probable maximum flood was placed at 24 887 cumecs. The present spillway obviously cannot cope with this large flood" (CCPA, 1996:xxix). The consultants go on to say that, "The present inspection seems to be cursory and the Dam Safety Organisation attached to the Gujarat Engineering Research Institute (GERI), because of staff constraint, finds time to inspect only once in 3 or 4 years. The necessity of dam break flood analysis and corresponding inundation maps as well as disaster preparedness plans has also been emphasised." (CCPA, 1996:xxx).

In none of the dams studied was there a proper disaster management plan, which would laydown not only how to prevent or minimise disasters but also how to minimise and mitigate the effects of such a disaster

The huge loss of human life and property that dam failures imply, along with the perceived threat that the downstream populations have to live with, make the assessment of dam safety a very critical issue. Unfortunately, in most dams it has been observed that the required attention is not being paid to this very serious aspect of dam appraisal. However, there is a dam safety organisation which presumably is charged with assessing the safety status of dams in the country Unfortunately, despite efforts to procure them, reports of this organisation were not available and do not appear to be accessible to the public.

ix Decommissioning of Dams

At the end of the life of a dam it has to be decommissioned otherwise the structure could collapse and cause havoc downstream. Decommissioning involves the safe disposal of all the silt that has accumulated in the dam, of the dam material and of the water accumulated in the reservoir. It also involves the opening up of the river course. All these processes bear significant financial costs and also various environmental costs, especially if they are not done properly. At the time of decommissioning it has to be ensured that the structure does not suddenly collapse as this would lead to huge destruction downstream.

Unfortunately, for none of the dams were the impacts of decommissioning studied or the costs calculated.

5.2.2.2 Discussion

It is clear from the findings presented above that all is not well with large dams, at least as far as the anticipation, assessment, prevention and mitigation of environmental impacts are concerned. However, by just looking at the findings, it is not obvious why such a state of affairs exists. To understand that, the process by which large dams are assessed for their environmental impacts must be examined.

For activities and projects that can have an impact on the environment, it is usually considered necessary to conduct an environmental impact assessment (EIA), which assesses the likely impacts of the project or activity on the environment. Based on an EIA, preventive and mitigative strategies can be designed and the cost of such strategies and the residual impacts can be calculated All this should be the basis for assessing the environmental viability of the project or activity and should also feed into the overall decision-making process, by which the proposed project or activity is approved or rejected.

The Process in India

For large dams, the requirement of obtaining environmental clearances and, therefore, conducting an environmental impact assessment, was introduced in India only in 1978, and more as a matter of policy than a statutory requirement. The EIA became a statutory requirement only in 1994, with the necessary modifications in the rules of the Environment (Protection) Act (EPA) of 1986.

From 1978, all dams were required to obtain an environmental clearance from the Department of Science and Technology (DST), before they could be proposed for investment clearance to the Planning Commission. The DST accorded environmental clearances based on an environmental impact statement (EIS) prepared by or on behalf of the project proponents and assessed by the National Committee for Environmental Planning and Co-ordination (NCEPC).

In 1980, the Department of Environment was formed and the responsibility of according environmental clearances was transferred to it. In the same year, the Forest (Conservation) Act was notified and under this act any diversion of forest land for non-forest purposes, which included dams, had to be cleared by the Government of India. From 1980 till 1985, the Department of Forests and Wildlife in the Ministry of Agriculture had the responsibility of according forest clearances for forest lands to be submerged or otherwise diverted for dams

In 1985, the Ministry of Environment and Forests was set up and both the Department of Environment and the Department of Forests and Wildlife became a part of this new Ministry. Since 1985, it is this ministry which has the responsibility of carrying out an environmental impact assessment and granting both the environment and forest clearances. Though forest clearances were legally mandatory after 1980, environmental clearances became legally mandatory only in 1994

In 1985, the Ministry of Environment and Forests (MoEF) issued guidelines for the environmental impact assessment of river valley projects. These guidelines are still in use and deal mainly with upstream impacts, but include questions relating to rehabilitation (see Annex 2.1)

For many years now, the Environmental Appraisal Committee (EAC) for river valley projects, set up by the MoEF, performs the function that was originally performed by the NCEPC The EAC is composed of expert members from both within and outside the government. Traditionally, the chairperson has been a non-governmental official. Since 1994, it has been specified in the rules that the chairperson must be "an outstanding and experienced ecologist or environmentalist or technical professional with wide managerial experience" (EAP Rules). Unfortunately, in the recent past there has been a tendency to appoint retired government officials as chairpersons, only some of whom might have the prescribed qualifications.

The EAC assesses the impacts of river valley projects, based on the EIS prepared by or on behalf of the project proponents. The EAC also visits some of the project sites. Taking all these factors into account, the EAC recommends to the MoEF whether a project should be unconditionally cleared, cleared with conditions or rejected. Even before the final recommendation is made, the EAC advises the MoEF on what further information or undertakings are required from the project authorities and assesses the information and undertakings so provided. However, the EAC is essentially an advisory committee whose advice can be rejected by the MoEF, or by the Government

Similarly, there is an advisory committee to recommend cases for forest clearance.

In January 1994, the rules of the EPA were amended to make public hearings a mandatory part of the assessment process. However, within a very short time the rules were again amended to make such hearings optional, replacing the word "shall" with "may" in the operative sentence In 1998, public hearings were once again made mandatory by a further amendment to the EPA's rules

Within the Central Water Commission, an Environmental Monitoring Committee was constituted in 1990. This committee is supposed to oversee the implementation of environmental safeguards stipulated by the MoEF (CWC, 1996b). Similarly, state and project level environmental monitoring committees were also supposed to be set up and in fact many have been.

Some Issues Relating to the Assessment Process

i. A lack of assessment till 1978

Projects cleared before 1978 were not required to go through any environmental assessment. The results of this are obvious when the data concerning such dams are studied. In such cases the only two environmental aspects assessed, and then only in a few cases, as part of project assessment were the rates of reservoir siltation and the extent and severity of waterlogging. However, these were also not assessed from the environmental perspective but only from the techno-economic perspective, in terms of the threats or design challenges they posed and the economic costs they implied. This scenario emerges from the findings discussed earlier.

Even for these two aspects, the findings suggest that in many cases the actual rates of siltation and the actual extent of waterlogging were much higher than what was anticipated. Unfortunately, information on only a few dams is available for, in most cases, no retrospective assessment was done

Another aspect that was sometimes studied was the threat to the dam of possible seismic activities. Here, again, the techno-economic aspects specific to the dam were studied.

There was also, in a few cases, concern about the impact of the dam on fisheries, especially at the reservoir, but again only in terms of economic losses and gains. Apart from these, most of the many other likely and inevitable impacts of dams that are listed above were, by and large looked, not examined

ii Appropriateness of Environmental Impact Assessments

There is a general paucity of data, especially credible independent data, on environmental aspects relevant to the assessment of dams. There are Botanical and Zoological Surveys in India, and a Ministry of Environment and Forests along with state departments of the environment and forests Despite these, detailed information on terrestrial and aquatic ecosystems for almost all of the potential impact areas of dams are not available in advance of the dam being proposed. Therefore, much of the data required is collected after the dam has been proposed and the environmental impact assessment initiated. This results in at least the following problems:

- As the environmental studies are usually initiated very late in the day, there is a tendency to hurry them along so that the environmental clearance and the consequent completion of the project are not delayed. Considering that data have often to be collected from scratch, this haste results in the use of unscientific methodologies and a resultant inadequate assessment An example of this is the Tehri Dam where the fauna and flora studies were not even initiated by the time the dam was cleared, and were finally taken up only after the passing of the deadline prescribed for completion in the clearance letter. The fact that these studies were taken up at all was probably owing to public pressure, in the form of public interest litigation in the Supreme Court of India.

- As a result, the study on fauna was completed within six months of initiation, though scientifically at least two annual cycles must be studied before any assessment of fauna can be made The botanical studies were conducted with similar haste and carelessness (Tehri, 1997).

  Similar experiences are recorded for most of the few projects for which such studies have at all been undertaken. These include the Sardar Sarovar and the Indira (Narmada) Sagar

Unfortunately, there is no system by which basic environmental parameters are studied much before the project is posed for clearance or as soon as potential sites for dams have been identified.

- These studies are done at the cost of the project proponents and form part of the project cost in the calculations regarding the economic viability of the project. This results in a tendency to try and conduct them as cheaply as possible, which leads to cutting corners and compromising on quality.

- The project proponents are interested in getting their project cleared as soon as possible and at the least cost. Consequently, there is pressure on project consultants to produce a report that either shows no adverse environmental impacts or suggests very cheap (and, as seen earlier, usually ineffective) methods of mitigating these impacts. The problem is exacerbated by the fact that the MoEF and its EAC have little ability to independently verify these reports and the data they contain. They can, at best, check superficially on a few aspects or refer a matter back to the same consultants to review the data provided. Such procedures also result in delays in the assessment process that, in turn, makes the MoEF susceptible to criticism and to pressure for early clearances.

  Unfortunately, there is no system by which the financing of environmental studies can be undertaken by an independent institution like the Planning Commission and debited on a fixedpercentage basis to project cost, thereby freeing the project consultants from pressures by the project authorities.

- The guidelines of the MoEF, which were drafted in the late 1970s, have not been significantly amended since then and are woefully inadequate (see Annex 2.I for text). As the project authorities follow these guidelines, which do not cover many of the critical aspects at all.

iii Lack of Retrospective Assessments

Apart from the fact that, for all the projects designed and initiated before 1978, none of the environmental impacts were assessed, there has also not been any retrospective assessment since these projects were constructed. Though it might no longer be possible to fully assess many of the adverse impacts, especially those on terrestrial and aquatic biodiversity, many of the other impacts could be assessed even today. However, no effort has been made towards this end, except for siltation and water-logging, as already mentioned.

Yet the need to conduct retrospective assessments has often been highlighted by various agencies and experts. The Working Group on Major and Medium Irrigation Programme for the Eighth Plan states, in their report "... studies are necessary in respect of the environmental impacts created by the projects. There is a considerable divergence of opinion in the country regarding both the beneficial and adverse impacts created by the major and medium projects However, it is based mainly on the experience of projects in other countries. There is hardly any realistic data on the performance of Indian Projects" (GOI, 1989:IV 18).

The lack of such assessments makes the task of assessing the overall impacts of dams on the environment very difficult. It is also a wasted opportunity to learn from past experience Consequently, even today, many of the impacts assumed and the mitigative measures planned have little experiential basis

iv Political and Administrative Pressures

The process of environmental impact assessment has been subjected to political and administrative pressures almost from the start. Pressure is exerted on the professional project consultants to prepare the EISs in such a manner that the project is cleared. Pressure is exerted on the EAC to recommend the clearance or rejection of projects. Also, if the MoEF or the Government of India rejects the recommendations of the EAC, it does so without assigning any reasons.

A well-known case is that of the Tehri Project, in Uttar Pradesh. The EAC (1990) that considered the project was unanimous in recommending that the project should not be accorded environmental clearance. However, despite that, the government decided to give environmental clearance without assigning any reasons for rejecting the advice of their own expert committee. In his submission before the Expert Committee set up by the Power Ministry of the Government of India to assess the rehabilitation and environmental aspects of the Tehri dam (1996-97), the then Secretary of the MoEF said: ". . that records indicate that the decision for conditional clearance of the Tehri project was taken not by the MoEF, which did not favour clearance, but at a higher level" (Tehri, 1997:-104).

The minutes of the said Expert Committee go on to record that:

> *The Secretary was also asked to comment on how the MoEF could have determined that the Tehri Project was environmentally viable, and consequently given environmental clearance, when the various studies which were to assess the environmental impact of the project had not been completed. The Secretary agreed that the MoEF could not determine the environmental viability of the project prior to the studies being completed and reiterated that environmental clearance had not been given at the behest of the MoEF but at the behest of a higher level (Tehri, 1997:-105).*

Similarly, in the case of the Narmada (Indira) Sagar and Sardar Sarovar projects, the MoEF categorically stated, in writing, that the projects were not fit for to be accorded environmental clearance. Yet, at the highest level, the decision was taken to grant the project conditional clearance with a *pari passu* clause.

In other cases, projects were initiated long before clearances were received. The Government of India was then pressurised to clear the project on the grounds that so much expenditure of public funds had already been incurred.

This is what happened in the case of the Tehri Project, where work started long before environmental clearance was finally given in 1990. This also occurred in many other projects, for example:

- Rengali Project in Orissa where Rs186.95 crores of the total estimated cost of Rs233.64 crores had been spent by March 1994, without any environmental clearance (CWC, 1996).
- Bargi Project in Madhya Pradesh where Rs360.74 crores of the total estimated cost of Rs566.34 crores had been spent by March 1994, despite no environmental clearance (CWC, 1996)
- Jurala Project in Andhra Pradesh where Rs23.18 crores of the total estimated cost of Rs275 crores had been spent by March 1994, without environmental clearance (CWC, 1996).
- Karjan Project in Gujarat where the dam had been completed, the Right Bank Canal completed, the Left Bank Canal 90% completed and Rs222.80 of the total estimated cost of Rs264.10 spent by March 1994, without environmental clearance (CWC, 1996).
- Tillari Project in Maharashtra and Goa where, by March 1994, the dam was 86% complete, and the Maharashtra canals were 89% (LB), 65% (RB) and 88% (Link) complete. In Goa, 73% of the LB canal and 199% of the RB canal were complete. Rs179.01 crores of the total approved cost of Rs217.22 crores had been expended, without environmental clearance (CWC, 1996)
- Jayakwadi Irrigation Project in Maharashtra where the Malagaon Dam has been completed, Paithan RB Canal completed and Majalgaon RB Canal half completed by March 1994, without environmental clearance (CWC, 1996).
- Mahanadi Reservoir Project in Madhya Pradesh, involving the Sondur Dam and Pairy High Dam, where Rs337.54 crores had been spent by March 1994, out of a total estimated expenditure of Rs1223.45 crores, without environmental clearance (CWC, 1996).

- Upper Wainganga Project in Madhya Pradesh where by March 1994, the dam had been complete and the canals were nearly complete. The total expenditure thus far was Rs136.19 out of an estimated total of Rs176.53 crores, without any environmental clearance (CWC, 1996).

This was the status of these projects as on March 1994; their current status is not known.

v. The Ability to Enforce and Monitor Conditions

Projects that are cleared are basically of three types.

- First, there are those that are unconditionally cleared, which means that the project proposal, in terms of the anticipated environmental impacts and the proposed preventive and mitigative measures, is found acceptable.
- The second (a large majority) are those in which certain conditions are specified when clearance is being granted and, in that sense, the clearance is conditional.
- The third are those in which the required environmental assessments have not been carried out but clearance is given with the understanding that the required environmental studies will be completed within a specified period and that the preventative and mitigative measures will be carried out *pari passu* with the construction work.

For each of these types, it is essential to monitor that their environmental impacts are within the anticipated limits, that the preventive and mitigatory measures proposed by them or stipulated by the MoEF are carried out properly and in time, and that the measures are having the anticipated affects For the third type (with *pari passu* clearances), it is also necessary to ensure that the studies are carried out within the stipulated period and that the viability of the project is assessed as soon as possible and certainly before it has reached a stage where it cannot be abandoned When the project is found viable, it then has to be ensured that appropriate preventive and mitigatory action plans are formulated and implemented in time.

The MoEF must also have the willingness and capability, as is implied by the law, to withdraw environmental clearance from, and thereby stop construction of, projects in which the prescribed environmental conditions are not being complied with. The MoEF must also have the willingness and ability to scrap projects, even after their initiation, if they prove to be environmentally non-viable.

The ability of the MoEF to monitor compliance with the stipulated conditions is limited. The MoEF is expected to monitor compliance through its regional offices which, in turn, rely mainly on the returns submitted by the project authorities themselves. This system of monitoring has come into being only in the last five years or so.

Far more serious is the inability of the MoEF to enforce compliance. A study done by a member of the EAC for dams, in 1998, states that:

> Data emerging from the records of the Government of India, collected by the regional offices of the MoEF, suggests that in a shocking 90% of cases, project authorities had not complied with the conditions which their projects had been cleared under (Kothari, 1998:-5).
>
> Our EAC assessed the state of monitoring and reappraisal of the dams cleared by the MoEF in the 1980s and 1990s. The most shocking fact that our EAC found was that, despite being told of the huge scale of defaulting (that) was taking place, MoEF rarely took stringent action, indeed, on no occasion had it used its powers to halt construction and prosecute concerned officials even in cases of extreme violations of conditions. (Kothari, 1998:-7).

(Kothar, 1998 5,7)

An interesting example is that of the Tehri Dam. As already mentioned, the viability of the dam was not assessed before it was cleared. In 1996, an expert committee was set up to assess the environmental aspects of the project. The findings of the committee, in terms of compliance with conditions of clearance, were as follows:

> Consequently, the committee came to the conclusion that the conditions of clearance. as laid down by the MoEF in its letter No. 2-19/81-HCT/IA-I dated 19 July, 1990 read with DO letter No. 2-19/81- IA.I dated 11 October, 1993, had not been complied with. The status of compliance is summarised in table 5.G below (Table 5.7 in this report), and is discussed in the relevant chapters.

Table 5.7 Management Plans / Action Plans

Management Plans/Action Plans	Prescribed date of submission	Actual date of submission	Whether approved by MoEF	Whether implemented as per conditions
Catchment Area Treatment	31.12.90	January, 1994	NO	Not fully implemented as per conditions as it was not completed by 31.12.1995, as stipulated by the MoEF in its letter of clearance. Also, though 29 000 ha have been treated up till today, only directly draining areas are being treated
Command Area Development	31.3.91 (31.12.93)*	Not yet submitted	NO	Not relevant, as the plan has still not been drawn up
Flora	May 1991	July, 1993	NO	Not as per conditions. See the section on fauna and flora for details.
Fauna	May 1991	March, 1993	NO	Not as per conditions. See the section on fauna and flora for details
Water Quality Maintenance	No date specified	November, 1992	NO	Not applicable
Disaster Management	31.3.91	April, 1992**	NO	Not relevant as the plan has Still not been submitted to the MoEF

Activity	Prescribed date of completion	Actual date of completion	Whether completed by approved date
Setting up Bhagirathi Basin Management Authority on a statutory basis through legislative action	31.3.1991 (12/1993)*	Not yet set up	NO

(SOURCE Tehri, 1997.)

* *extended date*

** According to THDC, submitted to the Ministry of Agriculture

> *The findings of the committee (as seen in the table) were that "while there have been delays in the submission of studies and action plans, the position is that even several years after such submission there has been neither any final approval by MoEF nor a final rejection followed by consequential action in terms of the conditions of clearance*
>
> (Tehri, 1997 -29)

In the case of the Tehri Dam, despite these violations, the work on the project continues uninterrupted.

In the case of Narmada (Indira) Sagar and Sardar Sarovar, the project authorities violated most of the conditions of clearance (NCAenv, n.d.). Despite this, the work on the project continued till the Supreme Court had to intervene, on the basis of public interest litigation, and order a halt to the construction of at least the Sardar Sarovar Project.

The survey done by Ashish Kothari (1998:8) also establishes that:

> *Though it has the mandate and power, the MoEF has almost never exercised its right to revoke clearance, or punish the offending project authorities and state government officials/ agencies, in cases of violation of environment conditions. The few cases we came across where the MoEF had revoked clearance, were related to other violations or technical difficulties; but on environmental grounds, no project in the country had been stopped and the appropriate agencies punished.*
>
> (Kothari, 1998:-8).

5.3 Social Impacts

Social impacts are the overarching impacts that affect on the human society. All economic impacts also have social impacts; so do all environmental impacts, as the improvement or degradation of the environment also affects human beings. However, whereas economic impacts can all be seen as having essentially social impacts, environmental impacts do not affect only the human society but also affect plants and animals.

Dams are intended to produce beneficial social impacts, primarily through the enhancement of the availability of water for irrigation and other purposes, the generation of electricity for industrial, agricultural and domestic purposes, and the regulation of floods. Each of these has multiple beneficial impacts such as the increased availability of food, the increase in incomes, in industrial productivity and in the prevention of loss and destruction from floods. There are also incidental benefits, like those resulting from the restoration of catchments or the creation of the reservoir

However, large dams also have many adverse social impacts. Historically, most of the beneficial impacts were recognised but many of the adverse impacts remained unacknowledged. As the latter were neither assessed prior to dam construction nor examined after construction, it is difficult, in retrospect, to determine their intensity. Even today, only some of these adverse impacts are being introduced into the process of planning for and assessing large dams.

Nevertheless, an effort has been made to collect whatever data are available on the social impacts of past projects

Most adverse social impacts of large dams are either not reflected at all or only partly reflected in the financial and economic analyses of dams. For example, the financial analysis reflects the direct financial costs of relocating and rehabilitating project-affected peoples. These costs, therefore, are not discussed here. However, there are many other costs that remain unacknowledged and, therefore, are not reflected in the financial or economic assessments, or are inadequately reflected. These costs will be discussed here.

As in the case of most environmental impacts, it is difficult to lay down standards for social impacts, because most social impacts do not lend themselves to quantification. It is, for example, difficult to measure trauma, alienation, fear and insecurity and, for that and other reasons, it is difficult to prescribe how much of psychological trauma, indeed if any at all, is acceptable. To what extent is cultural and social alienation bearable? At what point does fear and insecurity become unbearable? One view is that none of it is acceptable, but by that token all large dams might become unacceptable. The other view is that though some social costs are inevitable, such costs must only be permitted under the "rarest of rare" circumstances and all efforts must be made to minimise them and to compensate for those that still occur.

As the direct economic impacts of dams are being discussed in another section, they are not repeated here. As most of the environmental impacts mentioned in the earlier section also have related social impacts, they are referred to briefly but not in detail.

Based on a survey of 67 dams (Annex 1.VI), the findings regarding the possible and actual social impacts of dams are given below. Detailed tables of the above-mentioned impacts are given in Annex 3.

5.3.1 Beneficial Social Impacts

The major beneficial impacts of large dams are captured in financial and economic terms and are dealt with in another chapter. There are, however, other benefits that are not usually included in an economic analysis of dams and these are discussed below.

Beneficial Impacts Upstream of the Dam

i. Beneficial Impacts of the Restoration of Catchments

One major beneficial impact, upstream of the dam, is the added biomass, incomes and ecological security for the local communities that follow from the restoration of degraded catchments. For almost all the projects approved after 1980, there is a requirement to treat severely degraded catchments However, in recent years, there has been a tendency to treat only the directly draining areas of the catchment

Where the catchment is actually restored, apart from the benefits to the project, there are various benefits to the people living in and around the restored areas: increased availability of biomass, better water availability, and restored microclimatic conditions.

These benefits have not been quantified in any of the dams studied and are not usually included in the cost-benefit calculations. They have been predicted for three dams. Polavaram (Rao *et al.* n.d), Chandil and Gandhisagar (ORSAC & WAPCOS, n.d., CBIP, 1987a).

Beneficial Impacts at the Dam/Reservoir

i Stimulation of Economic Activities

The reservoirs created by large dams often become tourist attractions. According to the data available, there are at least 50 reservoirs that have also been made into national parks or sanctuaries and, consequently, not only contribute to wildlife conservation but also serve as tourist resorts (see section on environmental benefits for details). The development of tourism, and of communications and other infrastructure, resulting from the dam, also contribute to the stimulation of the overall economic activities in the area. These benefits were not quantified for any of the dams that the authors studied and were not taken into consideration while conducting the cost-benefit analysis

ii. Increase of Fisheries in the Reservoir

Though the profile of fisheries might change because of the creation of a reservoir, efforts to stock commercially valuable fish in these reservoirs has often led to the increase in fisheries (catch and income) in the reservoir area. This has been a benefit to the fisher folk who have access to the reservoir fisheries and has been mentioned in three of the projects studied.

iii. Impacts on Microclimate

In dry or semi-arid regions the reservoir, by changing the humidity levels and temperature in its vicinity, might make the local environment more comfortable for people to live in. Five of the projects studied reportedly assessed this possibility. Of these, two of the projects,Champamati and Malana, reportedly predicted that no microclimatic change would take place owing to the project while one project, Sriramsagar, predicted an improvement. In the case of two projects, Mahi Kadana and Ukai, a decrease in the maximum and an increase in the minimum temperature were reported to have occurred (see Annex 3.III for details and sources).

Beneficial Impacts Downstream of the Dam

i. Flood Control

Dams often, by intent or otherwise, play the role of regulating floods. How effectively dams can regulate floods depends on many factors including the severity of the floods, the dam design, the time of the floods and the advance warning that is available. The number of large dams that specifically have flood control as one of their objectives are reported to be very small (0.5% of the total). The extent of floods controlled have been calculated for many projects. For example, In the case of Hirakud, the benefit was calculated at Rs12 lakhs per year (1947 prices) (IWRS, 2000). In the case of Ramganga, it was reported that low-lying areas in the command had been relieved of floods and could be used for growing crops (CBIP, 1995).

ii Improved Sanitation and Hygiene

In areas that are water deficient, the provision of water through dams can significantly improve the sanitation and hygienic conditions, thereby having a beneficial impact on human health. These benefits were not quantified for any of the dams that the authors studied and were not taken into consideration while conducting the cost-benefit analysis

iii. Improvement in Land Prices

The price of land in the command area also rises, except in those areas where land becomes water-logged or otherwise adversely affected This significantly benefits the landowners in the command area. These benefits were not quantified for any of the dams that the authors studied and were not taken into consideration while conducting the cost-benefit analysis

iv Impacts on Groundwater Recharge

In command areas and around the reservoir, the groundwater is recharged because of the reservoir or the canals Where groundwater is normally deep, this has a beneficial effect. These benefits were not quantified for any of the dams that the authors studied and were not taken into consideration while conducting the cost-benefit analysis.

5.3.2 Impacts of Displacement[12]

Among the most significant adverse social impacts of dams are those that result from forceful (or involuntary) displacement of human populations from their homes, fields, towns and regions Displacement has many specific impacts, which are described below As a part of the case study, the rehabilitation packages and details for 47 dams were studied. Details of the rehabilitation packages are given in Annex 3.V Relevant information is included in the description below

Displacement was caused not only by the dam itself, but also by canals and other dam structures and infrastructure Though the social impacts of all such displacement are essentially similar, often the people affted by the dam receive better rehabilitation packages than those affected by canals and other works. This occurs partly because sometimes the canals and other structures are completed long before or after the dam and much more attention is focused on the dam than on the other structures. Also, as the number of people affected by dams is usually (though not always) greater than that affected by canals and other works, the latter have a weaker voice.

5.3.2.1 Findings

i. Compensation

Eligibility

In most projects the family is the unit that is eligible for compensation and rehabilitation but the definition of "family" varies in different projects. Some of the definitions are given below.

- All those living under the same roof (eg Upper Kolab). This definition can be detrimental in areas where families live jointly. In many parts of the country the joint family system still prevails and, if this criterion is applied, then twenty or thirty people can be grouped one family and receive the compensation due to only one family.
- All those sharing a common kitchen. This can have the same problems as joint families.
- In terms of the "head of the family" or the eldest surviving male member, in whose name the property resides. This can also lead to problems For example, in Tehri, as in many tribal areas, there is a tradition by which the land and other property resides in the name of the eldest male, as long as he is alive, without being divided up among the sons/daughters or grandsons/granddaughters. At Tehri, following this system, in the original package, caused major hardships. Such a criterion of eligibility is also gender insensitive
- All married males (eg Loktak). This discriminates against women, especially unmarried, abandoned or divorced women; it also leaves out major unmarried sons
- All major males (eg Almatti, Narayanpur, Upper Indravati, Bisalpur, Srisailam) This is gender insensitive. Also, the cut-off date to determine adulthood, is critical. In most of the projects this is prescribed as the date on which the first notice was issued. However, as rehabilitation takes place long after this, such a cut-off date seems unfair.
- All adult married or unmarried sons and adult unmarried daughters (eg the new Tehri package) This discriminates against married women. Here, also, the cut-off date is critical.
- All married males (compensation and titles to be jointly owned by the husband and wife), all unmarried major sons and daughters (though only half entitlement), including widows/widowers, divorcees and abandoned persons. This is perhaps the best of the alternatives

Loss of common property resources

Though many rehabilitation packages attempt to compensate for the loss of individual property and livelihood, very rarely is there an attempt to compensate for the loss of common property resources, especially by replacing them. The displaced populations would most likely have had free access to the water and other resources of the river, including the riverbed land and the fish They might have had access to common grasslands, forests, wetlands and to a host of natural resources, from which they derived not only subsistence resources but also incomes. Most often the sites to which they are rehabilitated do not provide a similar access to nature and it is not easy, nor proper, to compensate for these in monetary terms.

Of the 47 projects studied, only two acknowledged the value of common property resources and attempted to compensate for them. Bisalpur and Upper Kolab reported in its official documents that the project sought to compensate in kind, though the local activists working in Bisalpur disputed this The adequacy of the compensation could not be assessed. (See Annex 3 V for details)

The loss of these resources remains a hidden social cost for most dams.

Loss of cultural heritage sites and monuments

Many individuals and societies have strong cultural and religious links with their ancestral surrounds. The displacement of such individuals and communities causes cultural and psychological trauma that is difficult to mitigate.

Some of notified archaeological sites and major temples were shifted out of the submergence zone in some projects, including Narmada Sagar and Nagarjunsagar. In a few cases, fresh places of worship were to be constructed (Tungabhadra, Bhadra, Nagarjunsagar (Rao, 1979), Srisailam, Konar, Pochampad, Sriramsagar and Lower Manair). In most other cases, either there was no compensation or monetary compensation was paid (Rs500 per temple in Warna). In a recent project (Singur in Andhra Pradesh), while some sculptures that were going to be submerged were removed to safe zones, they were still being kept out in the open and were not stored properly (CWC, 1995).

Sites and monuments of local significance are regularly lost and though this might not be preventable. the resultant cost to the society must be recognised as a cost of the dam. As such, it must form a part of the assessment of the costs and benefits of the dam.

In some cases, depending on the value of the site or monument, their existence in the submergence zone of the proposed dam must be reason enough to abandon the dam. The Indian national heritage should certainly be one of those values that cannot be traded off, whatever the financial incentives.

Loss of home and hearth

Most people have a strong attachment to their homes, especially when these are ancestral homes The forced abandonment of one's home is always traumatic and cannot be compensated for by an alternate house This is an inevitable, perhaps incalculable, but nevertheless significant social cost of a dam, which is rarely acknowledged. Unfortunately, the only cost that is recognised and computed is the cost of providing an alternate house.

Most of the projects provide some compensation for the physical loss of a house, either in terms of cash, or materials, or both. In many projects land is also made available for the construction of houses.

Only five of the projects studied proposed providing a house as replacement for the house being lost In one, Pipai (Rihand), it was proposed to construct houses for all those who lost houses. In four others, Konar, Maithon, Panchet and Tilayia, some of those affected were to be given houses, while others were to be given land and cash. In Upper Kolab, low cost houses were to be constructed for sale to the displaced persons, who would be compensated for their lost houses in cash. (See Annex 3 V for details.)

The practice of giving land for homes was also not universal Eleven of the 47 projects promised land for homes:. these included Tungabhadra, Pong, Narayanpur, Almatti, and Pochampad Another seven projects promised partly land and partly cash (including Bisalpur: Balimela and Srisailam) While another seven gave a choice. Eleven offered only cash: Majalgaon (ongoing) Rs105 per house, Rengali at the cost of construction; Warna (ongoing) Rs500 per house; Hirakud (1957) Rs3 000 per house; Vir (1965) Rs3 226 per house; Phagne and Ujjani (1975) Rs3 400 per house, and Kamthikairy (1977) Rs2 000 for 10% of the houses and Rs500 for the remainder. There was no information for the remaining projects. (See Annex 3.V for details.)

As can be seen, the rate of compensation for a house, varied from project to project In many projects the compensation was either a fixed amount or according to slabs In many other cases, the compensation was according to a pre-determined value, but was never the true replacement cost

Loss of familiar social and geographical surrounds

Communities, especially rural communities, have a strong social ethos within which individuals grow up and are shaped. These individuals have norms, values and traditions that help them to interact with one other and with other communities. When such communities are fragmented, isolated or placed in unfamiliar social surrounds, there is a lot of trauma, insecurity and social dislocation There is also a breakdown of the community's social and political processes and, consequently, of their decision-making abilities.

Similarly, the physical surrounds within which a community lives have a profound influence on the psyche and lifestyles of its members. The climate, terrain, scenery, even the types of plants and animals found, all shape the thinking and behaviour of these individuals and communities and a drastic change of physical surround can seriously disorient them. Where the change is to much less natural surroundings, there are additional deprivations, especially for tribals and other communities living in close harmony with nature.

These aspects and their costs also remained unacknowledged. There were also no perceptible efforts at trying to ensure that people were relocated in surrounds as similar to those of their original homes as possible.

Loss of preferred or familiar sources of livelihood

The forced change of occupation and methods of earning a livelihood, which often happens when people are displaced, can be a source of significant trauma. The world over, most people prefer to follow professions they know and are familiar with. Where changes are made, they are usually made on a voluntary basis, especially in mid-life, and are in keeping with talents and abilities. However, where forced displacement occurs, such a change is usually not possible. There is also the additional trauma of having to adopt a profession which one is not trained or suited for. To become a third-rate shopkeeper or vendor after being a first-class farmer or artisan, takes a toll on the self-value of an individual

Though some efforts have been made in a few projects to provide training for the project-affected persons and to ensure that farmers receive agricultural lands even after they have been relocated, this is not the universal practice

Of the 47 projects studied, only 14 proposed or gave agricultural land for agricultural land. In three of these (Pong, Lower Bhawani and Pandoh), part of the cost of the land given was taken from the compensation paid. In two (Bisalpur and Bhadar) compensation was partly cash and partly land In 11 there was a choice given between land or cash, although land was not guaranteed but was to be provided only if available. In another 16, only cash compensation was given for land. There was no information on this aspect for the remaining projects.

There are powerful and vocal advocates for discontinuing the practice of giving land for land Among these is BG Verghese (1990:203), who says:

That displaced persons should be rehabilitated in their chosen livelihoods as far as possible is understandable. Where land is available, even landless agricultural labour has been promised and given land on relocation. While this may be a viable policy in certain areas or to a certain extent, any firm or binding commitment to give land for land is unwise and impracticable and could and, indeed has aroused expectations that may not be easily fulfilled if at all.

The giving of land itself is not enough. The quantity of land and its quality are also important (what Verghese calls "soil for soil"). It was not possible to assess the quality of land but the quantity differed from 2 acres to 5 acres of irrigated land, free of cost. In the case of Pandoh and Pong, the project-affected persons were offered up to 15.625 acres of land per family on payment, albeit at a concessional rate. (See Annex 3.V for details.)

The fact that in many projects no land or very little land was given must have resulted in immense hardships for hundreds of thousands of poor people in various parts of the country. In many of the earlier projects, there was no real effort at rehabilitation and the project-affected persons have all scattered without there being any possibility of determining now what has happened to them.

Trauma, uncertainties and insecurities

The prospects of exchanging all that is familiar and known for the unfamiliar and unknown is always traumatic. It is especially so for rural communities that might not have had exposure to much more than their own and neighbouring villages. A new location often means new problems and conflicts, which the displaced persons are not always equipped to handle.

Though this is trauma an inevitable cost of relocation, it can be minimised by ensuring proper orientation for the project-affected persons, by effecting the shift in location gradually and by being sensitive to the suitability of the social environments within which they are being settled.

An interesting example is of the project-affected persons from Tehri. Many of them resettled in the plains of Uttar Pradesh and complained that while their families had lived in the hills of Gharwal, they were secure and the men could go and work in the cities, leaving the women and children behind. However, when they were shifted to the plains, the social conditions there made the families feel insecure and the men had to give up their jobs and incomesand come back to live with their families

Unfortunately, this trauma is another unacknowledged social cost of dams.

Adverse impacts on physical health

The change in climate, water, food, sanitary conditions and in the profile of pathogens and bacteria can seriously affect the health of the displaced persons. In addition, there is the adverse impact on physical health of the various psychological traumas listed earlier

Very often the relocation of project-affected persons is planned purely on an economic basis without any concern for their climatic preferences. Examples of this were recorded for the Pong, Bhakra and Pandoh dams where people living in the hills of Himachal Pradesh were to be relocated to the deserts of Rajasthan. Similarly, people being ousted from the existing Tehri town are being shifted to the new Tehri town, the location of which is much higher and colder. Others displaced by the Tehri Dam have been shifted from the hills of Garhwal to the hot plains of Uttar Pradesh.

Also, very often the project-affected persons, especially tribal peoples, find it difficult to obtain a nutritionally balanced and adequate diet in their culturally chosen foods. Traditional health practices are not always substituted by alternate, acceptable systems. Studies done on the Narmada Sagar and Sardar Sarovar dams indicate a higher rate of morbidity among project-affected persons than among control populations.

Unfortunately, more details of the impacts on physical health of such relocations were not available and these also remain as an unacknowledged cost

Adverse impacts on living standards

The economic and social factors listed above also adversely affect the living standards of displaced people and, consequently, their future prospects Though many of the recent rehabilitation packages take into consideration the direct and immediate economic impacts of relocation, the indirect impacts and the future prospects are never assessed.

No mention of these impacts was found in any of the documents studied and therefore these must also be classified as unacknowledged costs.

Social alienation from, and conflicts with, host communities

Given the density of human population in India, it is unlikely that displaced persons would be rehabilitated in areas that are unoccupied or unused. Mostly, rehabilitation sites come in existence near existing settlements and this can often result in tensions and conflicts between the host community and the displaced persons. These tensions are aggravated when land for resettlement is acquired, through a legal process, from host communities or their friends and relatives. Sometimes land for rehabilitation is made available by displacing those who do not have legal titles to the land they are occupying or cultivating. This, then, causes secondary displacement.None of the projects has schemes for rehabilitating those affected by secondary displacement. Interestingly, it was reported that the Government of Uttar Pradesh had passed an order specifying that all those affected by secondary displacement should also be rehabilitated at project cost and according to project norms.By all accounts, this order was never implemented.

There have been many instances of clashes between the host communities and the project-affected persons or the project authorities. One such clash was reported in August 1984 when five persons were killed by police fire in the Sabarkantha District in Gujarat. Villagers of neighbouring villages attacked the police party that had gone to Tarudi village to supervise the land allotment process to some displaced families (Verghese, 1990:204). Similar clashes have been reported from of Sardar Sarovar, Tehri, Bisalpur and many other dams (SM, 2000).

Tensions and conflicts can arise over the sharing of common resources, on social or religious grounds or, sometimes, just because the newcomers are treated as outsiders.

Sometimes the host communities resent the compensation package, whatever its value, being given to the displaced persons, for it might bring out more starkly the fact that the host communities are receiving nothing. This resentment is heightened when the host communities are themselves desperately poor

Loss of infrastructure and access

In those cases where rehabilitation sites are far away from other human settlements, there might not be problems with host communities but there is then significant isolation and loss of infrastructure. The access that the displaced persons had in their original homes to the facilities available in the region, like hospitals, educational institutions, places of leisure and entertainment, roads and transportation, might not be so easily available in the new sites. The access to such facilities is also often poor, especially during the rainy season.

In recent rehabilitation packages this loss has become an important consideration. Of the 47 projects studied, in 19 made provision for amenities like schools, dispensaries, roads, community centres and such like. (See Annex 3.V for details.)

The adequacy and appropriateness of these amenities could not be determined, for example, in the case of a recent project (Telugu Ganga, Andhra Pradesh), it was reported by the Central Water Commission itself that the provision of amenities left much to be desired (CWC, 1995).

ii. Estimates of Displacement

For the purpose of this case study it was possible to compile figures for human displacement for 83 dams. In compiling these figures the most conservative estimates available were chosen. Wherever official figures were available, they have been relied upon. Where such figures were not available, the most conservative of the figures available were taken, provided they did not seem obviously wrong. Dams, for which the displacement figures available seemed obviously wrong, have not been included in the list.

The debate on how many people have been or are being displaced by dams has raged for many years. Though no definitive figures exist, some of the estimates that have become public include those of Fernandes. Saxena and Roy. Himanshu Thakkar (2000), in his paper on displacement for the WCD. says:

> *"Displacement due to dams in India has been variously estimated. Fernandes. Das & Rao (1989) claimed a decade ago that Indians displaced by dam projects numbered 21 million. As the authors themselves pointed out, these were very conservative estimates. A recent statement by Shri N C. Saxena (the then Secretary. Ministry of Rural Development. Government of India) however put the total number of persons displaced due to large dams at 40 million. He said in an open meeting that most of them have not been resettled. Roy (1999), based on a survey of 54 projects, estimated the people displaced by large dams in last 50 years to be 33 million.*

The compilation of figures in the present study shows a total of 4 387 625 persons displaced across the 140 large and medium dams included in the survey. The average for these 140 dams thus comes to 31 340 persons per dam. It is apparent then that estimates of only 2 million people having been displaced by all dams in India till 1990 are vastly inaccurate (Gleick 1999). While the sample used here is not meant to be representative of all of the India's dam projects, it emerges that the order of magnitude in which displacement should be estimated is in the tens of millions

An estimate of the total area submerged has also been attempted, based on figures from the data at the authors' disposal, which is listed in the Annex. According to the author's calculation, in the 213 dams for which this information was available the average area submerged, per dam, was 8 748 ha Interestingly, a study of 11 dams between 1978 and 1988, conducted by the World Bank and quoted by the Central Water Commission (CWC, 1992:10), records 13 000 ha submergence per dam In addition. CWC study (CWC. 1992:10-11) of 54 projects shows a per dam submergence of 24 555 ha

Similarly, taking the average of the 83 dams for which there is both submergence data and the number of people displaced, the average submergence per dam comes to 16 604 ha. Compared to this figure, the author's estimate of 8 748 ha per dam is conservative.

According to the author's calculations, the average displacement of people per hectare is 1 51 The World Bank study of 11 dams, quoted above, records that human displacement was a little over 2 6 persons per hectare. The CWC study quoted above shows a per hectare displacement of 1 1 person. Therefore, the author's estimate, on the basis of 83 dams, seems plausible

The total number of large dams constructed or under construction, according to the CBIP (CBIP. n.d.(a):21) is 4 291. According to the author's calculations, the total area that can be expected to be submerged is 4 291x 8 748 ha, which amounts to the enormous figure of 37 537 668 ha. Based on this figure, the number of people displaced, using the average of 1.51 persons per hectare, would be an astounding 56 681 879. This is clearly an overestimation. However, given the hesitation of the government to make data available, this is the best estimate that can be made. In any case, what it does establish is that the displacement figures cannot be nearly as low as suggested by some official sources At best the variation would be of the order of 25%.

It must be noted here that, for the most part, these figures represent only those persons displaced by dams. Those displaced by the canals, or by the construction of colonies or other infrastructure, by transmission lines, and those displaced while acquiring land for the resettlement of project-affected persons, are not necessarily included in the author's estimates. Judging by some recent projects, the number of such displaced people would also be significant.

Added to these would be those who have been subjected to multiple displacement, as in Rihand, Koyna and Sardar Sarovar.

iii. Implementation of Relocation and Rehabilitation Programmes

Earlier, it was mentioned that the official compensation packages, as announced by the government and the project authorities, for various projects, were given. In reality, much of what is promised, however inadequate it might be, is also not delivered. Some of the major movements against dams, in India and worldwide, are fuelled as much by the inadequacy of the compensation package as by its poor implementation. In fact, it is mainly because of the abysmal records of governments to properly rehabilitate dam-affected people that an increasing number of people today refuse to accept that justice can or ever will be done for those who pay the major price for large dams.

Official data on what actually happened to the project-affected persons of various dams, are very scarce and not always reliable. For this section, a heavy reliance had to be put on information gleaned from people's movements and from independent institutions and sources.Wwherever credible government data have become available, they have also been included.

Given below are a few of the many problems and issues related to the implementation of the rehabilitation process. Though it has not been possible to verify each of the issues raised, the fact that there is widespread dissatisfaction with the rehabilitation efforts regarding many, if not most, dams, is well accepted.

- **Eligibility**: Apart from the problems of definition of eligible families or individuals, already described earlier, there are problems relating to the application of these criteria. The most common complaint relates to the inclusion of names among those considered eligible for rehabilitation. There have been complaints that the original lists of project-affected peoples do not include all those families and individuals who qualify to be as such. This not only results in a lot of effort and anguish on the part of those who are left out but also distorts the economic assessment of the project. In many cases, such an underestimation also results in a shortage of resources for proper rehabilitation, especially land. There are also complaints of corruption and arbitrariness in applying the criteria and sometimes an unwillingness to apply the criteria universally even when they have been officially accepted.

- **Process of displacement:** Many complaints have been made regarding the process of displacement: a lack of information, wrong and misleading information, not being given adequate warning and notice of impoundment, not being informed of the processes of relocation and rehabilitation, not being helped in the process of relocation and of secrecy, and corruption and incompetence

- **Quality and quantity of land**: Perhaps the largest number of complaints concern the quality of land given for rehabilitation, in those few dams where land is given. In many projects, the project-affected peoples have complained about their land being uncultivable. There are also complaints about the non-availability of irrigation and about poor soils and rocky land. In other cases there have been complaints that the quantity of land given is less than what was promised or is scattered rather than consolidated.

- **Availability and adequacy of other compensation:** Another common complaint is the non-availability or the inadequacy of the rehabilitation **compensation** to be given under the project. The major complaints focus on the cash compensation. There are many complaints that cash compensations are delayed, often not given till bribes are handed out, and are inadequate for the purpose, for example, for constructing a new house or buying adequate land. The provision of other facilities and common resources and infrastructure are also often reported to be unsatisfactory, either because the promised inputs are not given, delayed, or of inadequate or bad quality.

- **Availability and quality of services:** Many of the promised services, like transportation, education, health care, electricity, drinking water, roads and security are also found to be non-existent, delayed or inadequate.

- **Follow up and grievance redressal:** Another common complaint is that once the initial removal has taken place there is no system of monitoring and correcting problems or of redressing the grievances of the displaced populations.

5.3.2.2 Discussion

It isclear from the findings given above, that the rehabilitation experienced by people displaced by large dams is generally not a happy one. The basic reasons for this can be understood only if one examines the processes and institutions involved in rehabilitation.

Rehabilitation Institutions and Processes

i Laws and Policies

At present, only two national laws pertain to the regulation of displacement and rehabilitation of persons affected by dams. The basic law, which has guided the resettlement and rehabilitation of displaced people in India, has been the Land Acquisition Act of 1894. Under this Act, the government is empowered to acquire any land for "public purpose" and to pay cash compensation determined by it according to a prescribed procedure. Up to 1978, there was no assessment of the rehabilitation package of people being displaced by dams. In 1978, the MoEF initiated a process by which all major dams had to obtain environmental clearance prior to their construction, on the basis of an environmental impact assessment. As a part of the EIA, the rehabilitation packages of people being displaced by dams were also assessed. This process continued without any legal sanction till 1994. In 1994, the rules of the EPA were amended to make the seeking of environmental clearance legally binding for major dams. This clearance continues to include the rehabilitation package.

In the last few years there has developed a practice by which the resettlement and rehabilitation plans of proposed dam projects are also submitted to the Ministry of Social Justice and Empowerment (MoSJE), for its concurrence. However, this is not yet legally mandated.

However, all these legal and informal provisions do not seem to ensure that the basic rehabilitation packages are invariably offered and delivered.

The Land Acquisition Act specifies cash compensation, but little else. The EPA does not specify any content of the rehabilitation package but just insists on the assessment of rehabilitation. The MoSJE also does not seem to prescribe any basic package, though the process of formulating a policy is reportedly underway.

There is also no national policy on resettlement and rehabilitation for people displaced by dams. Though the Planning Commission and the Ministries of Rural Development, and Social Welfare have made efforts in the past to formulate such a policy, and many drafts exist, they have been unsuccessful. Therefore, the assessments and prescriptions of the MoEF and the MoSJE remain arbitrary and legally non-enforceable.

Some States, like Maharashtra and Madhya Pradesh, have State acts for rehabilitation and resettlement (R&R) and other States, like Gujarat, Orissa and Karnataka, are in the process of developing R&R policies. In some cases (like Sardar Sarovar), in the same inter-state project, people from different States are subject to different R&R policies.

Consequently, as matters stand, the legal framework in India does not require that:

- before a project is sanctioned or undertaken, the social impacts of the project have been comprehensively and adequately assessed and the project has been found to be socially viable;
- the social costs of the project have been adequately computed and included in the cost calculations of the project before its economic viability is assessed;
- the various possible measures for preventing social costs have been planned for and implemented (such as shifting the site of the project or lowering its height, etc.);
- the compensatory package offered ensures that basic principles of rehabilitation are respected, including adequate provisions to ensure that people are not worse off after relocation;
- the package also ensures that people are not forced to change their way of life or profession, that adequate measures are provided to safeguard their physical, emotional and psychological well-being, that their traditions and culture are respected;
- the package includes compensation for all the losses, not just in cash but also in kind, and provides agricultural and homestead land to all those who want it.

As there is no comprehensive policy, these matters are also not covered under any policy directives However, various internal departmental guidelines and memos exist and there are court orders pertaining to the R&R package and processes for some of the past and ongoing projects

This absence of legal and policy directives make it difficult for the affected people to fight for their rights. It also makes it difficult to ensure that compensation packages are uniform across dams and regions and that they all provide at least the basic minimum.

ii Processes and Institutions

In almost all cases, right from the start, the planning and implementation of resettlement and rehabilitation was, till recently, carried out by the government through its own agencies with no participation by the people, especially the affected people. These agencies were also not multi-disciplinary but manned mostly by engineers. The identification of areas to be submerged or otherwise affected, the determination of who would qualifyfor compensation, of the nature and quantum of compensation, and of the time frame and process by which relocation, resettlement and rehabilitation would take place, were all done by the project authorities along with other government agencies. In some cases, the district authority or the State government was made responsible for carrying out relocation, resettlement and rehabilitation (as in the Tehri Project), and in others (as in Sardar Sarovar and Indira (Narmada) Sagar), it was done by the project authorities themselves

The departments or agencies concerned of the State or Central Government propose projects. The Central Water Commission and the Central Electricity Authority (CEA) of the Government of India then evaluate these projects, from the techno-economic angle. At this stage, the proposed financial costs of rehabilitation are included as part of the project costs.

Once the project receives techno-economic clearance form the CWC or the CEA, it is then sent to the Planning Commission and the MoEF. The MoEF, as a part of the EIA process, assesses the rehabilitation package and either approves it as it is, or prescribes improvements

Till 1998, the MoEF clearances were again an internal matter, though they were based on recommendations made by the EAC, which has non-official members. Since 1998, it has become necessary to hold public hearings regarding a project, at or near the project site. This provision is aimed at ensuring that people are at least informed about the project and have an opportunity to express their views, though there is no guarantee that their views will influence the final outcome.

Finally, after MoEF approvals, the project receives investment approval from the Planning Commission. Based on this approval, allocations are made in the annual plans of the ministry or state departments concerned. Past experience reveals that a large number of projects were begun long before any of the clearances were received. In such cases, by the time the project comes up for final assessment, a lot of money has already been spent and the project is presented as a *fait accompli*.

Although in recent years, rehabilitation committees – and often with non-government members - have been set up for some of the projects they never have any decision-making powers and usually function either as advisory committees or as grievance redressal committees. Rarely are the affected people associated with such committees.

This lack of participation and decentralisation leads to many problems, some of which are described below.

- Lack of information about the project

The affected people often do not know till very late that they are going to be affected by a project or, indeed, very often that a project is going to come up in their area. This lack of information leads to a lot of insecurity, rumourmongering and misinformation. It can also lead to significant economic losses as people might make investments in areas that will be submerged. It also gives an unfair advantage to those few well-connected people who obtain advance information about the project. The time available to the local people to prepare for displacement is also drastically reduced. The lack of advance information also deprives the people of any opportunity to influence the design and planning process of the dam or to even to protest about the proposed dam.

- Insensitive planning

Because the affected people are not usually involved in the planning of the project, except sometimes through the recently established public hearings, their preferences and sensitivities are usually not taken into consideration. This lack of involvement results in a project design that is devoid of local realities. This also results in a situation where the affected people feel alienated from the process and are, therefore, not willing to cooperate.

- Inappropriate planning

The knowledge and wisdom that the local people have about the people, the land, the water and the ecosystem are not taken into consideration while planning the rehabilitation process. This constitutes a serious lacuna as the local people can very often guide the planners and point them in the right direction. Though public hearings have now become mandatory, their mechanism precludes, even with the best of intentions, any detailed assessment of the project design and options by the local people. Besides, the hearings are usually conducted at a point when much of the planning process is already over and only the environmental clearances are awaited.

- Inadequate costing

Developing rehabilitation packages and resettlement schedules without consulting the affected people invariably results in these being inappropriate and having to be changed when the actual implementation starts. in the result is no only additional costs but also delays, which adversely affect both the economics of the dam and the welfare of the affected people.

- Lack of transparency

Even during the implementation of the resettlement process, a lack of transparency affects the process. The manner in which resettlement and rehabilitation is handled becomes susceptible to patronage and corruption and it becomes difficult to ensure that every affected person is treated fairly and receives his or her due.

- Poor implementation

Because of the non-involvement of the affected people. the implementation of most of the rehabilitation schemes leaves much to be desired. In some cases, NGOs and people's movements have successfully fought to better the plight of the project-affected peoples. However, such successes are few and far between and they mostly result in a betterment of the conditions and not necessarily in the removal of all the problems and lacunae.

5.3.3 Other Social Impacts

5.3.3.1 Findings

Impacts upstream

1. Reduced water availability for the people upstream

When dams are planned, a certain quantity of water is anticipated in the river upstream of the dam. An assessment of the amount of water available is critical for establishing the dam's economic viability. In order to ensure that the flow does not fall significantly below what has been anticipated and planned for, there is sometimes a ban on any scheme that diverts water upstream of the dam. This ban can cause significant hardships to communities living upstream of the dam, even before construction on the dam starts.

Mention of this aspect was found in two projects, Chandil and Tehri: in the first it was predicted that there would be no adverse impacts (ORSAC & WAPCOS, n.d.); for the Tehri project, there was no assessment of this impact prior to clearance for the dam. The villagers of the Bhagirathi Valley complained that village water schemes were not being sanctioned because it was stated that all the water upstream would be required for the dam (Tehri, 1999).

Given the tendency to overestimate water availability and the disruption of water flows owing to the degradation of the catchments, this is an aspect that needs to be studied. Unfortunately, no information exists about what deprivations that were faced and continue to be faced by the people living upstream of dams.

Clearly, as the economic and technological viability of a dam is based on the amount of water that reaches the reservoir, some restrictions on upstream diversion have to be imposed. In fact, battles over the diversion of water are now becoming a common feature among States within India, and within countries across the world. However, the intensity of the adverse impacts that such restrictions would cause are reducible if the water rights of the people living upstream are statutorily recognised and the estimates for water availability at the dam are made keeping these rights in mind. This does not appear to have happened in any of the dams studied, except where there were issues regarding the interstate sharing of waters. Here, the shares of the various states were demarcated (eg The Narmada Tribunal).

ii. Impacts on forest-based resources

As the forests and other vegetation in the catchment of the dam are degraded owing to additional pressures caused by the dam (see section on the environment for details), it becomes harder for the people dependent on these forests to gather firewood, fodder and other basic necessities (Dharmadikari & Agarwal, 1991). Conflicts also grow with members of the labour force building the dam, as they also have to use the same catchments.

Though there is a lot of information about the adverse impacts of dams on catchments (see Section 5.2 on environmental impacts), there appears to have been no cognisance of the inevitable impact on the people living in and around the catchments.

This impact can also be reduced by the proper protection and regeneration of the catchments and by the project authorities ensuring that alternate supplies of biomass are made available to the affected populations. In recent projects, the requirement to carry out catchment area treatment and to provide alternate sources of fuelwood has been stipulated.

iii. Impacts of backwater build-up on property and agricultural fields

The build-up of backwater, especially during the rainy season, poses a threat to property and agricultural land (for details of backwater build-up, see Section 5.2 on environmental impacts). However, no assessment of the social and economic impacts that such a build-up might have were found in any of the projects studied.

The damage can be minimised if the extent and severity of possible backwaters are anticipated, and populations, property and agricultural lands likely to be affected are either relocated or other protective or ameliorative methods used. Where backwater damage is anticipated, there should be a policy to acquire the land that will possibly be affected and the cost of this should be built into the project. In none of the projects studied was this aspect assessed.

iv Social and economic impacts caused by disruption of access to the opposite bank.

The filling up of the reservoir disrupts access by local communities to the opposite banks Prior to the reservoir being built, people could cross the river over bridges, by boat or by other means including on foot, especially during the dry season. However, the reservoir submerges the bridges and makes it difficult to get to the other side without going all the way round the reservoir, which might entail many kilometres of travel.

Access is also disrupted by the filling up of tributaries by the backwater affect, and also by the accumulation of silt that sometimes becomes a physical barrier between the people and their water sources.

This disruption of access can have serious economic implications, as people are cut off from their market or their places of work. It can also have serious social impacts, as neighbouring communities become separated and distanced.

Though this is a phenomenon that must be accompanying most large dams, it was not mentioned in any of the documents studied. The adverse impact can be reduced by the creation of alternate, convenient routes, regular transportation and, where necessary, a ferry across the reservoir

Impacts common to the sites of the dam/reservoir/canals/transmission lines

i Suspension of development/maintenance activities

As soon as a dam is planned, many development activities that were intended for the area that is to submerged are suspended. The creation of new assets, building of roads, construction work and other investments are frozen as the area is to besubmerged. Even maintenance work is sometimes suspended. This causes immeasurable hardships to the people living in the submergence zones.

The same problem occurs with canals and transmission lines. Even before a canal or transmission line is constructed, development and maintenance activities are curtailed in the area concerned. Though this impact is not as severe as in the case of a dam, it is similar in nature.

The adverse impacts of this are exacerbated because of huge delays in the completion of the dams From the date when a dam is first planned, it might take twenty or more years for its completion.

According to the Government of India (GOI, 1989), the major schemes still under construction during the Seventh Plan (1985-90) were:

Schemes continuing from:

I	Plan	(1951-56)	4
II	Plan	(1956-61)	5
III	Plan	(1961-66)	16
Annual	Plans	(1966-69)	6
IV	Plan	(1969-74)	26
V	Plan	(1974-78)	68
Annual	Plans	(1978-80)	15
VI	Plan	(1980-85)	41

If the starting date is taken as the mean of the plan period, this would imply that projects had not been completed even after:

33 years for 4 projects
30 years for 5 projects
26 years for 16 projects
22 years for 6 projects
17 years for 26 projects
10 years for 15 projects.

These figures give the time taken after the start of the project, whereas development activities are suspended as soon as a project is planned, which may be long before its start It must, however, be kept in mind that these are the time-frames of projects and not necessarily of dams. Therefore, in at least some cases, it is possible that the dam was completed much earlier but the canals or other aspects of the project continued for some time afterwards.

This, then, is a major social cost of dams that has been mostly ignored In only one of the dams studied (Almatti) was this impact acknowledged (GOK, 1998). In the case of Almatti the project document stated that efforts were being made not to suspend development activities It is not known whether these efforts were successful

In the case of Narmada Sagar, Sardar Sarovar (NCAenv, n.d.) and Tehri (Tehri, 1997), the people in the submergence zone have protested bitterly against the suspension of development and maintenance activities. In the case of Tehri, some of the citizens have even approached the Supreme Court because the schools and hospitals that were used by the people of Tehri town and the neighbouring rural areas have been closed and shifted to the New Tehri town far in advance of relocation and submergence (GOI, Supreme Court, 1999).

These are also preventable impacts for which the government has to make a policy decision regarding the continuation of at least maintenance activities while the project is pending. In cases in which the construction of the project drags on beyond a reasonable period, then the affected people must all be paid compensation for lost development opportunities.

ii. Impacts on property prices and transfer of immovable property

The value of immovable property and land in the submergence zone plummets as soon as the dam is planned. No one wants to buy property or land that is ultimately to be submerged, especially when compensation is either payable only to the original owner or is not commensurate with the real value.

This drop in value results in much hardship, especially when the construction of the dam is slow. as is usually the case in India, and compensation is paid after many years. People wanting cash for emergencies. or for marriages and other social obligations, are unable to liquidate their holdings or even borrow against them.

There are cases where the delay in implementation and compensation has made it difficult for the women in the area to obtain suitable grooms. Such cases have been reported from the Bargi and Subarnarekha projects, among others (Patkar, pers. comm., 2000).

These are again unacknowledged social impacts of dams. They can perhaps be minimised by having a policy that allows borrowings from anticipated compensation against land and property Project authorities or the government can set up a special fund for this.

Again, like for dams, this is an impact, though to a lesser extent, for canals and transmission lines also Again, it remains an unacknowledged impact

iii. Health impacts

The dust that is raised by various dam-related activities, including the movement of heavy vehicles and machinery, mining and quarrying and construction work, seriously affects the health and well-being of the people living in the vicinity.

The manner in which dams are constructed and related earthworks and excavations are carried out in India, results in a lot of dust pollution. Though this is a widespread phenomenon, it has almost never been acknowledged in project documents. For one project, Ramganga (CBIP, 1995), it has been stated that the incidence of tuberculosis increased because of dust pollution from the dam construction In the case of Tehri (Tehri, 1997), the people living around the dam site have protested about the high levels of dust pollution but there seems to be no study on the consequent health impacts

The levels of dust pollution can be controlled if water is sprinkled at the construction and excavation sites and the trucks and dumpers used are covered. The proper paving of roads also brings down the levels of dust

Unfortunately, excessive dust remains one of the unacknowledged social impacts of dams

The water quality of the reservoir/river deteriorates because of the dam (for details see section on environment). This deterioration affects the health of the people and of the livestock depending on these water supplies. This impact has also not been acknowledged in any of the projects studied and remains a hidden cost.

The reservoir is often a fertile breeding grounds for disease vectors, like mosquitoes An increase in the incidence of hepatitis has also been reported. This aspect is discussed in detail in the section on environmental impacts.

Most of the health impacts experienced at the site of the dam, during construction and subsequently, are also caused by canals: dust pollution during construction, changes in microclimate and the breeding of vectors. In addition, the extensive waterlogging that occurs because of seepage from canals and interference with natural drainage aggravates many adverse health impacts.

There are many reports of such impacts: for example, for the Sirhind feeder canal in Punjab that the incidence of malaria has reportedly increased (Dhesi, 1996). It is also mentioned that health hazards owing to the careless use of pesticides may also increase. In fact, canal irrigation and the cropping patterns that result from it have significantly increased the use of pesticides and their consequent health hazards. Whereas the benefits of the increase in productivity are taken into consideration when the costing of a project is done, the social and environmental costs of pesticide use are never calculated.

No evidence was found that, in any of the dams studied, the adverse impacts of canals on human health were taken into consideration while assessing the project.

iv. Impacts on fish catch

The construction of the dam and other related factors, especially pollution and the diversion of water, seriously disturb the aquatic ecosystem and impact adversely on the fisheries in the area. This can have serious implications on the livelihoods of the local fisherfolk and on the diet of the local people. Consequent to this, the price of fish can also go up. This impact has also not been acknowledged in most of the project reports.

The earlier mentioned disturbances also impacts on the fish species and, consequently, local fishing, even while the dam is being constructed. However, such impacts during the construction of the dam have not been assessed in any of the dams studied.

Subsequent to the reservoir being formed, the formation of a lake and the consequent changes in the water profile also affect the fisheries profile. In some cases, through the introduction of adaptable species, the economic value of the overall catch can be maintained or even improved, in other cases, this does not work. In both cases, the species mix of fish and their natural diversity are adversely affected

After the reservoir is filled, there is a mixed impact on fisheries. In some cases the availability of commercially valuable fish goes down; in other cases, especially because of artificial stocking, the availability goes up Even where it goes up, the control of fisheries is very often taken over by the government or the project authorities. The fishing rights are then either auctioned or given to a few people or institutions, on the basis of a licence. This has adverse impacts on the livelihood of the local fisherfolk. Instances from Pench (IIPA, 1994) in Maharashtra and Madhya Pradesh, from Polavaram and from Gobind Sagar (IIPA, 1990) have been recorded. This is another aspect that has not been widely acknowledged and remains a hidden cost.

The post-construction impact on fishery and aquatic ecosystems has been studied in only 7 of the 67 projects surveyed. Of these, three projects list an increase in fishery in the reservoir. These projects are: (i) Chandil (ORSAC & WACOS, n.d.], (ii) Mahi Kadana (Purohit, n.d.), (iii) Tawa (Dharmadikari & Agarwal, 1991). A decline in diversity of fish species has been witnessed in one case (Teesta Stage V), and no change in two other cases (Isapur, Sriram Sagar & Lower Manair) (See Annex 2.IV and 3.1 for sources).

Impacts on fisheries in the reservoir cannot be prevented, but through proper management, the availability of commercially valuable fish can be enhanced in many cases The costs of loss in fish biodiversity and of enhancing commercial fisheries must be taken into consideration while assessing the project.

v. Impacts on land productivity

Often lands lying near the reservoir are affected by waterlogging. This can affect the productivity of the land and lead to various other social problems relating to health, the safety of houses and other structures and to the deterioration of roads. Waterlogging is an aspect that has been often studied though its occurrence has also often exceeded anticipated levels.

vi. Impacts on grazing land, sources of timber, fuel wood and other non-timber forest produce

The people living around the reservoir lose access to the resources that become submerged by the reservoir: grazing land, sources of timber, fuel wood, fodder and other non-timber forest resources. This loss can result in significant social and economic costs, with people, especially women, having to travel longer distances in order to meet these requirements and having to pay higher rates for these necessities. This impact was not acknowledged in any of the projects studied.

The imperatives of catchment area treatment and compensatory afforestation, as well as the need to compensate through national parks and sanctuaries for the loss of biodiversity because of the dam, lead to the closing of areas. This has an adverse impact on the access of the local people to natural resources.

vii. Impacts on life and property resulting from reservoir-induced seismicity

As reservoirs sometimes catalyse earthquakes (see section on environment for details), the result is a heavy toll on life, property and the well-being of the people in the region. This is again an impact which is rarely computed.

viii. Impacts on health and agriculture resulting from to microclimatic changes

The reservoir can raise humidity in the region and affect temperature, which can affect the health of local inhabitants. These changes can also affect agricultural productivity. Depending on the region, these impacts can be negative or positive

Impacts specific to the canal

i Impacts on natural drainage

Canals, both during construction and after they become operational, can interfere with natural drainage. This can result in the higher (up slope) reaches becoming waterlogged and the lower (down slope) portions becoming arid. In both cases, there can be a significant loss of productivity and even adverse health impacts, apart from other attendant hardships.

ii. Impacts of waterlogging and salinity

Seepage from canals has been a major source of waterlogging and can result in loss of land and productivity, soil erosion, loss of property, destruction of roads and even negative impacts on human health. The extent of waterlogging that results has been described in the section on environmental impacts. Unfortunately, in none of the dams studied were the social costs of waterlogging taken into consideration while appraising the dam.

Where project-affected persons are allotted land in a command area, which subsequently becomes waterlogged or saline, their plight is really pitiable. Along with all the other problems of forced displacement, they also have to confront the degradation of their lands and their subsequent impoverishment.

In many of the commands, much of the waterlogging is preventable by better managing the water, lining the canals and by other measures, but there are some commands where any canal irrigation will inevitably result in waterlogging. It is unfortunate that this factor is not adequately considered while designing and constructing dams and canals.

Impacts specific to transmission lines

i. Health impacts

The major health impacts of transmission lines relate to radiation and accident hazards. High voltage transmission lines can pose a hazard to people living in the vicinity, especially in the case of accidents. High voltage transmission lines are known to emit radiation and thereby adversely affect the health of people.

These impacts, however, remain unacknowledged.

Impacts downstream of the dam

i Impacts on fisheries

A dam has many adverse impacts on downstream river ecology (see section on environment for details). One major impact is the disruption of fisheries downstream, both during construction and subsequently. Often the availability of fish declines and some fish of high commercial value are lost altogether (for details see the section on environmental impacts).

The data available from the dams surveyed are mixed, with some dams reporting an increase in downstream fisheries and others either no perceptible change or a decrease. However, the number of projects in which availability of fish downstream has actually been studied during or after construction is very small (only three) Bisalpur (GOR, 1995d), Ukai (Purohit, n.d.(b): vol IV, 26.2); Hasdeo Bango (CWC, 1991).

The disruption of fisheries downstream affects the livelihoods of thousands of people. For example, for the Sardar Sarovar Project it is estimated that nearly 10 000 workers downstream could be affected. Yet, these people are never included in the category of project-affected people (Patkar, pers comm 2000)

Though some attention is now paid to fisheries in the reservoir, very little is paid to fisheries downstream. This is partly because of the mistaken assumption in most projects that the water flows downstream will improve after completion of the dam, at least in the dry season when it really matters. However, as mentioned earlier, it is the reduction of the peak flows, when many fish breed, and of the nutrients that become trapped at the dam, which have major impacts on fisheries. The debris and pollution that come down the river during construction also adversely affect fisheries

The disruption of the upstream migration of certain species of fish also affects their populations downstream, though this can be partly averted by providing fish ladders or fish lifts. Though many projects in India have fish ladders, none of them have fish lifts.

Also, many projects, especially the earlier ones, limited their attention to the dam, reservoir and catchments and did not bother to assess impacts above or below these. In many cases, the impacts become evident only gradually over time and only an in-depth study can establish how many of these are are a result of the dam.

Impacts downstream constitute some of the undetermined costs of dams.

ii. Impacts due to changes in water availability downstream

A dam reduces the river flow downstream, often adversely affecting the availability of both surface and groundwater. This reduction is most marked during the rainy season but can also occur during other seasons owing to inadequate storage or the requirements of irrigation; the voluem of water diverted to irrigation canals can be as much as 60% of the river flow. An increased proportion of the water is lost owing to evaporation from the reservoir and from canals.

All these factors, which can adversely affect the availability of surface water and the recharging of groundwater sources downstream, are rarely acknowledged.

iii. Health impacts downstream

Because of reduced water flows and for other reasons, pollution levels in the river downstream can rise, thereby affecting the health of people and livestock. Irrigated agriculture usually leads to the increased use of chemical fertilizers and pesticides, which have adverse effects on the health of the farmworkers who use them and those who consume the resulting food. The residues from the fields flow straight into the river, which means that the pollution load of the river increases while the quantity of water available for diluting the pollutants decreases.

Considering that the increase in agricultural yields in the command of a dam is at least partly the result of the application of pesticides and fertilizers, and that such increases form a part of the benefits ascribed to the dam, then it is correct to also ascribe the adverse health impacts of the fertilizers and pesticides to the dam.

In addition, reduced water availability can aggravate poor health conditions related to sanitation and environmental health

No data were available on this aspect, indicating thatthis is again an unacknowledged impact.

iv Impacts on agriculture and water availability from possible salt-water ingress

In coastal areas, reduced downstream flows can often mean that sea water encroaches upstream and contaminates both river water and groundwater (Jain, 1990). This salt-water ingress can have serious health implications and adversely affect agricultural productivity thereby causing untold hardships

In coastal areas, where the flow of rivers is disrupted by to dams upstream, many of the traditional wells and underground aquifers have become brackish, resulting in serious shortages of potable water. For further details see the environment section.

This impact is not assessed in any of the projects surveyed.

v Impacts on life and property from sudden releases of water

There are sometimes sudden releases of water from dams (either operational or under construction) in order to safeguard the dam structure. Such sudden releases flood downstream areas, causing loss of life and property and destroying agricultural fields and riverbed crops (see section on environment for details)

vi Impacts on life and property from dam failure

Dams the world over have been known to fail, with catastrophic results. Apart from the cost in terms of life and property when a dam actually fails, there is the additional trauma for people living downstream that they have the threat of dam failure constantly hanging over their heads (see section on environment for details).

5.3.3.2 Discussion

The factors responsible for this poor state of anticipation and management of the various social impacts are similar to those responsible for poor rehabilitation.

5.3.4 Impacts on Equity

Equity (or inequity) is always measured between two individuals or groups of people in terms of the differences between them or the gaps in their incomes, resource levels and quality of life. In the context of dams, what needs to be determined is whether the construction of the dam has changed the equity ratio between the categories listed below and was this change positive (promoting equity) or negative (promoting inequity). Changes in the equity status can be measured:

- between the beneficiary generation and future generations;
- between human beings and other species;
- between those who lose (mainly the upstream populations) and those who gain (mainly the populations in the command and the recipients of electricity);
- among those who lose (project-affected persons), especially between different castes, classes, gender, and age groups;
- among those who gain (project beneficiaries), especially between different castes, classes, gender, and age groups, and between those living at different locations in the command.

5.3.4.1 Findings

Equity between those who gain and those who lose

Many social and environmental impacts that affect people upstream, in the command and downstream of dams have been identified in the sections on environmental and social impacts. The section on economics describes the various economic costs and benefits of dams. In order to determine the impact on equity of all these costs and benefits, it has also to be determined whether those who pay the costs are better off or worse off than those who reap the benefits.

In other words, a class-benefit analysis, or an equity impact assessment (EqIA) as A. K.N Reddy calls it, determines not just whether some pay costs and others receive the benefits but whether the gap between these two is, as a result, made smaller or widened.

In order to assess the equity impact of a dam between two groups, it is essential to.

- determine their relative economic and social status prior to the dam;
- determine the net impact (beneficial or adverse) of the dam on each group;and from there
- deduce the impact of the dam on equity.

i Impact on equity between populations upstream (project-affected persons) and those downstream (irrigation beneficiaries)

Relative socio-economic status: Though data on the social profile of displaced persons, in terms of their being members of the scheduled tribes or scheduled castes, are available for some of the dams, data on their economic status prior to the dam were not collected for any of the projects studied No data on either the social or economic status of beneficiaries of irrigation are available.

Data regarding the number and proportion of members of the scheduled castes and scheduled tribes displaced by dams were compiled for the dams for which such data were available and are given in the table below.

Table 5.8 Scheduled Caste Persons Displaced/to be Displaced

Name of Dam	Total of People Displaced	Scheduled Caste Persons Displaced	Percentage of Scheduled Caste Persons Displaced
Bargi	37 725	3 840	10.2%
Bisalpur	57 138	5 900	10.3%
Hasdeo Bango	13 585	680	5.0%
Hirakud	75 000	10 125	13.5%
Isapur	16 940	14 399	85%
Polavaram	154 484	15 757	10.2%
Rengali	4 015	233	5.8%
Nagarjunasagar	24 400	1 708	7.0%
Narmada Sagar (Indira Sagar)	82 120	10 090	12.3%
Sipu	5 494	495	9.0%
Sondur Dam	1 510	55	3 6%
Teesta (Stage V)	1 020	25	2.5%
Tillari	4 274	183	4.3%
Upper Indravati	26 630	10 985	41.3%
Upper Wain Ganga	6 435	860	13.4%
Upper Wardha	11 817	1 195	10.1%
Warna	7 906	132	1.7%
TOTAL	**530 493**	**76 662**	**14.5%**

(SOURCE : Annex 3.VI; IIPA n.d.(a))

Table 5.9 Scheduled Tribe Persons Displaced/to be Displaced

Dam Name	Total People Displaced (Official)	Tribals Displaced	Percentage of Tribals Displaced
Balimela	60 000	5 880	9 8%
Bargi	37 725	11 430	30.3%
Bhakra	36 000	12 514	34.8%
Bisalpur	57 138	5 700	10 0%
Bodhghat	12 700	9 520	75 0%
Chandil	48 500	46 075	95.0%
Daman Ganga	11 805	7 770	65.8%
Hasdeo Bango	13 585	10 910	80.3%
Hirakud	75 000	24 975	33.3%
Icha	30 800	24 640	80 0%
Inchampalli	38 100	29 063	76.3%
Jakham	335	320	95.5%
Karjan	8 025	7 970	99 3%
Koel Karo	66 000	58 080	88 0%
Konar	5 747	1 224	21.3%
Maheshwar	20 000	12 000	60.0%
Mahibajajsagar	34 875	26 017	74.6%
Maithon	28 030	15 837	56 5%
Masan	29 975	9 292	31 0%
Nagarjunasagar	24 400	8 784	36 0%

Dam Name	Total People Displaced (Official)	Tribals Displaced	Percentage of Tribals Displaced
Narmada Sagar (Indira Sagar)	82 120	15 870	19.3%
Polavaram	154 484	81 722	52.9%
Pong	20 722	11 656	56.3%
Rengali	4 015	23	0.6%
Sardar Sarovar	150720	92770	61.6%
Sondur Dam	1 510	1 250	82.8%
Tawa	3 070	3 070	100.0%
Teesta (Stage V)	1 020	255	25 0%
Tultuli	13 600	7 019	51.6%
Ukai	80 000	15 120	18.9%
Upper Indravati	26 630	4 285	16.1%
Upper Wain Ganga	6 435	1 835	28.5%
Upper Wardha	11 817	3 466	29 3%
Warna	7 906	93	1.2%
TOTAL	**1 202 789**	**566 434**	**47.1%**

(SOURCE : Annex 3.VI; IIPA n.d.(a))

Altogether, nearly 62% of the population displaced were tribals and members of the scheduled castes. Considering nationally they make up only a little over 24.5%. of the population then clearly their representation among those displaced is disproportionately high.

For tribals, this is particularly significant as their proportion in the national population is only a little over 8%, while their proportion among the displaced was over 47%.

Though no data were available regarding the socio-economic status of the downstream populations, it would not be unfair to assume that the proportion of tribals among them would be very small. If the assessment is further restricted to those who benefited directly from irrigation, then this would include mainly the landed classes and would, therefore, effectively exclude most tribals and scheduled castes, even if they were physically located in the command area.

Consequently, it could be safely concluded that, prior to the dam, the project-affected persons upstream, as a whole, were economically (in terms of monetary incomes) far less privileged than the downstream beneficiaries of irrigation

Very often the upstream populations, mainly tribals or other forest communities, are rich in resources but without high monetary incomes. The downstream populations are relatively poor in resources but have higher monetary incomes. The construction of a dam takes away the resources of the resource-rich community and impoverishes them, not even giving them high monetary incomes. In contrast, the dam enhances the incomes of the downstream landed class, which is already in a higher income bracket.

Net impacts

It is an accepted fact that the irrigation benefits of dams accrue to the downstream populations and that none of these are ordinarily shared with the upstream project-affected peoples. In none of the dams studied were any irrigation benefits claimed for the upstream regions

There could be a sharing of benefits if the displaced upstream populations were given a part of the irrigated lands belonging to the downstream beneficiaries, once the dam was constructed but this has been attempted in very few of the projects surveyed. Moreover, where the social, climatic and geographical profiles of the command are significantly different to those of the submergence area, such an arrangement might not be without its problems. One other solution is to get the downstream beneficiaries to contribute to the better rehabilitation of the upstream project-affected peoples. However, there was also no evidence that betterment levies were being collected from downstream beneficiaries and were being transferred to the affected people upstream.

Laxity in collecting water rates from downstream beneficiaries, which is common in India, also adds to their benefits. A revealing example is the Ukai-Kakrapar Dam in Gujarat, where the arrears in water-cess collection increased from Rs529 lakhs to Rs677 lakhs between 1979/80 and 1982 (Jain, 1990) and cases of unauthorised irrigation have rose from 1 781 to 6 525. Similar results have been obtained for the Mahi-Kadana project. It is clear that these projects further subsidise the already benefited farmer in the command.

In contrast, the adverse impacts of displacement that affect the upstream project-affected peoplesare further aggravated by tardy implementation of the rehabilitation programmes and poor efforts at preventing and mitigating environmental damage.

Environmental impacts, especially the submergence of forests and the destruction of terrestrial and aquatic biodiversity, also affect the upstream populations, especially the tribals and the rural poor. Loss of access to common property resources (CPRs), including the loss of access to forests and pasture lands, if not compensated for adequately, tends to have a higher differential impact on the poor and the landless than on the rich landed farmers because the dependence of the former on these resources for meeting subsistence needs is much greater than that of the latter

Though direct data are not available on the loss of various other types of habitat, in the 43 dams assessed for their submergence (see section on environment), the forest area submerged was over 25% of the total area submerged. Estimates made on the basis of these and other data suggest that the total amount of forests that have been or will become submerged under the completed or ongoing dams between 1980 to 2000 will be about 1.3 million ha. Such a large submergence of forests will have a very devastating impact on the poorest segments of society, especially the tribals, who heavily depend on these forests for their subsistence needs.

In general, once irrigation becomes available, a host of other developmental activities is also initiated in the command (for instance, Command Area Development or CAD schemes, On Farm Development or OFD schemes, Agricultural Research and Extension activities, and so on), bringing in an even greater inflow of resources. At the same time, in the upstream area, there is a tendency to cut expenditure on development and maintenance activities of different types (welfare schemes of the government, water use schemes for upstream areas, and so on), owing to the fact that the area is to become submerged There is a general rise in the resource flow to the command area, and a fall in resource flow to the upstream areas during the period of, and in the wake of, dam construction. This imbalance can have a further deleterious impact on equity between those who gain and those who lose.

Impact on equity

Given the data available, it seems clear that the net benefits accrued to the beneficiaries of irrigation downstream and that the project-affected peoplesupstream were net losers It also seems clear that the losses were significant, as were the benefits. Though complete data on the relative socio-economic status of project-affected peoplesand irrigation beneficiaries were not available, it also seems certain that the former as a group, were, relatively disadvantaged compared to the latter, as a group right from the start

Based on this, it cannot but be concluded that the impact of the dam on equity between the project-affected peoplesand the irrigation beneficiaries was adverse.

ii. Impact on equity between populations upstream (PAPs) and those who receive the power benefits

The distribution of power from dams is more difficult to track as the power from a particular dam is not supplied to an identifiable area or group. The power produced is fed into the national grid and therefore it is impossible to determine who uses the power produced by any particular dam.

In addition, most of the contribution by dams to the energy sector is in terms of peaking power.

Given these constraints, the only alternative was to look at the overall use and distribution of power and to assess which class of people benefits from it.

Relative socio-economic status

The costs of the dam, as described earlier, are mostly borne by those who are relatively disadvantaged in socio-economic terms., In the case of power, some of the project-affected peoplescould also be beneficiaries, so the divide between the those affected and the power beneficiaries is not as clear as it is between the project-affected peoplesand the irrigation beneficiaries.

The statistics on power consumption in the country distinguish different categories of users:

Urban
Rural
Industrial
Domestic
Agricultural
Transport
Others

Considering that very large proportions of the project-affected peoplesare from the rural areas, the first distinction that could be made for the purpose of a class-benefit analysis is that of urban versus rural, including the industrial in the urban, as industry only marginally benefits the very poor. Among the rural, a further distinction can be made between agricultural and domestic uses, and within domestic uses, the class that uses it in the rural areas.

Various estimates of the electricity used by each of these categories exist. The latest statistics of the Planning Commission (1999) indicate the following patterns of use as expressed in Figure 5.1

Figure 5.1 Estimates of Consumption Used

Category	Consumption (MkWh)	% of total consumption
Domestic	57 553	18 4
Commercial	15 182	5.0
Agriculture/Irrigation	93 687	30 0
Industry	105 207	33.6
Railways	6 660	2 1
Outside the Respective States	3 642	1 2
Others	30 754	9.2
Total	3994	99.50

(SOURCE. Planning Commission of India, 1999).

The categories of domestic, agriculture/irrigation, and industry,. together account for 82% of the power consumed; the other categories can be disregarded as being irrelevant or insignificant

In assessing the profiles of the consumers, industrial consumption can be combined with the urban consumption as being used primarily by the organised sector According to the Planning Commission (GOI, 1990): "Within the industry sector, only six industries viz. iron and steel, aluminium, cement, paper, fertilisers and textiles consume about 43% of the total electricity consumption in the industry sector."

The domestic sector needs to be further subdivided into the urban domestic and the rural domestic sectors.

Though there are no comprehensive figures indicating the break down of consumption between urban and rural domestic sectors, the figures available indicated that, by March 1997, over 80% of the villages (491 465 out of a total of 587 288 villages) in the country had been electrified (Planning Commission of India, 1999). However, this "achievement is to be viewed with the existing definition which declares 'a village as electrified if electricity is used for any purpose within the revenue boundary of that village'. Thus, even in all these electrified villages, power connection may or may not be available on demand. A large number of hamlets and *harijan bastis* adjoining the villages are yet to be electrified." (Planning Commission of India, 1999).

According to Reddy (1999), "India's population according to the 1991 census was 846 million The rural population was 74.34% or 623 million which at 5.5 persons per household corresponds to 114 million households. 69% of these households, ie, 78.6 million households, were un-electrified."

In another study done in the Bankura district in West Bengal (Banerjee et al., 1999), a stratified sample of 163 households revealed that none of the households below the poverty line used electricity as a source of non-cooking energy. The use of electricity as non-cooking energy rose sharply with the rise in the economic class of the households, doubling between the above poverty and the middle income households, and nearly tripling for the high income households.

In none of the studies was electricity recorded as a cooking fuel for rural areas. Banerjee et al (1999) go on to observe:

> *Non-cooking energy accounts for a small proportion of the household energy use in Bankura. Non-cooking energy is predominantly for lighting. In electrified house-holds some electricity consumption is also for fans and higher income households also have other appliances like television sets etc . . . Even electrified households have kerosene consumption for lighting. This is because the rural electricity supply is unreliable and there are many hours during the day when there are supply interruptions.*

According to the Planning Commission (1999), in 1996 to 1997 there were 86 53 million consumers of electricity Though these would include industries and commercial enterprises, even if all these consumers were considered as households then, of the 173 million households in India, only about half would be electrified. It does not require a separate study to determine that these would necessarily be the better off households.

It would not be unreasonable to conclude that, even in the rural areas, the bulk of the domestic supply of electricity goes to the well-to-do families partly because the (unreliable) electricity supply in rural areas is used primarily for devices like fans and televisions, which cannot run otherwise and the poor do not own these. Moreover, the capital cost of obtaining an electrical connection for lighting is too high for most rural families. According to Reddy (1999), " . . . the operating costs of traditional devices (eg, kerosene lamps) are a sort of upper bound for the costs of an alternate technology From this point of view, it appears that the problem arises more with the capital costs of new technological options than with their operating costs."

A similar view is found in an action plan prepared by the Planning Commission (GOI, 1990): "Rural electrification in the coming years will gradually, to some extent, replace kerosene as a fuel for lighting but the heavy initial investment required for electrification makes it difficult to achieve more rapid rural electrification. . . .consequently kerosene may very well continue to be the common man's fuel for domestic lighting for years to come."

As far as the use of electricity for agriculture/irrigation goes, Reddy (1999) says "Actually, subsidies granted in the name of the poor often end up going to the better off. For example, free electricity to rural areas goes primarily to farmers rich enough to own an electric pump for pumping irrigation water."

The Planning Commission (GOI, 1990) appears to concur: "The emphasis has been mainly for rural electrification for energising agricultural pumpsets. In any case, owing to the high initial costs, it may be difficult for the low income section of the population to take advantage of the programme . . . ."

Again, it is self-evident that the landless and the marginal farmers would not be the owners of electric pumps and, consequently, the benefits of rural electric supply would not flow to them.

Net Impacts
Clearly, the recipients of electricity are major beneficiaries of dams, whether they live in urban or rural areas. In contrast, those among the project-affected peopleswho are too poor or isolated to have access to electricity are the ones who pay the major costs, as already described earlier.

Impact on Equity
If a broad generalisation is made, it can perhaps be argued that the direct benefits of power go to the various classes in the following manner:

Table 5.10 **Electricity Consumption**

Class of people	Domestic use	Industrial use	Agricultural use	Remarks
Upper class/ industrialist (urban)	+++++	+++++		The electricity consumed by multiple air-conditioners and other gadgets and in large and multiple houses, and by five star hotels, and by industries owned by this class
Upper middle class (urban)	++++	++++		Domestic electricity consumed as above but to a lesser extent Ownership of/ employment in industry
Middle class (urban)	+++	+++		Electricity consumed for coolers, fans, and other devices. Employment in industry
Lower middle class (urban)	++	++		Electricity consumed as above but to a lesser extent. Employment in industry
Poor (urban)	+	+		Living in *jhuggis* or homeless, with negligible electricity consumption. Employment as labour in industry
Big farmer/ rural industrialist (rural)	++	+	+++++	The primary user of domestic and agricultural electricity
Small farmer (rural)	+		++	Occasional domestic and agricultural use
Marginal farmer and the Landless			+	No domestic connection and no direct agricultural use. Employment as farm labour

Further, considering that a bulk of the power produced by dams is used as peaking power to make up the shortfalls during the peak demand time, the contribution of hydropower can be further narrowed down. The main peak demand comes from the urban domestic sector. According to (TERI, 1991):

> *While residential electricity demands have gone up from 11% to 14% of total electricity demands (over the period 1980-81 to 1988-89), the issue of significance here is that these demands are found to coincide with the peak demand. In the case of the agricultural sector the increase in demand is largely due to the Government policy of rural electrification and thereby energisation of pump-sets. The electricity boards however adopt a number of measures to ensure that rural pump-sets do not operate during peak demand periods.*

Is there also a conflict between power and irrigation demands in periods of peaking demand, especially in the dry season? Is it the case that at this time of the year, less water is released from the reservoir for irrigation needs so as to maintain power generation levels at the maximum to meet peaking demand? If so, then again there is an element of inequity, between rural (irrigation) and urban (domestic) users.

The matter is exacerbated by the high rates of subsidy attached to the power sector, primarily for domestic and agricultural power. According to the Planning Commission 1999), the subsidies to the agricultural and domestic sector in 1997 to 1998 were an enourmous Rs.22 216 crores. The losses by the state electricity boards (without subsidy) were Rs10 684 crores. These subsidies and losses are also derived mainly from the common man and woman in India, but the benefits, as has been seen, accrue mainly to the rich in the urban and rural areas.

Added to this are the very high transmission losses in India. According to the latest figures available, the transmission losses in 1995 to 1996 were 22.3% of the generation It is also estimated that a significant proportion of these losses are the result of theft. Considering that the poorer half of the country has little or no access to electricity, a large proportion of these thefts must be committed by the better off 50%.

As has been seen, much of the electricity produced by a dam goes into the grid and is then primarily used (or stolen) by the well-to-do populations in urban or rural areas. Consequently, the dam promotes inequity between the well off and the poor and disadvantaged, the latter receiving little or none of the benefits but paying much of the price.

Among those who lose

i. Impact on equity among different categories of Displaced Persons

Relative socio-economic status: As already described, some data are available concerning the socio-economic profile of displaced persons. A large proportion (nearly 62%) belong toscheduled castes or scheduled tribes and most are from rural areas.

However, there are also economic disparities within the category of displaced persons. Though no detailed data are available, there is no reason to believe that those being displaced or otherwise being affected by dams are any different to the rest of the rural population of India Some are large farmers, many are small and marginal farmers, and others are landless.

There are also women, children, old people and physically and mentally challenged people among the displaced persons.

Net Impacts

The survey of dams reveals that at least for one category of displaced persons, some of the dams have had a positive impact; in those few dams where agricultural and homestead land was provided even to those who were landless, there could be a net positive impact. Also, where the marginal farmer was given land in excess of his/her original holdings, there could be a net positive impact. Of course, this is only if the land allotted was of equal or better quality than that which was lost and the other costs that the displacef persons had to bear did not offset the benefits of the land.

In a few recent projects, adult unmarried males were also recognised as families, and were given land. The net impact of this policy on their families and on the younger generation of males could be positive, provided the quantity and quality of land given was adequate and the other costs they had to bear did not offset the benefits.

Insofar as the allotment of land was restricted to a maximum limit and people who owned more than the limit were still given land only up to the prescribed limit, the impact on the large landholders was negative.

In all cases where the net benefits were positive but the control and ownership of the benefits was vested solely with the male members of the family, the impact on women was negative as they received no special economic or social status in the rehabilitation package. In most of the dams, this is the situation that has prevailed. In one or two of the recent projects there has been an effort to ensure that the title of land is in joint name of the husband or wife, but this is still a proposal and has not become reality.

In one or two of the recent projects there is also a provision to treat adult unmarried daughters as a separate family unit. In such cases, there would be a positive impact on women and on the younger generation, provided the quantity and quality of the land and other compensation was adequate and the other costs were not so high that they offset this benefit.

Where land was not allotted (as was the case in a majority of the projects) or where land was allotted only to those who had already held land, the net impact on the landless, given the various other costs they had to pay, was adverse

In none of the rehabilitation packages studied were the special needs of children, old people or the physically and mentally challenged, explicitly addressed. Considering the other costs they had to pay as a result of the dam, the impact of the dam on these groups would be negative.

In addition, the special problems that tribals and other forest-based communities experience because of displacement do not seem to be addressed in most of the projects. Whereas, all the project-affected persons suffered the various deprivations listed above, those communities that had little or no contact with the outside world and with alternate lifestyles suffered these deprivations more acutely

Given the special vulnerabilities of the landless, the tribals or members of the scheduled castes, except in those cases, as mentioned earlier, where there was an explicit effort to compensate them at a higher level than the less disadvantaged, the impact on them would also be negative.

<u>Impact on Equity</u>: In those rare cases where the landless and the marginal farmer were given an adequate amount of good agricultural land, and where the large landowners were given land up only to a ceiling, and the other costs of displacement were equitably distributed, the impact on equity between the poorer and richer displaced persons would be positive. In all other cases it would be negative. This is especially so because, in most circumstances, the rich and influential among the PAPs would be able to ensure that they paid the least costs and received the greatest benefits.

Where women were given joint title to the land and joint control over all other compensation, the impact on equity between men and women would be positive. Where the net benefits were conveyed into the control of men only or where natural and other resources that the women depend upon more were depleted or not replaced, the impact on women would be negative.

Given the special vulnerabilities of children, old people and the physically and mentally challenged, and given that there were no special arrangements made for them, the impact on equity between them and the rest of the population would be negative.

ii. Impact on equity between those who lose upstream and those who lose downstream

There are various categories of people downstream who also suffer adverse impacts from a dam: these include those affected by the varying water flows in the river, by depleted fisheries, by sudden releases of water, by dam failure, by salt-water ingress, by the aggravation of floods, and by other adverse impacts on the riverine ecology. There are also victims of reservoir-induced seismicity or of the health hazards that reservoirs and canals bring.

Very little information is available about the socio-economic profile of people downstream or, indeed, about the extent and severity of their loss; nothing can be said about the impact on equity between them and those who are the losers upstream. All that can be said is that the dam has a negative impact on the equity status between those who lose and those who benefit from the dam.

Among those who gain

i. Impact on equity among those who gain from electricity

Relative socio-economic status

The profile of those who gain from the electricity produced by dams, has already been described above The main benefits accrue to the richer urban and rural populations.

Net Impacts
The access to electricity in the rural areas provides large farmers with a net gain.

The access to electricity for domestic use also has a net positive impact on the domestic urban and rural users and on industrialists. This gives an advantage to both the urban and the rural consumer over those who do not have such access.

Impact on Equity
The ability of the large farmer to draw out large amounts of water by using electrified pumps also lowers the groundwater levels in many areas and makes it increasingly difficult for the small farmer to access water. As the small farmer does not have the ability to use the electricity, the impact on equity between the big and small farmer is adverse.

The relative advantage that the large farmer and the urban and rural consumer of electricity obtain over the small farmer and those without access to electricity heightens the inequity between these groups.

The electricity that industrialists receive also heightens the inequity between the industrialists and all other groups affected by the dam.

ii Impact on equity among those who gain from irrigation

Relative socio-economic status

The socio-economic status of the beneficiaries of irrigation has been relatively better studied. The indicators that are relevant for the purpose of this study are the landholding patterns and the location of the landholdings in the command. As elsewhere, the command contains large farmers, small and marginal farmers and the landless. Land is also held at the edge of the canal, at the head reach and at the tail-end of the canal.

Net Impacts

The net impacts among the beneficiaries of irrigation can be considered separately for seven groups: the large farmer, the medium farmer, the small and marginal farmer, the landless, women. the head reach farmer, and the tail-end farmer.

The large, medium and small/marginal farmers

Considering that in most irrigation systems water is released according to landholdings. the general inequitable distribution of land in the country also reflects in the consequent inequitable distribution of water in the command. If in a command 60% of the land is owned by 30% of the farmers. it follows that. all other things being equal, 60% of the benefits of irrigation will go to 30% of the farmers

The distribution of benefits from irrigation projects can affect equity among the downstream population to a very significant extent. Empirical evidence of distribution of irrigation benefits from such projects in India is extremely scanty, as has been pointed out by Wade (1975). who argues that in general. the possibility of acquiring access to scarce water from irrigation projects is higher for the resource-rich farmers than for the poor. There is an attempt to ration the scarce resource (namely water) of canal irrigation among competing users by means of a non-price. administrative mechanism Hence.

> . *it is likely . . that inequalities of other resources - education. money. connections - intrude into the distribution system. and are used to apply pressure on individual officers directly or indirectly . . This may be expected to have large and cumulative effects on income distribution Farmers faced with a very uncertain canal supply use a variety of tactics to reduce the effects on their income: for example. diversification to include more crops which are resistant to water stress. the use of less fertiliser and at sub-optimal times . and keeping land unlevelled. so that if irrigation is late the crop in lower lying areas . might survive But all these measures lower maximum output. The worse is a farmer's standard of water service. the more he is likely to adopt these and similar measures. and therefore the greater the inequality in output between those with good water service and those with bad.*
>
> (Wade. 1975 - 1745)

Technical studies of yield from canal irrigated tracts according to size of landholdings have shown that benefits from irrigation do not tend to increase with a rise in the size of landholding, as long as there is equality in fertiliser use between large and small farmers. In the absence of such equality (owing to differential access to credit, information etc.), distribution of benefits becomes skewed. (Dhawan, 1985:A-128). As long as institutional changes like land reforms and a tilt in irrigation projects in favour of small farmers are not brought about, the tendency of skewed benefit-sharing is likely to persist. leading to the worsening of inequities.

As irrigation schemes are usually constructed against the backdrop of an already skewed distribution of income and wealth, their benefits may often be disproportionately greater for large landholders than for small and marginal farmers. Many studies have shown that the landholding pattern tends to become more skewed in the wake of canal irrigation. A Planning Commission study has shown that people from outside the command area tend to buy land in this zone, owing to its higher potential profitability (Singh, 1997:176-77). It has also been argued that large farmers, using various means, tend to establish control over land in the headreaches of the canal system (Thakkar, 1999:30-31) Other authors, like Vaidyanathan, have concluded that hardly one-fifth of Indian farmers have benefited from canal irrigation, and of these, the bulk of the benefits have been concentrated on the large farmers (Thakkar, 1999:~31).

As seen in the case of the Jamuna Assam canal project (WAPCOS, 1996c), there is a tendency towards concentration of land in favour of medium and large farmers (54%) in the command area, as compared to the non-command area (25%). For the Sirhind canal in Punjab (Dhesi, 1996), the number of marginal farmers (0-6 ha) has swelled from 32 to 91 in the sample studied, while the number of large farmers also increased from 13 to 19, thus widening the disparities between the two groups.

Consequently, the net benefits to both the large and the small and marginal farmer are positive, except in those cases where their land becomes water logged or saline. However, the large farmer receives many more benefits than the small and marginal farmer

Marginal farmers and agricultural labourers

The impact on the landless cultivators downstream can occur as a result of changes in employment opportunities. An increase in cropping frequency as a result of assured water supply can increase employment, but a change in cropping pattern in favour of more capital intensive and labour-displacing crops can reduce employment opportunities. With an assured water supply, landowners in the command area of a dam may find it lucrative to bring hitherto uncultivated land under the plough They may also find it lucrative to take away the hitherto less productive land from landless sharecroppers and cultivate it themselves. The sum total of the impact of the dam on employment opportunities available to landless cultivators in the command area would depend on the relative strength of each of the factors outlined above.

A typical example can be seen in the Sirhind canal in Punjab (Dhesi, 1996). Here, the pattern of farm asset possession has changed significantly owing to irrigation availability. There has been an astronomical increase in the numbers of mechanical/electrical, capital-intensive farm equipment held by farmers in the command area. Even more importantly, the concentration of these assets in the hands of the large farmers is bound to have a negative impact on employment generation It is found that for Sirhind, the number of seed drills held has changed from zero before irrigation to 2,688 after irrigation. The corresponding figures for diesel pump sets is 10 and 2,424, and for tractors 5 and 2,244 Sirhind (Dhesi, 1996) also shows that only 16% of small and marginal farmers possess tractors in contrast to 71% of large farmers. The impact of these changes on employment would be significant, because small farmers usually tend to use family labour, and it is mainly large farmers that generate employment opportunities for the pool of agricultural labourers. This impact can be seen from the changes in the pattern of labour use in this area between 1954-89. The number of labourers employed per hectare of land decreased for all crops (from 69 to 48 for wheat, from 87 to 51 for American cotton, and from 96 to 49 for desi cotton).

Similar trends have been observed for the Mayurakshi project in West Bengal (WAPCOS, 1996a), and the Bhadar project in Gujarat (CCPA, 1996). This fall in labour use per hectare may be partially or fully offset by the increase in area under cultivation that canal irrigation makes possible (as can be seen for projects like Sriramsagar (GOAP, 1994)] and Sirhind (Dhesi, 1996). The increase must be weighed against the observed trend of decrease in area under cultivation due to waterlogging, salinity etc. as outlined in the section on environmental impacts.

The trend of marginalisation of landless labourers and small farmers finds further support from data on fall in agricultural wages, rise in number and proportion of agricultural labourers in total population, and a steady increase in land prices that puts this asset out of the reach of the poor For instance, in the Sirhind command area, the proportion of agricultural labourers in the total population has increased rapidly from 25% to 40%, while the proportion as well as absolute number of owner-cultivators has declined significantly. In the same area, the average agricultural wage as a proportion of skilled wage has fallen from 70% in 1961 to 52% in 1981, which indicates a rising disparity in the sharing of gains from canal irrigated agriculture.

Typically, the crops grown on new land brought under cultivation are wet irrigated foodgrains or cash crops like sugar cane or a high yielding variety paddy. These are usually more capital-intensive than the dry irrigated crops, and this factor also contributes to the observed decline in the use of labour per hectare of irrigated land.

The availability of irrigation has also tended to strengthen the tendency of concentration of landholdings by raising profitability of cultivation and increasing land prices in the command area. As a result, it becomes more profitable to bring under the plough sub-marginal lands, wasteland and fallow tracts. Typically, such tracts are cultivated by small and marginal farmers, under institutional arrangements like sharecropping With the availability of irrigation, large landowners may find it worthwhile to take over these tracts for self-cultivation. In fact, the observed trend in some areas (like the Kosi command) has been of decrease in the security of tenure of small sharecroppers (Appu. 1973)

Marginal farmers and the landless often engage in riverbed cultivation in the dry season to supplement their incomes. After dam construction, sudden releases of water from the reservoir can cause damage to the crops of such riverbed cultivators. A smaller flow of water in the river also reduces the annual flooding of the river that washes away silt and brings in new, fertile soil.

A study of three large irrigation projects in Gujarat traces the adverse impact of the Mahi-Kadana and Ukai-Kakrapar projects on downstream riverbed cultivation. The damming of the Mahi and Sabarmati rivers has led to a drastic decline in cultivation of vegetables and fruits in the dry riverbed (Jain. 1990 52-53). In the case of the Sabarmati River, the construction of the Dharoi Dam is said to have devastated the riverbed economy of downstream villages, and specially of the Raval community (an OBC group), which previously thrived on such cultivation (Jain, 1990:69-70).

Consequently, the net impact on the landless, especially agricultural labour, can be mixed In some cases there is an increase in the demand for agricultural labour and this is a benefit but in other cases, the demand goes down, resulting in adverse impacts.

Women

Traditionally, the role of women in the irrigation system has been ignored and irrigation planning has been done mainly by men, for men. Dams and irrigation have been planned in India in a way such that issues of equity, even in the few cases where they have been explicitly addressed, have meant primarily the spatial distribution of water across the system. The fact that in India women very rarely have ownership rights over land does not necessarily mean that they do not work as farmers or users of irrigation. The traditional approach to distribution of rights over irrigation water has, however, tended to vest these rights exclusively in men, in the (misplaced) belief that it is predominantly men who are the farmers, users of irrigation water and "heads" of households in the command areas of large dams, as elsewhere. There is thus a "false, but predominant, division between water for domestic use (drinking, bathing, cooking, washing) and water for productive use (irrigation, industrial), with the former being seen, almost exclusively, as women's responsibility and the latter as men's" (Ahmed. 1999)

According to Ahmed, there is an artificial division between irrigation, agriculture and rural development in most bureaucracies, which in any case are male-dominated. Although the contribution of women to agriculture is better documented and understood, because of this artificial division their role in planning and managing an irrigation system (which is an essential input into the agricultural system) is ignored.

Further, little attention has been paid to various socio-economic differences among users and their gender differential needs., For example, "women may require water for subsistence crops – typically a few vegetables grown near the homestead – while men may be more concerned that all the water goes to the fields (cash crops)" (Ahmed, 1999).

As pointed out by Zvarteveen (1997), even when women farmers use irrigation water on the same footing as men (that is, for farms run by women, or for cases where women put in regular labour on their husbands' plots), there may be many differences in the preferences expressed by men and women in the delivery of irrigation services. Often women may require timely delivery of irrigation water not just at the time of sowing the crop (which is an activity typically undertaken by men as well as women) but also at the time of weeding (typically undertaken by women) because for crops like paddy, there is an inverse relation between the height of standing water in the field and the growth of weeds. Moreover, women may prefer a rotational system of water delivery, while men may express a preference for an on-demand system because the rotational system requires dealing or bargaining with the water guards, which women may find difficult

Zvarteveen goes on to argue that some of these gender differences in the pattern of preferences may themselves have arisen from the very fact that women do not have any direct and explicitly recognised rights to irrigation water. Zvarteveen makes a strong case for the granting of individual water rights to women, arguing that this would directly increase their physical well-being and reduce their risk of poverty, by giving them direct access to and control of a scarce resource. It would also indirectly benefit women by increasing their bargaining strength within the household, thus significantly helping to remove gender inequity in the command area of an irrigation project.

It is clear that there are many aspects of irrigation that affect women. Unfortunately, in none of the projects studied was there any mention of granting explicit and direct water rights to women, or of differential gender requirements for water, nor was there any effort to address these. In fact, irrigation management through decentralised institutions like water users associations would provide a good entry point for introducing gender concerns into command area development schemes. In none of the dams studied has any evidence been found of such concerns for gender equity having been considered.

Consequently, the net impact of large dams on women in the command area can be seen as adverse.

Head reach and tail-end farmers

An inherent conflict may exist between the protective and productive roles of irrigation projects The former would involve maximising the spread of the irrigation network to the tail reaches, but the latter would entail intensive supplies in the head reaches to enable farmers to switch to high value crops (Wade, 1976:-64). In most projects for which data were available, there has been a marked tendency for intensive irrigation to take precedence over extensive irrigation, and this has had an adverse effect on equity between the head and tail reaches.

The particular groups that may be more vulnerable to being excluded from the sharing of benefits of irrigation in the command area are: small and marginal farmers, the landless, and farmers in the tail reaches of the command area

If the downstream water availability is lower than expected, then inequity between head reach and tail-end users can emerge (Mitra, 1986:-497).

Many studies have shown that, with the availability of irrigation, farmers in the head reach tend to switch to the production of highly water-intensive crops, especially in the initial stages of canal construction (when the supply of water further downstream is minimal). Even with the spread of the irrigation network, the powerful lobby of head reach farmers tries to exert strong political pressure to ensure that their water supply is not subsequently reduced (Wade, 1976).

Data from the Chambal Command Area show that the yield rate of high-yielding paddy and potato is higher in the middle reaches than in the head or tail reaches. Panda has explained this phenomenon in terms of the excess availability of water in the head reach, and shortages of water in the tail reaches. An immediate solution to the problem lies in rationalising the water flows to reduce the supply to the head reach and enhance the supply to the tail reaches (Panda, 1986:530, 532-33). However, given the strong political pressures attached to irrigation programmes, this may be easier said than done (Mitra, 1986:754, 756). Similar evidence has been furnished by Mitra, linking cultivation of high value wet irrigated crops like sugar cane and paddy with water availability in the higher reaches, and of low value, dry crops like *jowar* with the lower reaches (Mitra, 1986:496-97). A study of irrigation projects in Gujarat shows that there has been a dramatic increase in the percentage share of perennial crops like sugar cane in the cropping pattern. Even the report of the Comptroler and Auditor General of India has noted that " . . the increased cultivation of perennials mainly in Kakrapar command resulted in increased use of water exceeding the maximum permissible limit of perennial crops to be grown in the command (usually 35%), leading to higher water table, salinity problems etc" (Jain, 1990:21).

Studies of Command Area Development (CAD) Programmes of Giri (CESPL, 1996), Jamuna Assam (WAPCOS, 1996c), Mayurakshi (WAPCOS 1996a) and other projects show that the%age of irrigated area to total holdings declines moving from head to tail reaches. A further inequity in the Giri project (WAPCOS, 1996c) arises because within the tail reaches, the large landowners manage to obtain some irrigation, but water availability for the marginal farmers is actually zero. Studies also show that the timeliness of water supply tends decline moving from the head to the tail reaches (WAPCOS, 1996a) which would also impact on the profitability of cultivation between these two categories, as high value high yielding crops require an assured water supply at fixed times The ability of tail reach farmers to grow such crops and obtain maximum output is lower than that of the head reach farmers

Another factor that reduces equity between head and tail reaches is the countrywide tendency to spread available financial resources over a large number of projects. As a result, for a number of projects, a severe resource shortage affects the extension of irrigation facilities to far-flung areas of the command, and expenditure on Operation and Maintenance (O&M) activities For example, in the Malaprabha Project, according to the official consultants, "Although only 70% of irrigation potential has been created so far, tail-end reaches in various parts of command area are not receiving their share of water." (CCPA, 1995).

Data compiled from the report of the Comptroller and Auditor General for some major irrigation projects in Gujarat show that, out of the overall targets set for 1983-84, only 33% of field channel construction, 73% of land levelling/land shaping, and 14% of canal-lining activities were actually completed. The direct impact of these shortfalls is on the tail reach farmers, because in the absence of these crucial activities, the capacity of the canals to provide the tail reaches becomes severely restricted (Jain)

Consequently, the net benefits to both the head reach farmer and the tail-end farmer are also positive, provided again that their land does not become waterlogged or saline As shall be seen later, the head reach farmer does receive more benefits than the tail-end farmer.

Impact on Equity:
The impact of the dam in terms of equity between large and small farmers is invariably negative, so is the impact on equity between farmers in the head reach region and in the tail-end of the command

The impact on the equity between landless agricultural labour and the landed farmers is mixed. In some cases, where employment opportunities increase because of irrigation, there might not be any impact. In other cases, where employment opportunities remain constant before and after the dam, or decrease after the dam, there is a negative impact.

The impact on equity between men and women is also usually adverse.

5.3.4.2 Discussion

The findings given above make it amply clear once more that the impact of large dams on equity is mostly negative. To understand why this is so, the processes by which large dams are assessed need to be looked at.

Interestingly, in India there is no process by which the equity impacts of dams are assessed. The Constitution of India declares India to be "a Sovereign Socialist . . . Democratic Republic" and states further the fundamental right to equality and the directive principle that "the State shall strive to promote the welfare of its people by securing and protecting . . . a social order in which justice – social, economic and political - shall inform all institutions of public life". Despite this, the major institution of public life, the Government, has no procedure or requirement by which dam projects are subjected to an assessment of their impact on equity or, as has been described earlier, a class-benefit analysis.

This absence by itself highlights the low priority that equity issues are given by the government, as far as dams go. It also means that hardly any data are available regarding the impact of dams on equity

During an economic assessment of dams, there is neither the requirement nor the practice of assigning weights in order of equity. None of the dams studied had any such assessment, in which costs to be borne by the poor were given a higher weight than those to be borne by the rich, and the benefits accruing to the rich were given lower weight than those accruing to the poor. The cost-benefit analysis of all the dams studied simply equated the costs, whoever paid them, and the benefits, whoever received them

Very few independent studies are available which actually examine the equity aspect of the costs and benefits of dams, either in an economic sense or in the larger social sense.

The aspect of inter-generation equity, ie, the distribution of costs and benefits between generations has only in the last twenty years or so become a part of development thinking. Sustainable development, as it is called, implies that natural resources are not depleted or degraded in a manner that renders them unavailable or relatively scarce to future generations. Sustainable development, as an objective, is now a part of Indian policy and law.

The sustainability of dams, in this sense, has not been examined for any of the projects being surveyed. The fact that many dams have adverse environmental impacts (the type and quantum of which are described in the section on environment) means that as they are currently designed and constructed they adversely affect the equity status between the beneficiary generation and future generations.

The impact on equity between species is an issue that does not attract much concern in today's world. If it is accepted, as it should be, that this world does not belong to human beings alone, then all human actions must also be assessed in terms of their impact on inter-species equity. The fact that dams flood huge tracts of wilderness areas and, by obstructing the flow of the river, degrade and destroy the habitats of many aquatic species must be taken into consideration while assessing their impacts on inter-generation equity.

Perhaps the destruction of some habitats is inevitable but efforts can be made to minimise the trauma and suffering of the animals that live in these habitats. Unfortunately, apart from fish ladders for commercially important fish species, there has been no effort in any of the dams studied to minimise the adverse impacts on animals. Numerous living creatures continue to face the prospect of suddenly being drowned by the rising waters of the reservoirs or being cut off from their habitats and feeding grounds.

In this sense, dams contribute negatively to inter-species equity. As this is an issue that is rarely taken seriously, no more than this mention is being made in this report.

5.4 Conclusions

5.4.1 Environment

The Indian experience of large dams, in terms of environmental impacts, can be summarised as follows.

Table 5.11 Environmental Impact:- Summary

Impacts	+ / -	Level	Prior Assessment	Prevention or Mitigation	Remarks
Premature cutting of trees to be submerged	_	M	N	N	
Degradation of catchment	_	H	N	P	Though CAT has been undertaken in many of the more recent projects, it has not been properly done. In many of the recent projects, fuel wood depots have been proposed.
Mining/quarrying in catchment	_	M	N	N	There is no stipulation about the prevention of this, except in a few recent projects.
Reservoir siltation	_	H	P	P	The fact that in a large number of reservoirs the assumed rate is much lower than the actual rate of siltation suggests that this aspect was only partly studied, costed and planned for.
Water availabilty	_	H	P	P	The continuing degradation of catchments has meant that water flows into the dam have become erratic in many projects. Post-construction data also confirm this
Catchment Area Treatment	+	M	P	NA	CAT has become a part of recent projects and its cost is included in project costs The extent of treatment is inadequate.
Backwater build-up	_	L	N	N	Not studied in most projects
Dust pollution at dam	_	M	N	N	In none of the projects surveyed has any action had been taken to prevent or mitigate this
On aquatic	_	H	N	N	Not studied prior to clearance in

Impacts	+ / -	Level	Prior Assessment	Prevention or Mitigation	Remarks
ecosystems at reservoir					any of the dams. No action possible subsequently.
On wetland ecosystems	+	M	Y	NA	The creation of a reservoir provides a habitat for some wetland species, especially waterbirds.
Fish at reservoir	_	H	N	N	Fish species always adversely affected by the formation of the reservoir.
On other fauna and flora at reservoir	_	H	P	N	Only in recent projects has this been studied. Costs have not been added to the project costs and no realistic mitigation has been planned or implemented.
On forests at reservoir	_	H	P	P	Since the statutory requirement for forest clearance, the impacts on forests are being assessed. The cost of loss is not computed and only compensatory foresting in recent projects is being taken up.
On cultivated biodiversity in submergence zone	_	M	N	N	The environmental loss from this is never assessed.
On grazing land and domesticated biodiversity in submergence zone	_	H	N	N	No effort to assess or mitigate
On local biomass availability	_	L	N	N	No effort to assess or mitigate
Rim stability	_	H	P	P	Only in recent projects has this been studied and some efforts at mitigation initiated.
Health in the submergence zone	+ & _	H	P	P	The adverse impacts are assessed in only a few projects. The mitigative measures proposed are weak
Water quality in reservoir	_	H	N	N	Hardly any comprehensive studies, especially prior to appraisal.
Reservoir-Induced Seismicity	_	M	N	P	No evidence of prior assessments or of strengthening structures
Micro climate at reservoir	_	L	N	N	
Water-logging at canal/ command	_	H	P	P	The fact that so much water-logging has taken place is an indicator of poor assessment and preventive action
Terrestrial biodiversity at canals	_	M	N	P	Only in some recent projects has there been an attempt to minimise this impact.
On natural	_	M	N	N	

Impacts	+/-	Level	Prior Assessment	Prevention or Mitigation	Remarks
drainage by canal					
Health at canal site	_	M	N	P	Only some ineffective preventive and curative methods are proposed.
Dust pollution at powerlines	_	L	N	N	
Terrestrial biodiversity at powerlines	_	L	N	N	
Radiation at powerlines	_	M	N	N	
Aquatic ecosystem downstream	_	H	N	N	Only concern seems to be for commercial fisheries
Fish downstream	_	H	P	P	Only mitigative measures are fish ladders or breeding programmes for a few species
Sudden water releases	_	H	N	P	Some efforts are being made to ensure that sudden releases are not inevitable
Of rehabilitation activities	_	M	N	P	In recent times there has been a ban on the diversion of forest land for rehabilitation.
Downstream water availability	_	H	N	N	There is usually an unfounded assumption that the water availability downstream would necessarily improve because of the dam.
Water pollution downstream	_	M	N	N	There is an unfounded assumption that this does not happen
Salt water ingress	_	M	N	P	This is a serious problem in many river basins.
Coastal and marine ecology	_	M	N	N	No studies were seen.
Dam failure	_	H	P	P	There is a tendency to downplay the risk.
Decommissioning of dams	_	H	N	N	This is a major future cost that is ignored

H = high; M = medium; L = low. Y = yes; P = partly; N = no; NA = not applicable

It is clear from the table above that for most of the dams no assessment was carried out with regard to most of the impacts. The reasons for this are many and have been discussed earlier

To draw any final conclusion on the impact of dams on the environment becomes difficult because there are no standards prescribed, specifying what levels of environmental deterioration are acceptable. How much of the environment can be allowed to be destroyed, and for what quantity of irrigation or power? These questions have not yet been answered in India

What does emerge clearly is that:

- Most of the possible environmental impacts of dams were not assessed adequately in the past and even today, though matters have improved, much still needs to be done.

- Even in retrospect, there has been no effort to assess the actual impacts that dams have had on the environment, for most of the parameters.
- The adverse impacts of dams on the environment, judging from international experience and the few case studies available in India, are significant and mostly irreversible.
- The preventive and mitigative measures that could have been taken to safeguard the environment have mostly not been taken.
- The financial, economic and social costs and benefits of the environmental impacts of dams have not been computed while assessing the economic viability of most projects, including recent ones

Lessons to be learnt

Perhaps the major lesson that should be learnt is that projects should not be initiated before a comprehensive environmental impact assessment has been carried out and the project has been determined to be environmentally, socially and economically viable. If projects are initiated without such an assessment, there should be a legal provision to prosecute the individual concerned who has allowed the construction to start. A similar provision exists in the Forest (Conservation) Act of 1980 where the forest officer concerned can be imprisoned if he allows the diversion of forestland without the clearance of the Government of India.

Another lesson that should be learnt is that there needs to be clear and transparent standards prescribed for the assessment of projects. In the absence of such standards, even where environmental impact assessments are carried out, the determination of the viability of the project becomes a matter of arbitrary opinion.

While standards have been fixed for air and water pollutants and an activity or project can be assessed as viable from the point of view of pollution, the same is not true for most other aspects of the environment

It is not that standards cannot be fixed. For example, the ecosystem types and the species that are threatened in regions, nationally and globally, and can be listed any activity that further degrades them can be prohibited. A land use plan can also be developed, in which, region by region, areas are demarcated for various uses and dams can only be made if they keep within the limits set by the regional land use plan. This would also reward those regions that have maintained their ecosystems well.

There is also an effort to do natural resource accounting and put monetary values on at least some of the elements of the environment. Once this is done, then the economic viability of the dam must be established taking into consideration the monetary costs of the environment it destroys One such attempt was made in the mid-1980s by the Ministry of Environment and Forests, Government of India, with regards to the Narmada (Indira) Sagar Project in Madhya Pradesh. Using norms of the Food and Agriculture Organisation (FAO), the Forest Research Institute and Colleges (FRI as it was then known) estimated that the cost of the forests to be submerged by the Narmada Sagar Project amounted to Rs30 923 crores for a 50-year period. Considering that the total cost of the project at that time, excluding the forest costs, was Rs6 000 crores, the additional forest costs rendered the project uneconomical. For obvious reasons, this estimate was not acceptable to the Government of India and the whole approach was shelved (DoEF, 1987).

There are many pitfalls in accepting the assumption that all of nature and natural resources can be correctly valued in monetary terms. It is not an approach, notwithstanding the Narmada Sagar case, that will safeguard the environment.

What is perhaps required is a two-pronged approach. Firstly, basic standards of sustainability must be formulated following from the avowed policy of the Government of India to pursue a sustainable path of development.

These standards can involve the setting of physical limits to the utilisation or diversion of natural resources. For example, the carrying capacity of each river system can be determined and the minimum flow required at all seasons for the ecosystem to remain healthy can be worked out. Dams can be designed to use only the surpluses available once this minimum ecological flow has been ensured.

Similarly, the minimum viable populations for species and the minimum unit area for each ecosystem type can be determined. Species and ecosystems can be prioritised and given weightage. No project can be allowed to reduce any species or ecosystem below its minimum viable population or area. locally, regionally and nationally.

A trade-off mechanism can be designed. Subject to the parameters already described, the inevitable environmental degradation caused by a project must be compensated for elsewhere by regeneration of degraded ecosystems or heightened protection.

Secondly, all possible environmental impacts, beneficial and adverse, need to be fully assessed prior to the clearance of the project. All those adverse impacts that can be mitigated or reduced, must be so planned for, and the cost of mitigation and reduction taken into account while appraising the project. In addition, the costs of regenerating and protecting the areas agreed on as a part of the trade-off must also be included in the cost of the project.

The monitoring of environmental parameters must be rigorously undertaken during and after construction. Any unanticipated costs or additional costs resulting from the ineffectiveness of the mitigative or preventive measures must also be borne by the project and channelled to environmenalt regeneration and protection. Similarly, all unanticipated benefits must be credited to the project account. All these conditions must operate without compromising the basic principles of sustainability, as described earlier

What remains to be assessed is which of the dams already commissioned or under construction would still be economically viable if the costs of preventing and mitigating environmental damage and the cost of the remaining environmental damage were taken into consideration.

It also remains to be assessed whether large dams would still be a viable technological option if all the inevitable environmental costs, which cannot be prevented or made up for, are taken into account

5.4.2 Displacement

Based on the findings described earlier, it could be concluded that in order to minimise adverse social impacts resulting from displacement, some principles need to be followed. These include the following.

- Project need and optimality must first be assessed and established according to the process described in the concluding section. Where, through such a process, the need for a large dam is established and it is the best of all possible options, then its social viability must be assessed. Some of the principles involved in assessing its social viability are listed below.
- The "project-affected persons" must not as a result of the project be worse off in any tangible terms, than they were prior to it. In fact, they must invariably be better off, so that they are at least partly compensated for all their intangible and non-quantifiable losses.
- Whatever the status of such persons prior to the project, they must, in economic terms, be above the poverty line as a result of the project.
- While determining compensation, replacement value at the operative market rates must invariably be the basic principle. Replacement must be at the market rates that actually operate, and at the time of purchase, and not just those that are officially recorded. Also, paying of depreciated value

is manifestly unfair for it often leaves the project-affected persons without adequate means to replace a critical need. For example, if a poor person is paid only the depreciated value of his or her house, he or she would be unable to buy or build a new house and would become homeless. The person's house, however old or ramshackle it might be, is providing shelter. When the house is forcefully acquired, it must be ensured that the compensation is enough to provide an alternate and equal shelter.

- Not only should lost property and assets be compensated for, but also lost livelihoods and lost opportunities. Communities must be adequately and appropriately compensated for common amenities and assets lost because of the project and all those amenities and assets required for fulfilling basic needs must be provided. This is especially important in order to prevent conflicts with host communities, whose common resources would otherwise be under pressure from the project-affected persons.
- It is not enough to just pay cash compensation, various other principles must be followed to ensure that social costs are minimised. Payment of large sums of cash, for example, might not be in the best interests of those project-affected persons who are unused to handling large amounts of money.
- The principle of "land for land" must be followed scrupulously and each project-affected person who loses land must be given land of equal size and of at least equal productivity The principle of giving land to project-affected persons in the command area of the dam is a sound one as it not only gives those who have paid the major costs a part of the benefits, it also lessens the inequities between the upstream displaced persons and the downstream beneficiaries.
- Usually the project authorities must also construct or have constructed appropriate replacement housing for the project-affected persons. However, in cases where the project-affected persons would prefer to construct their own houses, as among some tribal communities, they must be given the freedom to do so. Within the allocated resources, the design and location of the houses to be constructed by the project authorities must be decided in consultation with the project-affected persons.
- The process of selecting rehabilitation sites and lands must involve the project-affected persons and their preferences must seriously guide the final selection.
- Agricultural land must be consolidated, as far as possible, and communities kept together after displacement so that their social and cultural identities are safeguarded.
- As far as possible, displacement should not be forced and people should be made to feel that, despite inevitable losses, they are on the whole going to be better off and therefore should not resist displacement. There is also a growing demand that the prior informed consent of the community is obtained before any project, including a dam project, is approved.
- Wherever the affected people are not willing to shift, the fault lies in the package being offered, in the approach to the displaced communities, or in the implementation of resettlement and rehabilitation programmes, which is so unsatisfactory that the affected people do not feel confident of receiving what they have been promised. In any of these cases, this unwillingness must be recognised as a failure of the rehabilitation process.
- The timeframe for the displacement process should be sensitively determined and people given enough time to adjust to their new locations and lifestyles. It is a good practice to allot land to the project-affected persons at least two years before they are to be displaced so that they can get used to cultivating their land even while they continue to live in their original homes; this makes the process of displacement more gradual and humane. All compensation should be paid before a person is displaced. Delays in the rehabilitation process and its various components can cause major hardship and to prevent this, time frames must be finalised well in advance and adhered to Delays must be looked into very seriously and involve serious consequences for the functionaries responsible
- Even delays in finalising the policy related to rehabilitation and other aspects of dams, and delays in initiating the planning process can seriously affect the well-being of the affected people These processes must also be conducted according to a pre-determined time-frame that statutorily allows adequate time for the concerned persons to submit inputs and intervene in the process of policy formulation and planning

- Whereas it must be ensured that project-affected persons are not forced to change their occupations and professions, there must, of course, be the flexibility to allow individual project-affected persons to choose from among other viable alternatives. Some might not like to go back to the land and might prefer to pursue other professions; they must be helped to do so.
- The project-affected persons must also have the first right to obtain employment in the project. The need for trained and experienced personnel should not be a constraint as training should be organised for interested project-affected persons even before the dam construction is initiated The trained project-affected persons should be to other projects to obtain the experience they need. In fact, the availability of sufficient trained project-affected persons should be a precondition to the construction of the dam. Where necessary, even basic literacy lessons must be organised for the project-affected persons and they should be properly equipped to make the most of the opportunities being presented to them.
- The project-affected persons must also have the first right to irrigation waters from irrigation projects and to power from hydroelectric projects, and to both in multi-purpose projects.
- The definition of project-affected persons who are entitled to receive compensation, must include the landless, those who are tenants, agriculturists, adult unmarried daughters and sons, adult married sons, and widows, divorcees and women abandoned by their families. All those affected by any of the works or activities related to the dam must be treated as project-affected persons.
- Rehabilitation packages and processes must be gender sensitive. Land and other assets should be provided in the joint names of both spouses. Consultations with the project-affected persons must also be conducted keeping in mind the need to consult both men and women, the aged and the young, and members of all castes and communities
- The special needs of particularly vulnerable communities, like isolated tribal groups or other marginalised groups, must be catered for.
- The plight of those who have been affected by earlier dam projects must be recognised and they must be properly rehabilitated and compensated on a priority basis before any further dislocation and displacement is effected.
- The provisions of an enlightened rehabilitation and compensation policy, as and when formulated, must have legal backing so that not only the concerned agencies of the government but affected and interested citizens can ensure enforcement and legal intervention. A recent Supreme Court ruling on another matter, that the agency that seeks to intervene has the onus to prove that its intervention is beneficial, needs to be applied to the case of large dams.

5.4.3 Other Social Impacts

Large dams have many social benefits, including direct and indirect economic benefits but they also have many social costs. The fact that most of the costs have to be paid by those who do not directly share the benefits raises some difficult questions.

Where, after the payment of compensation and the rehabilitation of project affected persons, such persons still remain worse off than they were prior to the project, there is a question of justice. Is it just to penalise a group of innocent people just because the projected affecting them is considered to be in the larger public interest? Most enlightened societies reject such a trade-off, even where the number of people benefiting might be larger than the number being penalised.

Perhaps the only exception that enlightened societies make is in the interest of equity In most enlightened societies, can be deprived one group in order to benefit another, if this deprivation leads to a more equitable distribution of wealth or resources. Starting from variable tax rates, where the relatively rich pay a higher rate than the relatively poor, this principle has also been used to redistribute rural or urban land more equitably. Evidence suggests that large dams promote inequity rather than diminish it so there seems to be no justification for the imposition of costs on millions of innocent tribals and other rural people, who lose even the little they have in order to benefit those who already have more than they do.

What is the alternative? The frequent retort,, "You have to break eggs to make an omelette" overlooks the fact that it is not the making of the omelette that is by itself important, it is whose eggs are broken to make an omelette for whom. Development cannot merely be a blind and reckless passage towards economic growth and productivity; the price of such growth and productivity must be measured, both in absolute and relative terms. Large dams must not be assessed comprehensively only for their social costs but must be implemented only if they also serve the cause of equitable distribution of resources, wealth and opportunities. Such an assessment must be conducted in the context of simultaneously assessing all the other alternatives that are available for enhancing the availability of water and energy, for enhancing the availability of food and incomes, and for enhancing empowerment and justice.

5.4.4 Equity

From the findings and discussion it is clear that, for most categories of people, dams tend to promote inequity rather than equity partly because while determining the costs and benefits of dams, the equity factor is almost never taken into consideration. If, as has been suggested earlier, appropriate weightage was given for the impacts on equity while conducting the cost-benefit analysis for dams, most of the existing or ongoing dams would be found wanting.

However, irrigation systems can be designed in such a manner that they promote equity. In projects undertaken by NGOs in Bihar, engineers sensitive to equity concerns designed distribution networks starting from the tail-end, ie, from the fields of small farmers upwards to the head works (Jain, pers. comm., 2000) Similarly, in the minor irrigation projects taken up by the Association of Voluntary Agencies for Rural Development (AVARD), the small farmers were at the centre of the plan for the distribution network. Where necessary, contour mapping was done to level land to ensure that small farmers actually received their share of the benefits of irrigation.

Similarly, the planning of irrigation systems can involve women to ensure that the design and operation is not gender insensitive.

The use and distribution of electricity can also be rationalised in order to be far more sensitive to equity concerns. Subsidising to the domestic and agricultural sector can be curtailed as this clearly serves the relatively well-to-do. The savings from such a cut in subsidy can be used to expand the network of electricity provision to those segments of the society that could not earlier afford it. Considering that the major costs are the initial investments, the government would much better spend its money providing house-hold connections to the weakest segments of the society and community pumps for use by the small farmer, rather than supporting those who can afford to pay for themselves

Instead of building dams to meet peaking power demands which come mainly from the urban domestic sector and industry, variable, time dependent tariffs would go a long way to flattening the peak demand curve. In addition, tariffs linked to the slope of consumption, rising steeply as consumption levels rise, would encourage conservation and prevent waste.

Focus on demand side management, especially by prescribing energy use standards for industry, would also cut down on the profitability of using obsolete, energy inefficient machinery and processes in order to produce goods and services.

Despite these measures, the inequities between those upstream who are displaced or otherwise adversely affected by dams and those who benefit downstream and at the end of the power line, are difficult to remove It becomes doubly important to ensure that displacement and other adverse social impacts are kept to a minimum, are properly costed and are allowed only in the rarest of rare cases

There is a view that it is not fair to blame large dams for distributing costs and benefits inequitably, for inequity is inherent in Indian society. Even though that might be so, the evidence presented above seems to suggest that large dams are not just passively affected by the inequities prevalent in the society but actively contribute to the maintenance and exacerbation of such inequities. Insofar as dam do contribute, they must be seen as one of the causes rather than the victims of inequity.

In conclusion, the impacts on equity of large dams can be tabulated as follows:

Table 5.12 **Table Impact on Equity of Large Dams**

Impact on Equity Between	**Beneficiary generation**	**Future generations**	**Human beings**	**Other species**	**Upstream losers**	**Down-stream gainers**
Beneficiary generation	Negative. The rich gain more than the poor	Negative. Future generations lose				
Future generations	Negative.	Negative. The poor lose more than the rich				
Human beings			Negative. Some gain more than others	Negative. Other species lose		
Other species			Negative	Negative. Some are affected more than others		
Upstream losers					Negative. The poor lose more than the rich	Negative. Upstream loses while downstream gains
Down-stream gainers					Negative.	Negative. The poor gain less than the rich

5.4.5 Overall Conclusions

The planning of a dam cannot and should not be conducted in isolation: it has to be a part of the larger economic, social and environmental plan for the region and the country. The process of deciding whether a dam should be built in a particular location and with particular specifications, should be a part of the process of deciding how to provide goods and services to the people of a region and to help solve some of their main problems.

Long before the dam is even thought of, there must be a study of the social, economic and environmental situation of a country, and within a country of each state and region, identifying their major assets, potentialities and challenges.

A development plan must therefore be built, taking into consideration the existing assets, in order to use the existing potential to meet the existing challenges.

At the national level, some of the relevant challenges might include: the challenge of providing drinking water to all the citizens, of increasing incomes and agricultural production and productivity, of preventing floods and the devastation they cause, and of providing power to homes and industries; and possibly also, the challenge of protecting people, especially the poor, from social and economic insecurities, from injustice and from environmental degradation. For specific regions and areas, some challenges might be more important than others. For example, in a semi-arid and industrially underdeveloped region, there might be a great need to improve agricultural productivity; in a fast-growing industrial belt there might be a great demand for power.

However, the first step must be to determine the needs of the area being planned for. In this case, some of the relevant needs could be to:

- enhance income levels;
- enhance water availability;
- enhance the availability of energy;
- protect from floods.

Next, for each of these needs, a detailed assessment of the various options must be made. For example, should enhancement of income levels be attempted through the agricultural sector or through other means. If through the agricultural sector, should it be through irrigated agriculture or through rain-fed or dry land farming, or by effecting land reforms. If it is to be through the provision of irrigation, should this be through ground or surface, and if surface, through storage projects or through some other methods. If it is to be through storage projects, should they be ponds, or barrages, or small dams or large dams, or a combination of some or all. At each step, the costs and benefits (social, environmental, financial and economic) of each of the alternatives must be assessed, along with their technological feasibility

A similar process should be followed to determine the best method of meeting any of the other needs

Once the best method has been determined, then this must be integrated into the larger plan So, for example, if in an area the best method for enhancing incomes has been considered to be through non-farm sectors, then the backward and forward linkages of such a strategy must be interfaced with the larger area (regional, state or national) plan. The optimality of the chosen strategy must again be reviewed in light of such an interface.

Once the optimal strategy has been determined, then it must be assessed for its viability. Even if it is the least costly and most beneficial of possible strategies, is it still viable? In other words, does it impose costs that are unacceptable, especially in social and environmental terms? This is particularly important because most social and environmental costs cannot be quantified in monetary terms and therefore cannot be captured by the traditional methods of cost-benefit analysis. Besides, some social and environmental costs are such that they are not subject to a trade-off and must be considered by themselves. There are levels of social trauma and suffering that cannot be justified, whatever the economic returns. Therefore, if the project is only possible, or viable, if it inflicts such costs, then the project is clearly not viable. The same is true for some environmental costs.

The final development strategy that might thus emerge would certainly be a mix of many things Perhaps there would be a much greater stress on "demand side management", on the more efficient use of what is already in place, on the cutting down of waste and opulence, and on alternative methods of irrigation and energy production. In such a scenario there might also be a place for large dams But this would be a place that is deserved on the basis of a comprehensive assessment that establishes not only the social, environmental and economic viability of the large dam but also its optimality, in the face of all other alternatives.

6. Assessment of Options

Nirmal Sengupta

6.1 Institutional Framework for Options Assessment

Water resource development programmes are shaped after passing through many different stages: property rights considerations, planning and designing process, project approval, mobilisation of finance, implementation, operations, cost recovery and conflict resolution. The institutional set-up at every stage acts for and against specific orientations. All the different options may not find a level playing field in an institutional set-up: instead, choices are made, not necessarily on the basis of the true merits and demerits of a case, but often on the basis of institutional preferences. This chapter will review the existing institutional set-up for the water resources development process in India in order to assess whether all options for development are given an equal opportunity, and whether choices are made purely on the basis of technical and economic superiority. Large dam technology is one of the options. In fact, the way the dams are made in India may not be the only possible way of making them; different ways of making large dams are other available options. There are structures other than dams that produce the same output. These are obvious options. Different ways of investing of scarce financial and human resources are also options: scarce resources may be used either for new construction or for performance improvement. The same institutional structures regulate the choices amongst this plethora of options. What will be assessed here is whether all options are given an equal opportunity, and if not, which one has been favoured by the institutional set-up, in what way, and which others have been neglected in spite of their merits.

6.1.1 The Constitutional and Administrative Structure[13]

The Constitution of India envisaged two tiers of government, one at the Centre (the union or federal government) and the other at the State level. In the 73rd and 74th Constitution Amendments, local organisations, known as Panchayati Raj and Urban Local Bodies, have been added as a third tier. The States are administratively divided in three tiers: village, block (about a hundred villages) and district (about a hundred blocks; area, a few thousand sq kms; population, about 2 million). The administrative work of both Central and State governments is divided among various Ministries and Departments. The legislative body at the Central level is the Parliament, at the State level it is the State Assembly, and at the village level it is the Panchayat. All these bodies are elected. The head of the Central Government is called the Prime Minister, that of the States, Chief Ministers, and that of the Panchayat, Presidents. Under the Panchayati Raj system, the elected village *panchayats* (village councils) are also organised into federal structures at block and district level. Administration is organised as a hierarchy with Secretaries at the Ministerial levels, a District Collector (DC) at the District level, Block Development Officers (BDO) at the block level, and Village Level Workers (VLW) in charge of several villages as the lowest level functionaries at the block levels. The judicial process is organised into sub-divisional and district courts, High Courts at the State level and a Supreme Court as the apex body. Services are divided into Union and State services

The development process is planned but not fully centralised. The economy is a mixed economy with both private and public sector functioning side by side. The Central Planning Commission was set up in 1950 to formulate Five Year Plans (hereafter Plan) which would lay down policy priorities and sectoral investments for that period. Eight Plans have been completed; because of difficult circumstances some Plans could not be implemented immediately after the completion of the previous one. Since changes in policies are usually made by Plans, it is easier to understand the Indian development scene with reference to the Plans instead of years.

small dams. After the large Chandil Dam was built on the same river, a dispute arose between the Company and the Bihar Government. The government does not acknowledge the claim made by TISCO that the latter has a riparian and prescriptive right over Subarnarekha water by the fact of use of the water for the last 50 years. The controversy has entered into litigation.

The Parambikulam Aliyar Project in Tamil Nadu was constructed in 1967 and an area of 56.6 thousand ha was granted an irrigation facility once a year. In 1978 the Tamil Nadu Government issued a Government Order to supply water to an additional area of 465 000 ha. This order was challenged (Writ Petition Nos 575 and 1309 of 1978 in the High Court of Madras on 22 December 1983). An agreement was reached that the extension would be allowed after providing the original beneficiaries sufficient water once in eighteen months.

In 1993 the Government of Tamil Nadu passed an Act extending the command area by another 0.175 m ha providing irrigation once in two years to each zone within the command. The State asserted (Tamil Nadu Government Act No 20 of 1993) that, under a Directive Principle of the Constitution (Article 48), which says that the State shall endeavour to organise agriculture in modern and scientific lines, it has been considered necessary to bring more lands under cultivation. The original beneficiaries went to court, contending that the enactment was against the court order of 1983. The High Court dismissed the writ petition, holding that "the principle of promissory estoppel was not applicable in that case", and added that "the action of the legislature in seeking to provide water to additional land could under no circumstances be regarded as arbitrary or illegal". An appeal was also dismissed by the Supreme Court (12 August 1999) as it follows: "The order of the High Court dated 22nd December 1983, when read carefully, cannot be construed to mean that vested right had been created that the appellant would get water once in 18 months."

Even traditional irrigation systems that have served for hundreds of years and are still functional have little security. The sources of water supply for this systems can be diverted, and are diverted, to other uses if the irrigation departments decide that this is desirable for development. Consequently private initiatives to develop water resources in India are restricted to private land: wells and tubewells in the main. The traditional water harvesting structures that are being rebuilt by the Tarun Bharat Sangh have repeatedly been declared illegal, often through the use of the Rajasthan Drainage Act, 1956

Smaller structures constructed under a plethora of watershed development and rainwater harvesting programmes leave aside the rivers and streams. In some rare cases where natural streams are utilised, the continuity of the project depends on the leniency of the irrigation departments. Recently, scope for private sector participation has been created for hydroelectricity projects but no similar private sector participation programme exists for irrigation activities. A Committee, appointed by the Ministry of Water Resources in 1995 (P.V. Rangayya Naidu Committee) for inquiring into the possibility of private finance in the irrigation sector, recommended that the ownership of water, stored and flowing, should continue to remain with the Government. *In essence, non-government agencies have no scope for developing irrigation options in the river valley areas suitable for dams and canals* Panchayat Acts, however, have made some provisions that are yet to be used.

> The Panchayat Acts, in a section called Eleventh Schedule, have given rights to several subjects like water resources to the Panchayats. In a further development, under the Panchayats (Extension to Scheduled Areas) Act, 1996 for tribal (scheduled) areas, an additional provision was made: "the Gram Sabha o Panchayats at the appropriate level shall be consulted before making the acquisition of land in Scheduled Areas for development projects and before resettling or rehabilitating persons affected by such projects in the Scheduled Areas; the actual planning and implementation of the projects in the Scheduled Areas shall be coordinated at the State level." Ms. Medha Patkar said, ". . . if (this Act) extends to all village communities, there would be real democracy".
> (Bhatkal, 1999:166)

Private participation is permitted in another sphere. The impossibility of taking care of the structures down to the field level has led the State irrigation departments to relinquish parts of their absolute control. In construction, maintenance and operations of both canals and other surface irrigation structures the departments admit responsibility only above a certain cut-off mark; below that mark, the farmers are in control. The cut-off mark has varied. On the one hand, since villagers do not construct the supply channels, the department has been constructing these under performance improvement programmes, lack of channels has been identified as one of the major causes for under-utilisation of irrigation potential created. On the other hand, under participatory management programmes, the tendency is to transfer control of larger physical units to farmers. Practially, behind the talk of peoples' participation in canal irrigation systems in India, the only concession yielded is the transfer of a few more rights and responsibilities to farmers, at some tertiary level. The rights to prepare basic designs have remained State departmental prerogatives as always

The paramount right of a State enters into problems in the case of rivers that pass through several States or several countries; except for two smaller rivers, all 16 of 18 major river basins in India serve more than one State Co-sharer States therefore, may have disputes over the regulation of flows and the sharing of costs and benefits of projects, which are not easily resolved. These disputes are a stumbling block to effecting the full potential of river valley developments As early as 1948 the Damodar Valley Corporations Act was passed to facilitate the development of a whole river Instead of entrusting full responsibility to the Central Government the Act included the two States concerned in the decision-making process. Thereafter the Central Government has made many efforts to initiate a detailed study of the scope and feasibility of inter-basin transfers: the enactment of a River Boards Act, the constitution of tribunals, suggestions of basin-wide planning or the setting up of a National Water Development Agency. But the smooth conduct of whole river basin development programmes is still a distant dream. Several major projects have not made any progress or were severely curtailed because of the unwillingness of one or other of the co-sharer States.

6.1.3 Planning and Designing of River Valley Projects

No authority other than the State Government is empowered to issue administrative approval for the execution of any irrigation scheme and the functions of various Departments of the State Government have been defined in the Rules of Business. Accordingly, the Water Resources Department of the State Government is responsible for creating and utilising water resources for various purposes.

Investigations of schemes begin in either of two ways.

i. as a Government directive to the Department in pursuance of popular public demands, or resolutions of, or assurances given by, the Government in the State Legislature or

ii. as a routine development function through paper study of various possible projects of the Investigation Wing of the Water Resources Department.

Options, particularly different technological opportunities and alternate sites, are considered only at this stage, for the most part based only on the understanding of the Departmental personnel. Large dams, considered to be an immensely suitable carrier of development, find favour with the Department as well as with financing agencies, including foreign donors. After the formulation of the National Water Policy, 1987, some guidelines became available, but the Policy lends very poor support to small-scale structures, though it has been able to divert greater attention to drinking water and hydropower uses of water resources. The National Commission for Integrated Water Resources Development Plan has submitted its report: it is yet to become available to the authors.

> The National Water Policy recommends the taking up of individual projects within an overall plan for a basin or sub-basin (clause 3.2), the setting up of special multi-disciplinary units to prepare comprehensive plans for all water uses (clause 3.3), the planning of projects as multipurpose (clause 4.1), and the developing of groundwater recharge projects (clause 7.2).
>
> Eight years after the promulgation, of the National Water Policy, the National Academy of Agriculture undertook a study of its impact. Based on this study some policy recommendations were made at the Second Agricultural Science Congress in 1995. One of the eight recommendations was: "Appropriate rain water management techniques and farming systems need to be evolved and adopted to achieve sustainable agriculture in the dryland areas of India, an aspect about which the National Water Policy is silent."
>
> (Khepar & Sondhi, 1997)

Beside the National Water Policy guidelines, the limited awareness of government personnel in general and of the Investigations Wing in particular, restricts incorporation of the smaller components in basin and sub-basin master plans. In Annex 1 the water management expertise that is developed in Indian universities and institutes is reviewed. The orientations have changed over the years but at no time has any effort ever been made to impart some knowledge of small-scale surface irrigation techniques, both traditional and modern. Curriculum revisions are mostly inspired by foreign universities and agencies, which show little interest in indigenous water resource management systems.

To be fair, the choice of designs is also based on popular beliefs. Existing opportunities for rainfed cultivations are limited and there is a scramble for irrigation, except probably in the eastern part of the country. Popular belief is that there are not many other options for increasing agricultural productivity. Whether this is true or not will be discussed in a later chapter but this is certainly the current belief. The State Governments are under great pressure to construct more irrigation projects and to be seen as active promoters of irrigation for the people of the State (Vaidyanathan, 1999: 109). However, technically sound designs must also take into consideration several aspects which are not clearly noted by the people. Extensive groundwater irrigation, though promoted by the people themselves, has already resulted in a serious aquifer depletion problem. People's beliefs are often formed on limited knowledge and educating them may be more important at times than acceding to popular demands. Unlike the case of groundwater irrigation, in the case of projects like large dams, in which one section benefits and another loses, popular support exists on both sides. Circumstances then force the State to choose sides.

Paper investigation is followed by field reconnaissance surveys (Stage I), after which a plan of development is prepared. Annex 2 lists the procedures followed by the State Departments. In planning and in the preparation of reports and estimates of projects, in earlier years an attitude of pragmatic activism was adopted; as if the information on the most vital variables could be generated only by development actions and not by adopting a perfectionist attitude, which was feared could perpetuate stagnation. An expert Committee on Rise in Cost of Irrigation and Multipurpose Projects which was set up in the 1970s, is quoted here to indicate the state of affairs at that time:

> At one major irrigation project, the main canal had to be extended by 90 kms. and in the process crossing of a river by constructing a dam, had to be provided to get the stipulated area for irrigation, as no surveys were carried out for the main canal and the command area at the time of project formulation. In another case, involving the construction of a major dam, the layout and the design had to be completely changed because of a major surprise in the foundation, discovered during the construction period which could have been easily detected at the investigation stage. Failure to carry out adequate hydrological investigations resulted in under-provision of spillway capacity at the project formulation stage on a few projects. During construction, additional spillway had to be provided resulting in increased costs and extended period of construction. There are numerous examples where surveys for reservoirs, main canals and distribution system were not carried out before taking up the project which resulted in major changes in structures, channel lengths and costs later on. Even now, in many of the projects, the feasibility is determined on the basis of topographical, geophysical and cadastral surveys which are inadequate both as regards to content as well as their extent
>
> (Murthy, 1997 32-33)

Even exemplary projects were not exceptions. More recent proposals are required to follow detailed guidelines issued by the Central Water Commission (see Annex 2) Collection of information is both time and resource consuming and there are also unforeseen factors so that some inadequacy of data is inevitable at design stage. Additional help that could have been obtained is not sought scrutiny of designs and estimates is severely restricted to the government establishment and public participation in information collection and verification is not sought. Public awareness is now much higher and public scrutiny could supplement and reveal discrepancies in official data but this is considered undesirable "intervention", not help

The departmental officials are not, in general, indifferent to social and environmental issues and have indeed shelved projects because of these considerations. The rejection process usually remains confined within the walls of the irrigation departments with the result that such considerate actions do not lead to increased trust. Holistic considerations often cease to be at work when the impacts of projects are divided between States because the inter-State nature of most major rivers quite often means that one State reaps the irrigation benefits and another pays the cost of submergence and major environmental degradation. Technical designs have been compromised because of these problems, resulting in less efficient performance but better social and environmental care. Some projects have remained at the planning stage because of opposition by one or other State on the grounds of submergence and environmental degradations. Within States too, the ethnic composition of people may determine which way the State will decide: if predominantly tribal people are the losers and the socially privileged benefit, then a State is more likely to go ahead with the project

6.1.4 Scrutiny and Project Sanction - Large Projects

Apart from being the deciding authority in inter-State and international matters concerning rivers, the Central Government needs to be consulted by the State Governments for final approval Under the Planning process all major (above 10 000 ha CCA) and medium (2 000 - 10 000 ha CCA) irrigation projects and all multi-purpose river valley projects should be included in the National Plan The Planning Commission needs several clearances for its consideration. These are:

- clearance by the Central Water Commission (CWC) of the Central Water Resources Ministry,

- in the Power sector, projects costing more than a specified amount require the clearance of Central Electricity Authority. (At present the cut-off is, Rs.10 billion for projects valued through competitive bidding, and Rs2.5 billion for others. All projects having an inter state aspect require clearance.);
- in later Five Year Plans, clearance is also necessary from the Central Ministry of Environment and Forests;
- if the project is likely to affect any matter dealt with by other departments eg if it should affect tribal people or a major port, clearance from the Ministry concerned is necessary.

The Planning Commission examines the project from the point of view of accommodation and provision of funds, and issues a letter of acceptance (often referred to as "investment approval"). The Planning Commission conducts its appraisal exercise through its Technical Advisory Committee (TAC), under the Chairmanship of a Secretary (Ministry of Water Resources) and comprising members from several Ministries. Techno-economic examinations of projects for the TAC are done by the Central Water Commission (CWC). This organisation has a vital role; not only does it provide guidelines and expert assistance to the States but it is also the main organisation in the TAC approval process. In addition, if a State asks for financial support for a project, the Planning Commission is guided by the CWC recommendation. *In effect, the CWC regulates the choice of technology for water resources development in the country.*

> In the colonial days, all irrigation works costing more than Rs5 million required the administrative approval of the Secretary of State for India. In 1927, the Central Board of Irrigation, a coordinating body, was set up to help the Secretary of State for India. Later during the Provincial Autonomy, irrigation was transferred from Central control to the State governments but the Board was retained for the dissemination of technical information In 1949 the Board was further expanded to include power and renamed the Central Board of Irrigation and Power. In 1945, the Central Waterways Irrigation and Navigation Commission was established at the advice of the Central Board of Irrigation in order to make the fullest use of the waterways of the country. Later, the Commission was renamed the Central Water and Power Commission, when matters related to power development were included within its scope. It was entrusted with " . the responsibility of initiating, coordinating and furthering in consultation with the State governments concerned, schemes, for the control, conservation and utilisation of water resources throughout the country for the purpose of irrigation, navigation, flood control and water power generation". It functions as the highest expert body on these subjects, advising the Central government and Planning Commission on all problems related to water resource development. The organisation was subsequently divided into the Central Water Commission (CWC), and Central Electricity Authority (CEA), in which pattern it is still functioning.

Any project, large enough to need the Planning Commission's approval or financial help, has to abide by the CWC's demands In the past, this overwhelming importance of the CWC (then the Central Waterways, Irrigation and Navigation Commission) had been instrumental in promoting large dams, when they were still a new idea and were not favoured by many State-level engineers. Although the States have legal rights to develop their water resources, they find that proposals which fit the orientation of the CWC have a better chance of being approved. Within the existing institutional set-up new ideas can percolate most conveniently through an apex institution like the CWC.

A project that has been cleared by the CWC but has not as yet received the necessary clearances from other Ministries, creates a somewhat difficult situation for the Planning Commission. The multiple regulatory mechanisms demand a lot of time and effort; excessive delay in processing is not unknown Sometimes a project that has obtained CWC clearance but for which some other clearance is still pending, is given permission to proceed by the Planning Commission; more often, the States process after receiving only CWC clearance. The Central Governance clearance of State Irrigation projects is not a statutory requirement, but merely a discipline imposed or sought to be imposed via the planning and plan assistance process. Construction works of State projects often start without waiting for all the mandatory clearances, including that of the Ministry of Environment.

Usually, the question of financial allocation is the only other aspect that the Planning Commission takes into account after a project has obtained other mandatory clearances. The Planning Commission also has the authority for not accommodating a project in the Plan because of other national considerations. In the 1980s the Silent Valley Project in Kerala was denied approval on environmental grounds: this project would have submerged the only remnant of primal rain forest in India.

With the Structural Adjustment Programme (SAP), there is a tendency to simply matters. Recently, the Central Planning Commission has relieved smaller size power projects and medium irrigation projects, which have no inter-State ramification, of having to obtain its approval. From now onwards, these projects may be cleared by the Central Design Organisations of the State Governments: only the proforma report of such schemes have to be forwarded to the Central Planning Commission for final approval

6.1.5 Organisation of Finance: Central Government Assistance

The Planning Commission Working Group, for scrutinising which scrutinises proposals, consists of officers from the Planning Commission, Ministry of Finance, and State Government concerned, along with the representatives of the Reserve Bank of India and some other financial institutions. Although the Central Planning Commission issues guidelines to the States regarding the Plan objectives and needed thrust in different sectors of the economy these guidelines do not carry any obligation and the States are free to formulate schemes according to their needs In India the financial rate of return from irrigation has always been poor, and further, the cost of creation of irrigation potential per hectare began to increase rapidly after the 1970s, from the Sixth Plan period. In addition, since more hospitable sites have already been used up, future projects, which are located in more difficult terrain, can only be costlier.

If all the necessary clearances are obtained, then the project is approved by the Planning Commission and included in the National Plan. In that case, the State is eligible to request financial support from the Central Government which is given from the budget of the Central Planning Commission and is called Plan transfer. (This grant is different from the devolution of finance to the State exchequer by the Finance Commission.)

Originally plan transfers (totalling 30% of overall Central Government expenditures) were distributed ad hoc, for particular schemes or projects, largely at the discretion of the Planning Commission When State Planning Boards were proposed at the end of the Third Plan, a more objective approach was required. This new approach, which came to be known as the "Gadgil formula" after the then Deputy Chairman of the Planning Commission, D.R. Gadgil, is still in effect, though it has undergone several amendments The formula is such that a State attracts a greater share of Plan transfer by having more incomplete major/medium irrigation and power projects and externally aided projects (see box). Quite naturally, after the introduction of the Gadgil formula, several States rushed to start major and medium irrigation and power projects and to obtain external aid for these. They also continued to receive a greater share because of project spillover. There is also an earmarking procedure that is heavily tilted in favour of large dam projects; even if a State wants to deploy Central Government assistance to other purposes, it cannot do so

After the formation of the State Planning Commissions and the introduction of the Gadgil formula for the distribution of Plan transfer, States came forward strongly with proposals for major and medium irrigation projects. Both Central and State budgets were short of resources and could not allocate enough for each project so that there were excessive delays in the completion of projects From the Seventh Plan onwards, new projects decreased and available finance remained locked in the completion of ongoing ones. At the same time, the cost recovery process worsened. In 1987-88 unrecovered costs on irrigation became 1.4 times the State Plan outlays on irrigation, which amounted to a quarter of the total State Plan outlays. By 1993-94 unrecovered costs rose to Rs56.5 billion, 2.3 times the State Plan outlays on irrigation (Vaidyanathan, 1999:101).

Faced with the severe lack of resources for new projects, the Ministry of Water Resources has proposed several measures for increasing its share of financial allocations. There was a proposal in the Eighth Plan to earmark Central Government assistance in Plan transfers to new projects but the States were not ready to earmark a large part of their budget for the irrigation projects identified. The Ministry has also looked for private sources of financing. States like Maharashtra and Gujarat have made efforts to increase financial resource by selling bonds.

> Under the Gadgil formula, first priority is given to meeting the requirements of Special Category States (like Jammu and Kashmir, Himachal Pradesh, Assam and the North-eastern States), Special Area Programmes and Externally Aided Projects. The balance is then divided between the other States with some additional weightage given for different reasons. Some weight is given for backwardness of States. For many years additional weight was given for meeting spillover power and irrigation projects.
>
> Before the Gadgil formula for distribution, all plan assistance by the Central Government was project-specific. Even after 1969, up to a half of the assistance can be earmarked for specific purposes. The stated purposes are:
> Selected ongoing projects for power and irrigation
> Externally aided projects
> Schemes in one or two sectors which have priority
> Basic Minimum Services

6.1.6 Power Sector: Salient Features

The share of non-commercial energy sources in India, biomass and animal wastes, is steadily declining. Between 1971 and 1990 it came down from 70% to 30%. Coal, oil, natural gas, nuclear fuel, and hydroelectricity are the primary commercial energy sources, of which hydroelectricity is the least polluting. India meets nearly 25% of its total energy needs through imports. All other commercial energy sources, except hydropower, are partly imported. Thus, on several accounts, hydropower has an important role in the Indian economy. In the first couple of decades, hydropower production increased rapidly from the construction of several large multi-purpose dams but progress has slowed down in recent years reflecting the case of large dams in general. The different reasons are (IWRS, 2000: 5):

> *Despite hydroelectric projects being recognised as the most economic and preferred source of electricity, share of hydropower has declined steadily from 44% in 1970 to 25% in 1998. The constraints which have affected hydro development are technical (difficult investigation, inadequacies in tunnelling methods), financial (deficiencies in providing long term financing), tariff related issues and managerial weaknesses (poor contract management). The hydro projects are also affected by geological surprises (especially in the Himalayan region where underground tunnelling is required), inaccessibility of the area, problems due to delay in land acquisition, resettlement of project affected people, law and order problem in militant infested areas etc. These are all problems that can be resolved with some effort.*

The financial and tariff related issues associated with hydropower need to be understood in relation to the power sector, not the water resources sector. A brief introduction to the nature of the problems follows

The Ministry of Power has overall responsibility for power sector development. Its technical wing is the Central Electricity Authority (CEA) which has a role comparable to that of the CWC in the Water Resources Ministry. Large projects requiring substantial capital expenditure or projects having an interstate aspect require the technical approval of the CEA. In 1996 this limit was revised (see Section 6.1.4 b). The State Electricity Boards (SEB) have the sole right to distribute power in their respective States. But power generation is undertaken by three different types of organisations: the Central Government, the States, and private parties.

The Central Government generating companies, one each for thermal, hydroelectric and nuclear power, supply power in bulk to the SEBs. State power corporations construct power plants in the States and hand the plants over to SEBs after commissioning. Five private generating and distribution companies, which has been engaged in the generating and distribution of electricity in some important cities for a long time, were allowed to continue their operations under licence. While irrigation is managed as a departmental activity, the SEBs are constituted as Boards under Electricity Supply Acts, their capital structure is primarily based on debt, not on budget allocations. Apart from internally generated resources, other sources of finance are the State Government loans, Central Government assistance through the State Government as a part of the Plan Transfer, and external aid.

The power sector has always been treated as a commercial activity. The SEBs were required to earn a minimum rate of return of 3% on their net fixed assets in service after providing for depreciation and interest charges. However, excepting three SEBs, the others have negative internal resource generation, which is deteriorating over time. The average rate of return was -17.6% in 1997-98, resulting in a loss of Rs100 billion (Das et al. 1999:115). At the same time, the share of the State Government loans, which are the main source of finance for the SEBs, have been declining in several States due to the deteriorating resource position of these States. The World Bank stopped lending to the SEBs, which resorted to raising loans from financial institutions and open market borrowing which resulted in a substantial increase in the interest burden.

The only course feasible for meeting the growing needs of power generation was to bring in the private sector on a large scale through schemes like equity partnership, build operate and transfer (BOT) or in the form of portfolio investment by foreign financial institutions in Indian/foreign managed companies. In 1991 the Electricity Supply Act, 1948 was amended, providing for generating companies in the private and joint sectors also. The SEBs remained the sole distributors of power. The private sector generating units were to sell power to the SEBs under a commercial agreement. Thus, in comparison to the irrigation sector, the power sector has made much greater progress towards permitting private sector participation.

SEBs owe a huge amount to central organisations like the National Thermal Power Corporation (NTPC) and Coal India Ltd. The NTPC stopped power supply to West Bengal, Bihar, and Orissa during September 1998, becaase of the mounting arrears of about Rs30 billion of the SEBs of these States.

The resources that are available in the domestic capital market are too meagre to meet the massive capital requirement. Private sector participation is primarily directed towards attracting foreign investment. Since the SEBs are heavily indebted, the developers asked for guarantees from the government on payment of their sales to the SEBs. Several schemes have been introduced, but these proposals suffer from serious shortcomings like the granting of a counter-guarantee in a discriminatory manner and the absence of any measure to ensure minimisation of capital cost. If the SEBs fail to pay their dues, the counter-guarantee schemes will drain out from Central Government exchequer several billion $ every year. Other avenues are being considered. By September 1996, nearly 90 000 MW of generating capacity were proposed by the private sector which included foreign companies but till 1 March 1 2000, only eight plants with a total capacity of 473.25 MW were in operation. Private investors have not shown much interest in hydel power generation partly because the tariff structure and norms for hydro projects are considered unfavourable compared to thermal projects. In 1995 the government revised the tariff for hydel generating stations.

6.1.7 Planning Designing and Financing of Smaller Structures

(a) Irrigation and Water Harvesting

That only bigger projects could be included in and financially supported under the Plan bears administrative logic but no technological basis. Because of their size, large dams and canals were invariably included in the major/medium category, wells and tubewells in minor irrigation. The rich heritage of other traditional surface irrigation systems did not fit into the size category of a single department so a complicated system of compartmentalisation evolved. In the States of Haryana, Jammu & Kashmir, Madhya Pradesh and Punjab, "traditional" works were surveyed, executed and maintained exclusively by State Irrigation Departments. In most other States the general pattern was that works exceeding a certain size (defined by cost or irrigation potential) were handled by State Irrigation Departments and those below the prescribed limit by the Panchayati Raj Departments. Tank irrigation, for example, was distributed across different departments depending on the size of each tank. In the First Plan, minor irrigation was placed under the Ministry of Agriculture and Community Development. After this Ministry was split, resulting ultimately in the Agriculture Ministry and Rural Development Ministry, minor irrigation remained with both.

Extension plans, in such situations, had to fit to the class size appropriate to the department proposing

them. Their designs could not be adapted to the specific topographic and hydrological conditions of their locations. Nor could these minor irrigation departments aspire to link these structures to benefit from major and medium systems. The projects were selected for execution on ad hoc basis. A Joint Commissioner (Minor Irrigation), Ministry of Agriculture, Department of Agriculture, New Delhi, noted on 20 June 1972: ". . . Preparation of basin-wise minimum Key-Plans, based on reconnaissance surveys/short-cut studies and approximate hydrologic assessment of the available water resources is indispensable for selection of projects according to sound techno-economic criteria. " (Jain, 1972.65). But this was never done. Technical support was not lacking but was not streamlined. Panchayati Raj Departments (later Rural Development Departments) in some States had set up their own hierarchy of engineering officers to look after all their engineering works including minor irrigation projects In other States no proper hierarchy was ever built up Junior engineers belonging to many different departments were entrusted with these works along with multifarious other jobs (Jain, 1972.17-19).

In this situation there was little information exchange and no technological progress could be made. For historical reasons (Sengupta, 1991: 69-77), familiarity with these works has differed from State to State: in several States not even minimal information about their small surface irrigation works existed. This had resulted in some colossal ignorance, often reinforced by official reports (see Box) In 1986-87 an All India Census of Minor Irrigation Surface Water sources was conducted but has not made an iota of progress towards identification of these structures. The results of the second Census are about to be released.

The relative awareness in South India had led some engineers to notice the potential of these indigenous irrigation works. Of particular significance were the traditional systems, in which canals

> In 1966, after a "statewide field survey", the Irrigation Team, which was appointed by the Planning Commission for reviewing the minor irrigation works in the country, declared, "In the alluvial region of Punjab and Uttar Pradesh as also in Bihar there are not many irrigation tanks." (Planning Commission of India, 1966:8).
>
> According to the districtwise (Second) census report submitted by the Minor Irrigation Department (Bihar), the number of storage tanks (ahars) in the State is 39 009 out of which 4 453 belong to the Government and the rest are private or belong to public organisations (GOB, 1994:23).

were feeding tanks (called system tanks). In the late 19th century the supply systems of some system tanks were enriched by training the source rivers in various ways. After large dam construction techniques became available these techniques were also used for this purpose once in a while. These systems are the *prototypes of the bottom-up approach to water resource development* In Annex 4 the development of such a system is described. These works still exist and are not perceived as being in any way different from conventional dam and canal design. These tanks are not victims of departmentalisation; whatever their size, the system tanks are under the control of the same department that looks after major and medium irrigation. These are exceptional cases; the bottom-up approach has not been followed in general.

For years the smaller surface water structures remained neglected. At an estimate, during the period 1950-51 to 1968-69, about Rs4 billions were spent on these "traditional" works (Jain, 1972:12) as against Rs17.6 billion on irrigation and flood control. Jain (1972:64-65) felt that "The present rate of investment (which is about Rs500 millions per annum) will have to be increased manifold if satisfactory rate of growth is to be ensured in this sector." But nothing much happened till the 1970s. The realisation of the geographical bias of agricultural development policy led to some modest efforts for the development of dryland agriculture in the Fourth Plan. Real interest was aroused during the Fifth Plan period once it became known that nearly sixty% of land in India was degraded in some form or other. Soil conservation and watershed development programmes, with strong components of rainwater harvesting, increased dramatically in importance. The Agriculture Ministry started the National Watershed Management Project, which was renamed the National Watershed Development Project for Rainfed Areas (NWDPRA) It is now planned that the NWDPRA will cover all development blocks with less than 30% of the area under irrigation. Other Ministries followed.

> The National Commission on Agriculture (1976) estimated that 175 m ha of land out of a total of 304 m ha was degraded in some form or other and were in need of attention. The degreaded land includes not only culturable wastes and pastures but all those lands producing biomass much below their potential and includes considerable parts of cultivated and forest land which have lost their productivity.

The Integrated Wasteland Developments Project (IWDP), the major wasteland development programme of the Ministry of Rural Development, originated from a participatory afforestation programme located at the Ministry of Environment and Forests in 1985 Several other programmes of the Rural Development Department, like the Drought Prone Area Programme (DPAP), the Desert Development Programme (DDP), and the Wasteland Development Programme (WDP) are promoting rainwater harvesting. The Employment Assurance Scheme (EAS) requires that District Collectors take up public works which are durable in nature. Minor surface irrigation works and embankments for flood control are two very popular durable works. The EAS scheme has now been extended to all rural blocks in the country. Another wage employment scheme, the Jawahar Rojgar Yojana (JRY).

has made a similar contribution. The acute drinking water availability problem in the country had led to the inclusion of drinking water supply in the famous Technology Mission of the 1980s. Currently, there is an Accelerated Rural Water Supply Programme (ARWSP).

Foreign donors are also enthusiastic sponsors: The World Bank supports several watershed development programmes; There are projects assisted by Germany, Switzerland and DANIDA; And the European Economic Community (EEC) sponsors programmes for Tank Rehabilitation (renovation and modernisation).

Although both agriculture and rural development come under the State list, many of the above schemes are Centrally Sponsored Schemes (CSS), which has made substantial funds available for such works. It may be recalled that the total amount available for Plan transfers to States is determined after allocations for CSS are made. In 1995-96 the CSS received Central Government funding of the order of Rs160 billion, which is more than the States received from the Central Government as Plan Transfer. Allocation to individual schemes was not always very high as CSS have proliferated over the years. In 1995-96 there were 182 CSS under implementation. The total funds allotted to watershed development activities by the large number of agencies and schemes will not create any wrong impression should it be remembered that more than 50% of the geographical area of the country has to be covered by these programmes. In spite of two decades of the Drought Prone Areas Programme (DPAP) and the Desert Development Programme (DDP) only 10% of the total geographical area identified as drought prone and only 1% of the desert area have been treated (Planning Commission of India, 1999:II, 995). The amount available is also thinly distributed. The sanctioned rate for the Rural Development schemes is far too insufficient for constructing a structurally sound storage.

The sanctioned rates (Rsper hectare) for some relevant schemes are as follows.

Integrated Wasteland Developments Project (IWDP)	4 000
Drought Prone Areas Programme (DPAP) (6 000 with effect from 1.4.2000)	4 000
EEC Tank Rehabilitation Programme	11 000
Proposed Irrigation Department (Tamil Nadu) programme for Tank Rehabilitation with World Bank assistance.	27 000
Average cost of the Major and Medium Irrigation Projects cleared during 1990-92 (courtesy CWC)	28 166

Different irrigation departments prepared the last three schemes. Estimated costs of these schemes reflect what is actually necessary for construction or rehabilitation of sound engineering structures. The first two, those of typical watershed programmes, can be compared with these estimates. Many water harvesting structures built with such meagre allocations do not last.

The profusion of supporting agencies and schemes is indicative rather of a lack of organised effort. The low rate of financial allocation also prevents technical support from being sought. Technical assistance is generally provided by a multi-disciplinary technical team comprising officers from various line departments associated with different activities related to watershed development. As a result of the Hanumantha Rao Committee Report in 1995, some homogeneity has been introduced. Guidelines have been issued, but the Guidelines lay more emphasis on popular participation than technical details. Rare contributions to technological improvement include the operational research project of the Indian Council of Agricultural Research (ICAR), conducted on 47 watersheds. The

Technology Mission had made some significant contributions, but in general, there is little impact assessment and, therefore, little attempt to learn from experiences. This is in sharp contrast to the extensive guidelines and scrutiny undertaken for large dams and major and medium projects.

Technical inputs are rare. In 1970 ICAR had started the All India Co-ordinated Research Project on Dryland Agriculture (AICRPDA) which was later reorganised as the Central Research Institute for Dryland Agriculture (CRIDA). There is also an International Crop Research Institute for the Semi-Arid Tropics (ICRISAT). Being primarily agricultural institutes, neither of these has shown much interest in structural methods of water harvesting beyond terracing and contour bands, though their non-engineering methods of run-off prevention like mulching and vegetative barriers are of interest. Another department but also agricultural, that of soil conservation, has played a laudable role in pioneering some of the most successful watershed development programmes, like that of Sukhomajori. There are also a few works at the Agricultural Research Centres of the ICAR, and at the Agricultural Universities but engineering colleges and institutes generally show little interest. In brief, there is not a single organisation in the whole of the country for the systematic study and improvement of rainwater harvesting engineering. A former chairman of CWC and President of the Indian Water Resources Society, M.S. Reddy, drew attention (IWRS, 1998: Foreword) to this fact: "Strangely enough, the Ministry of Water Resources, the one Ministry which should be most concerned, is not even distantly connected with watershed management." In engineering colleges, no change has been made in syllabi in order to attend to the technological needs of these growing opportunities (see Annex 1). Whatever technical advances in water harvesting methods have been made, have been the results of efforts by NGOs like Tarun Bharat Sangh, Centre Applied Systems Analysis in Development (CASAD), or Peoples' Sciences Institute (PSI).

The agriculture department staff shares the ignorance that prevents the Investigation Wing of the irrigation department from developing the traditional systems of water harvesting. Prof Venkateswaralu (pers. comm. 2000), a renowned expert on dryland farming systems, indicates that works taken up under watershed development programmes mostly ignore the traditional systems of resource management. In fact, along with the Million Wells Scheme, watershed development through check dams and other mechanical structures is leading to the drying up of the traditional tanks.

While NGOs contribute sustained effort, the government approach is to develop one watershed every 4-5 years period and then leave the area. Watershed development cannot be a one-time event. From an analysis of the territorial jurisdictions of different programmes, as specified in their terms of reference (TOR), it is clear that these programmes are applicable only to areas beyond river valleys. Further, the watershed development is implemented in bits and pieces without first developing a total plan for a whole catchment. The average size of NWDPRA projects is 1 000 hectares, that of IWDP is 4 000 hectares and plans are made for this kind of scale only. Improved technology options are not based on a total plan. There is no thought of integrating these works with the river basin plans, or of integrating the smaller works so that together they constitute a single work. The World Bank-sponsored Watershed Development programme addresses 25 000 hectares, but that is to facilitate the Bank's financing procedure, not for technological reason (Pui, 1998). In general, these small surface water development programmes are planned to remain small forever and are developed in such a way as not to contest the case of major and medium projects.

(b) Flood Management without Dams

The National Programme of Flood Management was launched in 1954 for non-structural and structural works other than large dams. A number of State level committees were also set up from time to time. Rashtriya Barh Ayog was constituted in July 1976 and made 204 recommendations, both structural and non-structural. In July 1996 the Ministry of Water Resources (GOI) set up a task force that made some more recommendations. Flood management requires the coordination of work from many different agencies. In 1975 the Central Government had circulated a Model Bill to the States for Flood Plain Zoning, only Manipur State has enacted it. Mock floods are being talked of. The CWC has set up a network of flood forecasting and warning stations covering most of the inter-State rivers. There are above 150 flood forecasting stations and nearly 7 500 flood forecasts are issued every year, normally 24 to 48 hours in advance (Planning Commission of India, 1999:II, 511). The States have their own flood warning mechanisms but these are still insufficient. Every year the Ministry of Agriculture circulates a Model Action Plan for Disaster Preparedness for floods in the country.

The total loss from flood damage to crops, houses and public utilities is estimated at Rs412.5 billion for the period 1953-1994.
Between 1992 and 1996, Plan expenditure for flood management was Rs3.380 billion per annum and Relief expenditure for flood and cyclones together Rs7.04 billions per annum
(Planning Commission of India, 1999a:II, 511).

Because of paucity of funds many flood management schemes have remained incomplete. Schemes continuing from previous Plans need Rs33 billion for their completion (Navalawala, 1998:46) but no additional funding is provided for completion as in the case of major/medium irrigation schemes States themselves have to raise these funds. From within the State budgets, funds for Flood Management may be diverted to other sectors. Though not all States have done the same and some States have actually spent more than the approved outlays, the funding for the flood control sector has been decreasing from Plan to Plan. During the Eighth Plan it was a mere 0 69% of the total Plan expenditure in State Plans (Navalawala, 1998:46).

(c)_Small Scale Power Generation

At the time of Independence the country had some small hydropower generating units. After Independence only large projects were undertaken and small hydropower development was totally neglected Even nominal information about possible sites was not available. Only the public sector had the right to generate electricity. Hence the private sector, which had initiated small hydropower generation in the pre-Plan period, was prevented from undertaking any further development It is only in the last ten years that the Power Ministry has begun to pay some attention to small hydropower development. The CEA was asked to make site investigations. Programmes for non-conventional energy sources have increased attention on small hydropower production. The Ministry of Non-Conventional Energy Sources has been given the responsibility of developing of small hydropower projects of up to 3 MW capacity.[14]. This Ministry has been conducting site identification for these very small size projects.

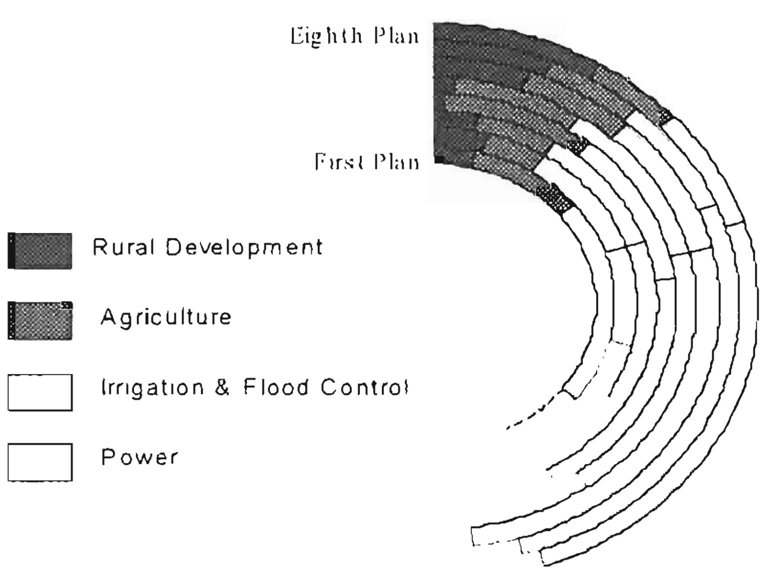
Massive private sector participation has been sought even in the small hydropower area. But private sector participation requires various kinds of legal and administrative measures: from permission to use water resources to linking with the electricity grid for transmission of generation Measures taken until now are not adequate and, as small scale pwer generation is a State subject each. State has to make its own laws and regulations.

India is one of the few countries in the world to have drawn up a comprehensive strategy and an action plan for renewable energy based capacity addition for power. In the face of a sharply increasing import bill for fuel following the oil crises of the 1970s, in the Fifth Plan (1974-79), self-sufficiency in fuel was mentioned as a priority. In 1982, the Ministry of Energy set up a special Department of Non-Conventional Energy Sources which was later made a full-fledged Ministry for promoting new and renewable sources of energy. The Central Government Ministry of Non-Conventional Energy Sources (MNES) works in co-ordination with the State Governments. National level expertise is available for site identification of Wind Power and Small Hydro Power. Wind Power sites are extensive patches of wastelands, which are leased to private producers. In many ways these programmes have relied heavily on Central Government subsidies, which are provided to individuals either directly through the Indian Renewable Energy Development Programme (IREDA) or to States through Central and Centrally Sponsored Schemes.

The poor and people of the remote areas are the worst victims of the energy crisis. On the one hand, their conventional sources of energy supply like firewood and animal waste, are being depleted: on the other hand, electricity has not reached many of them. Socially oriented programmes by the energy sector are intended to alleviate these problems. The Integrated Rural Energy Programme (IREP) was started as a planning exercise in the Planning Commission, during the Sixth Plan, taken up as a regular programme during the Seventh Plan and in the middle of the Eighth Plan (in April 1994), it was transferred to the MNES. The IREP aims to meet the energy requirement in selected blocks all over the country by providing a cost-effective and optimal mix of all the energy sources. The Central Government provides funds for creating capabilities (planning cells, staff, training), the States provide funds for actual implementation of the programmes by providing energy devices like biogas plants, improved chullas, solar cookers, etc. For maintenance, State and district level technical back-up units have been set up. A National Training Centre and Regional Training-cum-Research and Development (R&D) Centres already exist. Achievement in the Eighth Plan has been less than the target.

Figure 6.1 shows the changing pattern of Plan expenditures. Further breakdown, showing exactly the heads of our interest are not readily available.

Figure 6.1 Sectoral Expenditure in Different Plans



(Full circle represents total Plan size).

6.1.8 Foreign Financial Assistance

The Constitution of India permits only the Department of Economic Affairs of the Central Government to receive foreign aid. If any other Ministry or a State seek foreign assistance for projects, the loan agreement has to be signed by this Department. In earlier years, when Plans were made only at the Central level, both request and negotiations occurred at the Union Government. After the introduction of the State Planning process, the States also have an interest in finding foreign assistance for State Plan projects. The availability of additional foreign assistance to some of the States might have distorted the parity between States, which is taken care of by the Gadgil formula. In order to prevent this distortion, direct transfer to a State was not allowed at the beginning, disbursements from foreign assistance were transferred to the States in accordance with standard arrangements for Central assistance. However, following repeated requests by donors, since 1975 the government has adopted a principle that provides an incentive for States to prepare and implement foreign-assisted projects. In addition to its existing budget, a State can obtain a certain%age of the overall cost of foreign-assisted projects in that State. This is allowed for only certain categories of projects: irrigation, rural development, and water supply being among them. States have, therefore, a strong incentive to explore projects likely to attract foreign assistance. In turn, foreign donors, like the World Bank, that are interested in influencing policies have increased scope to do so.

The Reserve Bank of India (RBI) report on currency and finance shows that the contribution of all external donors is about 13% of total public sector outlays in the irrigation sector, and that of the World Bank and the International Development Agency (IDA) is about 10%. Till 1970, the Bank was not a major party in the extension of large dams in India; its contribution was confined to a small loan to the DVC in the 1950s. After the creation of the IDA in 1961 it was under pressure to commit the IDA funds. Many of it's the Bank's negotiations in the 1960s broke down for various reasons, including unwillingness by the Indian Government to accept the international competitive bidding condition. Since the 1970s the input of the Bank has increased significantly. This period marks the planning of State Planning and a very large number of dams were proposed. Total World Bank loans to India have double and trebled, on average, every decade. Loans for irrigation, flood control and drainage, account for about 14% of total World Bank loans to India (Guhan, 1995). Hydroelectricity generation received about 7% of the total World Bank loans to India.

In addition to these direct contributions, about 10% of Bank loans (Guhan, 1995) have gone to rural electrification, agricultural credit and area development programmes, which have a significant effect on the water management sector. Programmes for watershed development, tank rehabilitation, etc have received considerable support from the World Bank and other donors. External donors, particularly the World Bank, have given valuable support for the development of non-conventional energy sources. IREDA constituted in 1987 for providing soft-term loans to private developers of non-conventional energy, receives assistance from World Bank, the Government of the Netherlands, the Danish International Development Agency (DANIDA) and the Asian Development Bank (ADB). Under the Kyoto Protocol, developing countries are asked to invite free equity from developed countries for hydro development. The Global Environmental Facility (GEF) is already funding several small hydel projects in the Himalayan region. The Global Infrastructure Fund (GIF) Research Foundation, Japan, is keen on developing multi-purpose schemes in the Himalayan region.

As the major external donor, the World Bank has played a significant role in the promotion of large dams in India. Some other donors have also contributed their share. The Tehri Dam, which did not get environmental clearance at first, revived after the Soviet Union agreed to underwrite the project in 1987. Contrary to what is sometimes suggested, the role of external donors in promoting large dams in India is limited; none of them had any significant presence in the 1950s and 1960s when the pro-dam orientation of water resource development was firmly established. Also, external agencies are approached for financial assistance only after a project is conceived. The primary responsibility of making choices in favour of large dams as against other indigenous water resource development techniques, lies with the Indian planners and designers.

In reality, a substantial part of World Bank assistance in earlier years went, purportedly, to promoting better management and better organisation in irrigation (Command Area Development) and drainage. Later, the Bank was instrumental in promoting dam safety measures. In the course of time, the Bank increased its focus on social issues. Thereafter, Bank assistance was directed towards promoting performance improvement of existing schemes, participatory development, increased accountability, privatisation, cost recovery, rationalisation of tariff structure in the power sector, improved environmental management, and better rehabilitation policy. While it is true that some of these policies were adopted only after popular demand, the Bank may be credited for being responsive to such demands.

However, the Bank's success in implementing the above policy reforms is nominal, if any (Guhan, 1995). No doubt, the Bank conducts several assessments at different stages of those projects receiving its support. Paperwork for these, demanded by the Bank, diverts considerable attention on the part of technical staff in the preparation of polished reports. These are simply wasted because the Bank has no mechanism for ensure the implementation of these reports. In fact the government officials routinely violate the demanded conditions knowing that the Bank will not insist. In a nutshell, the Bank's own performance in its "performance improvement and policy reform programs" in India is poor.

Instead, some programmes have had an adverse impact on the existing smaller units. In the early 1970s, going beyond its usual procedure, the World Bank made loans available to the agency later named the National Bank for Agriculture and Rural Development (NABARD), which was engaged in providing agricultural credits to individual farmers. By operating through co-operative credit institutions at the State and district levels, NABARD helped the Bank to bring credit to remote areas and to small farmers. Minor irrigation projects (open dug wells, tubewells, and electric pumpsets) account for a sizeable section of loans granted by NABARD. Further credit was given for rural electrification. The subsidy for groundwater exploitation methods, coupled with a subsidy on power, made the rural population rely more on tubewell irrigation and neglect the existing "traditional" irrigation systems. But for these credits the massive extension of tubewell irrigation would not have happened. Without the subsidies the arduous task of lifting water could never have competed with the minor surface irrigation methods.

In another innovative approach adopted in the 1970s, several medium irrigation projects received Bank assistance. This approach, known as the composite project approach, permits combining, for a single loan, several projects that individually are too small to justify Bank participation. In the implementation of all these programmes the individual units are treated as independent projects Spatial aggregation is simply a matter of financial convenience, not a technical consideration In fact, the Bank's spatial aggregation, along with its need to look for a convenient disbursement mechanism, has become the most serious danger to the survival of irrigation options. A massive programme, called the Tamil Nadu Water Resources Consolidation Project (WRCP), was taken up for improved utilisation of water resources throughout the State. Because they were too small, the 30 000 tanks of Tamil Nadu had no place in this Statewide development programme and their sources of supply were threatened. Similarly, river basin planning that is being promoted by the Bank makes no demand on the government to ensure inclusion of the smaller surface irrigation structures and sharing of water by major/medium projects along with these structures. While dam construction, tubewell extension and river basin planning for major/medium irrigation are orientations of the Indian establishment the Bank's promotional policy, which provides unqualified support in favour of these orientations along with a reluctance to verify social and scientific optimality of the programmes, cannot but make it a willing partner in all positive and negative impacts of the accepted course of development

6.1.9 Implementation and Operations

In the case of large projects, after approval by the Central Planning Commission the project returns to the State Government for implementation. The State Government accords administrative approval and sanctions expenditure through budget allocation, which requires approval by the State Legislature Thereafter, the chief engineer of the project starts construction work. The various components of the projects are designed in the Central Design Organisation. Annex 2 lists the implementation and operations procedures of large dams.

Programmes for small schemes are implemented within the confines of a village or a watershed. At the district level, the appointed district collector is in charge of the planning and implementation of policies and programmes of both Central and State Governments. The district collector consults the zilla parishad, the district level federation of Panchayats under the Panchayati Raj system Technical teams comprising officers from various line departments associated with different activities generally provide technical assistance.

Details of project and programme implementation are outside the scope of the present report In Annex 3 contains a recent summary of several evaluation studies of the Central Planning

Commission. In general, considerable improvement is needed in both project and programme implementation.

In areas where private sector participation is allowed, the investment made by the government is restricted to the initial stage and to infrastructure creation.

Programmes like watershed development do not impose any recurrent cost on the government; they are directed to construction and capacity building. On the adverse side however, this eliminates continued interest by the government and the development agencies at operations and management (O&M) stage. Poor construction, poor maintenance and inefficient operations may result in wiping out the investment. Post-commencement evaluations of stray cases confirm that this happens; but there is no compiled information. In the case of major/medium projects, O&M tasks remain the responsibility of the government. This aspect is rapidly increasing and, at present, eats up very substantial part of the departmental budgets leaving very little for further construction and development. The need of cost recovery from the beneficiaries of public irrigation works has been stressed by all Committees and Commissions (Vaidyanathan, 1998) but with little effect.

Since existing generation and transmission capacities are in the public sector, both Central and State, supply side management can be undertaken only by the government. The National Energy Efficiency Programme (NEEP) was initiated during the Eighth Plan. The Ministry of Power prepared an action plan for supply side measures while demand side management measures can be effective only if users co-operate. In 1989, the Ministry of Power set up an Energy Management Centre (EMC) to implement various demand side measures. These measures have been less than effective because of the following: tariff structure rationalisation needs strong political will which is not forthcoming, power subsidy for agricultural uses continues unabated, development and production of energy saving equipment, by private producers, are slow and there is very little in the way of education campaigns to increase public awareness.

6.1.10 Information Sharing and Public Participation

In small works, like watershed development or tank rehabilitation, the requirement of public participation is now invariably included in project designs. Whether the methods adopted are satisfactory or not may be debated. But in most schemes this is a mandatory requirement. Also, Participatory Irrigation Management (PIM) is now on in the agenda of performance improvement and cost recovery programmes in existing major and medium irrigation systems. Public participation in the planning and implementation process of major/medium projects is still, not guaranteed. Allocations are decided in State Assembly debates, and in competitions with other departments. Since large dams and multi-purpose river valley projects use up a considerable part of the total Plan budget of States, the allocation decision is usually political, needing extensive support beyond the water resources department. This is practically the only established channel through which information flows out of the Government. The technical details are rarely asked in the Assembly, nor does the Technical Advisory Committee of the Planning Commission publicise the technical aspects of proposals inviting opinions. As usual, there are notable exceptions.

Following severe public grievances against the construction of embankments on a section in the right bank of the Damodar in 1978, the Marxist-led multiparty Government of West Bengal decided to review the construction in public. A technical committee was appointed, chaired by a retired Chief Engineer of the Irrigation and Waterways Department. The task assigned to the Committee was to examine the drainage scheme under construction, afresh and in detail, and to draw up a revised Lower Damodar Drainage Scheme as may meet with public approval for implementation. The Committee conducted intense discussions with representatives of the affected areas and laid greater weight on public opinion than on the specialised knowledge of its members. The revised scheme was implementated in its entirety.

Article 19(1)(a), the right to freedom of speech and expression, included among the fundamental rights guaranteed in the Constitution of India, has been interpreted as inclusive of people's right to information (right to know). Violation of the right to know violates the right to life enshrined in Article 21. Right to livelihood, right to health and right to a clean environment, right to shelter and privacy, are already read into Article 21 by the Indian Judiciary (Dias, Bhattarai & Kakarala, pers. comm.). But violation of Article 19(1)(a) in the developmental works has been so routine that hardly any notice is ever taken. The demand for the right to information earned many supporters after the Bhopal gas leak disaster of 1984 Soon an organised movement developed directed against corrupt officials who were often taking recourse in the Official Secrets Act to hide the misappropriation of funds in the implementation of various programmes. Several Chief Ministers of States expressed favourable opinions regarding transparency in government works and public right to information. Very recently, on 28 November 1999, the Union Minister for Justice and Company Affairs announced that the Official Secrets Act, a relic of the past, would be scrapped and the Right to Information Bill would be introduced to make governmental functioning transparent. Corruption is widespread, so much so that during the last General Election many political parties openly debated whether to exclude known corrupt persons while selecting candidates.

> In the system of governance of material resources evolved in India, one can discern parallel lines of evolution between the Constitution and the laws and administration concerning the development process. While the Constitution celebrates the spirit of participatory governance, the planning process, both in its intent and impact, regards the citizens as no more than objects of developmental decisions. Decisions concerning large, medium and small irrigation projects are glaring examples of inversion of the Constitution, as they are projects *for* the people but not *by* the people.
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> Prof. M. K. Ramesh of National Law School of India University

The right to information is blatantly violated in land acquisition for projects. Sometimes the people who will be affected are not even informed sufficiently in advance. The Land Acquisition Act, 1894 allows acquisition of land for public purpose but does not require the informed consent of the affected person Other serious shortcomings of the Act and its use are that "public purpose" was not originally defined, nor has it been defined since. . In determining what can be considered as "public purpose", the court has normally relied on the judgment of the Government. The Act does not allow the affected persons to question the "public purpose" of the projectnor does it refer to rehabilitation. Cash compensation has been the predominant mode, except for considerate actions by the conscientious project authorities The deficiency of the existing Land Acquisition Act was first acknowledged, though only implicitly, by the Narmada Water Dispute Tribunal Award, 1979 Following this award and subsequent agitation the need for a uniform norm on resettlement and rehabilitation became necessary Earnest efforts in evolving a national policy for rehabilitation in India began only in the 1990s and have yet to culminate in an accepted policy.

Project proposals are also believed to contain misinformation, in the matters of submergence area, cost benefit analysis etc. The demand for the right to information is gaining ground on this account. In some places local people engaged professionally competent NGOs to conduct an "independent assessment" of expected submergence area, siltation rate, fair pricing of trees and forests, and likely water use pattern. Such studies were conducted at the proposed Auranga Dam site in Bihar (Roy et al, 1992) and two medium irrigation projects in Rajasthan (PSI, 1999). The studies had to be both technically sound and understood by people so as to be acceptable to both. Local people were trained in survey methods and the investigations were done in a participatory manner The results show a considerable amount of discrepancy with the official project proposals. Science and technology education in India is well developed, and the country has a strong heritage of popular science movements, which gives social activists and NGOs a strong scientific base

Non-government development activities have a long tradition, beginning with the Gandhian Sarvodaya movement of the 1950s. Understandably, environmental movements often find their inspiration in Gandhian philosophy, drawing explicit praise from the Green Movement of the developed world. The Seventh Plan acknowledged the role of NGOs in the development process and made scope for their involvement. The Indian Government allows NGOs to obtain funds for many programmes for delivery among the target groups. Estimates of the number of NGOs in India vary from about 10 000 to 100 000. Put (1998:201-207) classifies the approaches of the NGOs into three types:

(i) welfare oriented: providing basic needs, relief etc such as services to poor;
(ii) development oriented: working uncritically as deliverer of the government programmes believing that poverty can be tackled by increasing the asset positions of the poor. Understandably, this block is welcome by government agencies.
(iii) empowerment oriented: some NGOs are critical about government approaches, about the appropriateness of the programmes, suitability of technology package, policies regarding development, including water resource development. Many of them are actively engaged in the development of alternate models.

Sometimes, government-NGO co-operation and peoples' participation have attained spectacular heights. Recently, in Kerala State, 10 000 technically qualified and experienced people have joined a Voluntary Technical Core to extend aid to Panchayats in preparation for their development Plans. Andhra Pradesh has started a massive programme, called the Janmabhoomi programme, for involving people of different walks of life in different development activities. The water resources departments and personnel are not indifferent to these developments, but more often these activities are discussed at policy levels, as normative matters. Perceptible change is confined to the participatory programmes, which are being tried at a very low level of the major and medium projects.

6.2 Performance Improvement Options

Performance depends not only on the *technolog*, but also on the *environment* in which the technology is used, and the quality of *management*. In the matter of the achievement of each of its objectives, the performance of large dams in India is poor. This is partly owing to poor management and can be improved. It may partly be that a dam was built at a location where it should not have been, this factor will have an adverse effect on the performances of some dams, not all. The final reason is the inherent weakness of the technology itself; the technology is just not economically viable, which is reflected in a kind of cost-benefit analysis. The fact that better management can improve performance necessitates consideration of this activity as an option. At certain junctures of history, scarce resources may be better served by performance improvement measures instead of additional capacity creation. This chapter will study whether water resource development activities in India are at such a stage

6.2.1 Power

Supply Side Management:

Electricity generated from the existing capacities can be substantially increased by improving the performances of existing power plants. The capacity utilisation measured by the Plant Load Factor (PLF) for thermal power plants was only 54% in 1990-91, but increased to 64% in 1996-7 (TEDDY, 1998/99:93). This capacity still awaits substantial improvement: just 1% improvement in this area is equivalent to an additional 650 MW of generation capability. The transmission and distribution (T&D) losses in the country are as high as 21.4% (GOI, 1999:696) and are increasing (TEDDY, 1998-99.78). This is according to the official estimate, independent experts put the figure anywhere between 30-40% (Das et al, 1999:119). By comparison, T&D losses in China are 7% and in Thailand 10%. Just 1% reduction of this loss is worth the new generation of 800 MW. On a conservative estimate, the ultimate potential of these supply side management activities is to extract, from the existing installations, an equivalent of about 20 000 MW new generation capacity.

Demand Management by Price Structuring

In agriculture, the two major operations, land preparation and irrigation, are the major consumers of energy. Land preparation by power tillers uses diesel; in comparison, irrigation is the major user of electricity. Owing to rural electrification and the substantial increase in the number of energised pumpsets, coupled with highly subsidised electricity, utilisation of groundwater has dramatically increased since the 1960s. As a result, the total electricity consumption in agriculture has increased from 15000 GWh in 1981-82 to 79000 GWh in 1994-95 (TEDDY, 1908-99:152). The share of the agriculture sector in electrical energy consumption has increased from a mere 3.9% in 1950-51 to 30.54% in 1994-95. Considerable reduction in demand may be effected here by a rationalisation of the price structure. Currently, agriculture pays Rs0.21 per kWh while the supply cost of power is Rs1.86 per kWh. Domestic consumers pay at the rate of 0.91 per kWh and in most States industries pay over Rs3.50 per kWh. (Das et al, 1999:121). The cheap electricity is used without much consideration of efficiency and this has spelt environmental disaster in the form of groundwater depletion. Although the problem has been widely discussed and steps have been recommended repeatedly, most of the State governments are either refusing to raise the tariff for the farm sector or are raising it only nominally.

Prediction of possible savings depends on the new tariff structure and price elasticities of demands. But from the point of the efficient use of power, a reduction in power use by about half may not affect agriculture adversely and that would be the equivalent of adding another 15 000 MW generation capacity by current standards. There is an important connection between rainwater harvesting and power tariff rationalisation in the agriculture sector. The highly subsidised groundwater programmes, in the name of minor irrigation extension, were in large part, responsible for diverting farmers' attention away from surface irrigation systems. Extension of surface irrigation systems like rainwater harvesting, to meet parts of the irrigation and drinking water demand, will reduce electricity demand. Also, the recharge of the aquifer obtained thereby will reduce power requirements for lifting water. If by these measures the electricity consumption can be reduced by just about one-third from now, that will be equivalent to an addition of about 5 000 MW of generation capacity. Whether rainwater harvesting structures can be used for nano hydel generation has not been investigated, but indirectly, they contribute to electricity saving. Tariff rationalisation measures have also been argued for other electricity consuming activities. For brevity, these have been omitted from this report

Demand Management by Efficient Utilities

Agriculture and the domestic sectors consume 30% and 16% shares of power respectively, industry consumes another 38%. There is considerable scope for of electricity conservation by using energy saving equipment. Better designed and better maintained irrigation pumpsets, industrial motors and motor drives could save a substantial quantity of electricity. In the domestic sector considerable conservation is possible through extensive use of energy saving lamps, electronic ballasts, better design of fans and better insulation of refrigerators. Some of these measures do not require much financial input. The initial cost of some others, like energy saving lamps, is still relatively high, but even this has come down in recent years and is likely to go down further; longer life compensates for the higher initial cost. If just about 10% savings can be achieved that is equivalent to adding some 5 000-6 000 MW new generation capacity.

Peak Demand Management

Power demand varies over the hours of the day, peaking regularly at some specific hours. A power system based on total thermal power will have to back down partially during off-peak hours, thus decreasing Plant Load Factor (PLF) and increasing cost per unit generation. Hydel power can be put on and off quickly, which is the most important argument in favour of a hydel power mix of generation.

Small hydel does not serve the purpose owing to lack of storage. Gas based generation may serve the purpose but gas is largely imported. Somewhat lately it has been noted that the development of pumped storage facilities offer an attractive alternative. A power system may maintain a constant rate of generation of thermal power, using any excess produced during off-peak hours to pump water to a higher reservoir. During peak hours the stored water in the higher reservoir may be released to produce additional power to meet the peak demand. The net power generation in this process is negative but the peaking capacity creates its own value by increasing the PLF of thermal plants. The water is recycled and is not lost. The CEA has identified 63 sites for the development of pumped storage schemes, out of these seven are already in operation or under construction. The other 56 schemes have an estimated potential of about 94 000 MW. Without any further addition of dams, the mere development of this potential at the existing reservoir sites will be enough to support a 60:40 mix for an additional 140 000 MW thermal generation capacity.

In addition, the optimum mix can be regulated by demand side management. At present the desirable thermal-hydel ratio is taken to be 60:40 meaning that a 40% increase in demand may occur during the peak hours over the average demand throughout the day. The domestic sector demand peaks in the evening, when lights are switched on, which does not coincide with the peaking of agricultural demand, which occurs in the morning, with the switching on of the pumpsets Industries operating throughout the day do not produce excessive variation: their demands peak during certain operations that require massive power input. It is possible to avoid these demanding operations in industries during the evening and morning peak hours through variable pricing or through regulations. It has been shown that considerable reduction in peak demand may be made in this way, implying that a much smaller proportion of hydel power mix will be enough. If, in addition, improved equipment reduces the electricity demand in the domestic and agricultural sectors, a still lower proportion of hydel power would be sufficient.

6.2.2 Irrigation

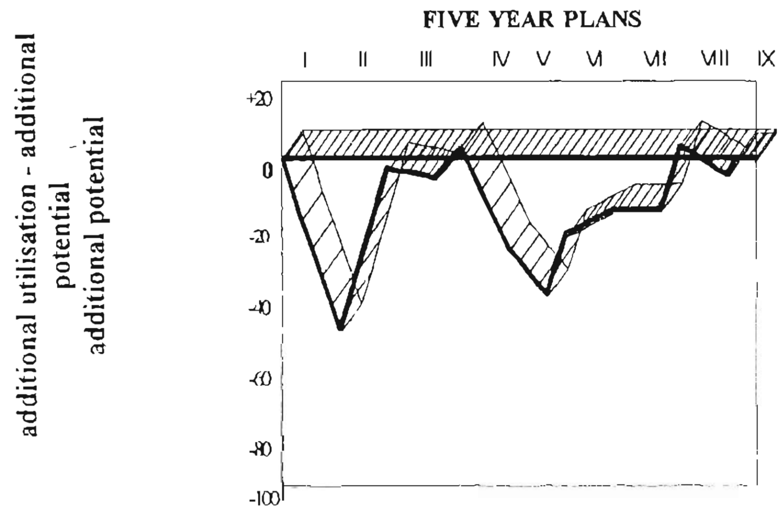
The ultimate irrigation potential of major and medium irrigation is estimated at 58 m ha of which 33.8 m ha has already been created. Thus, at the most, an additional 24.2 m ha can be brought under irrigation through this source, all of which may not need large dams. Potentials of performance improvement options can be compared with this figure.

Under-utilisation of Created Potential

According to Irrigation Department data, 13.7%. of created potential in major and medium irrigation in India is unutilised According to the Land Use Statistics, collected by the Revenue Department, underutilisation amounts about 25%. As much as 4.52 m ha may be brought under irrigation in major/medium irrigation by utilisation of full potential. Another 4.29 m ha may be added by utilisation of the full potential installed in minor irrigation A lag of a few years between the introduction of irrigation and its utilisation is expected because of the time required for construction of the distribution system and for the farmers to internalise the new system In that case, the later years should show a relatively greater addition to the area utilised than potential created. Figure 6 2 does not show such a pattern; the area added in the utilisation has never substantially exceeded the potential created in a year Thus backlogs have been accumulating and the gap between potential created and utilised has been increasing from Plan to Plan

The CAD Programmes, supported by the World Bank, were introduced in the late 1970s, for improvement in this area. This programme includes both structural measures like construction of field channels, land levelling and field drains, and non-structural measures like rotational irrigation By now 14 94 m ha of potential created in major and medium irrigation have been brought under CAD programmes. Some projects included at the inception of the programme now have cent-per-cent utilisation of irrigation potential (Planning Commission of India, 1999:II, 508). Whether all the projects included at the inception stage have shown similar progress is not clear from the available data.

Figure 6.2 Under-utilised Area as Percentage of Potential Added



(Annual Average of Data for Five Year Plan, or that of Annual Plan)

Land Degradation

According to an estimate made in 1991 by the Ministry of Water Resources, about 2.46 m ha of command area of major and medium irrigation systems suffered from waterlogging, and 3.30 m ha were affected by salinity/alkalinity. This kind of summary estimates does not capture the totality of the problem. Excess water retention as well as salt and alkali content of the soil vary over a wide range and affect productivity in various degrees. The summary estimates are based on some cut-off points and show only the most seriously affected areas. In reality, a much greater area is affected by waterlogging and salinity/alkalinity. For the same reason, whether the affected area is actually decreasing or not, in spite of the steps taken, cannot be concluded beyond controversy. Existing programmes include construction of drainage structures and chemical treatments of saline soils, both of which are costly. Vertical drainage, effected by the use of groundwater on an extensive scale, has proved to be a success in some of the adversely affected canal commands. Whether this method can be used everywhere is yet to be established. In any case, it is a solution achieved by farmers' initiatives to cope with a problem created by the irrigation system.

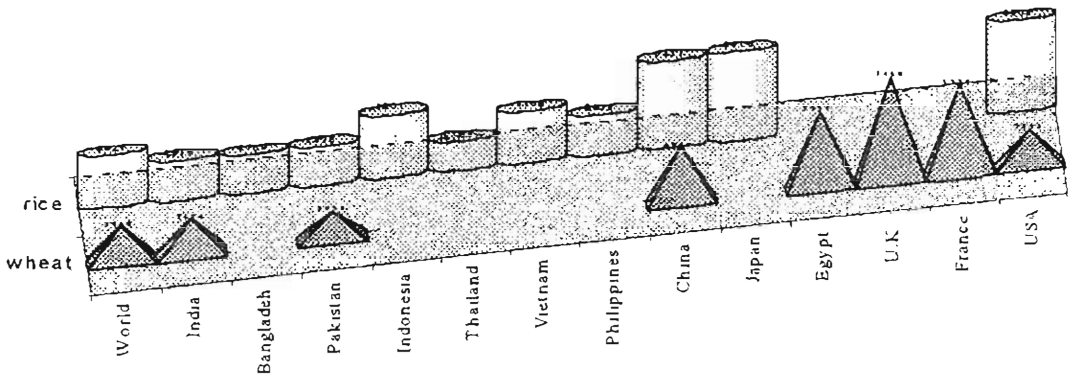
Low Water Use Efficiency

Water use efficiency rates are presently estimated to be only 38 - 40% for canal irrigation and about 60% for groundwater schemes. A 10% increase in the present level of water use efficiency of the existing irrigation systems would be equivalent to the creation of an additional 14 m ha of irrigated area (Planning Commission of India, 1999:II, 483). In the absence of volumetric supply, a pricing mechanism cannot be used for increasing efficiency of water use; only structural measures can be taken such as : renovation, modernisation, and upgradating of existing structures. The possibility of these measures has received attention only very recently. A couple of externally aided programmes have been introduced in the last decade but because of the expensive nature, these measures can be adopted only on a selective basis.

Low Productivity

The productivity level of irrigated agriculture in India is lower than the world average, very much lower than what has been achieved by some countries in the world (see Figure 6.3). Considerable difference exists among States and regions. For example, the yield of rice varies between 1.5 to 3.5 t/ha from irrigated land. Countries like China, Japan or the USA have reached figures of more than 6.0 t/ha. Some of the reasons, like inadequate agricultural extension or weakness of the input delivery system, originate in the inefficiencies of other departments. Other causes lie with the irrigation department itself: water availability is insufficient because reservoirs do not fill up, poor O&M at both the main system and on-farm level is a contributing factor, waterlogging and salinity/alkalinity reduce productivity and the water supply, directed primarily to meet the power generation objective, fails to meet the water demand of crops in time. The exact conditions differ from project to project and would need flexible operations, in consultation with the farmers, to meet the different contingencies. Lack of farmer participation is now considered to be an important factor that could improve productivity. However, very little has been done towards involving farmers in operations of the main system. A productivity increase of irrigated land to 4.0 t/ha – comparable to rice productivity of Vietnam or Indonesia - would be equivalent to the addition of 35 m ha irrigated area by the present standard; raising it to 5.0 t/ha – as in China, Japan, USA, UK, France - would be equivalent to the addition of 55 m ha.

Figure 6.3 **Rice & Wheat Productivity: India & the World**



Performance Improvement Measures

The achievements of all the performance improvement programmes, CAD, National Water Management Project (NWMP) and WRCP, are far below target. This raises a fundamental question is the technology appropriate? Underutilisation of created potential, waterlogging, salinity and low productivity, all these are interrelated. Although the engineers and policymakers assume that dams and canals are essential, the unwillingness of the farmers to avail themselves of the created potential, while spending a substantial amount on the purchase of tubewells and pumpsets, raises a fundamental doubt. The limited success of the performance improvement programmes reinforces the doubt. Some authors (eg Sengupta, 1995) are of the opinion that, though canal irrigation was known in India for centuries, it was sparingly used because of these accompanying problems. Over large parts of India, the land-forms, soil characteristics and drainage difficulties demand that primary attention be paid to these issues instead of increasing water application. If water resource planning is approached from this perspective, it is found that maximum retention of local precipitation through rainwater harvesting structures is highly successful. Rainwater harvesting does not tamper with the natural drainage system and improves soil quality by leaching through vertical drainage. Apart from above-surface storage, rainwater harvesting also provides extensive sub-surface storage, which has much higher water use efficiency than major/medium irrigation systems. In actual fact, many of the techniques termed "rainwater harvesting" in the irrigation terminology in India are proven irrigation and water application systems, as will be seen in the next chapter. If the irrigation planners had considered these techniques with due seriousness, along with dams, canals and tubewells, they might have found that these currently neglected options were better suited to those areas with problems of drainage, effervescence and saline ingression from the sea.

Participatory Irrigation Management

That user participation can bring about considerable improvement in irrigation performance is now generally recognised. The efforts and achievements of PIM programmes in India are still far less compared to the leading countries in this area. One of the greatest bottlenecks for PIM development in India is the absence of any legal rights. Even those organisations that are desired by the government do not have any right to develop water resources. Water rights situations are far more congenial in countries where participatory programmes have achieved greater success (Sengupta, 1991).

In most PIM programmes in the world, performance improvement standards are set largely in terms of cost recovery, rather than in terms of formal organisational structures and abilities of the organisations to meet the paperwork demanded by the authorities. Actual benefits, in terms of imaginative agricultural and irrigation practices and increase in productivity, are yet to be assessed, long-term sustainability yet to be demonstrated. Important lessons may be learnt from long-standing farmers' participation in some of the older systems in India (see Annex 4). Analysing these systems, Sengupta (1993: 249-273) recommended attending to the designing of irrigation systems as a prerequisite of successful participation. The bottom-up approach followed in the Tambaparni irrigation system development and modernisation has retained many user-friendly features of the small-scale irrigation systems, which sustain participation. It is likely that a similar approach, extended to other modern systems, will promote farmers' participation and be rewarded through performance improvement. In China, farmers initiated a similar modification in a large modern irrigation system for the purpose of performance improvement. This was known as the "melons on a vine" design (Nickum, 1977). Although major and medium irrigation systems are pampered as "assured irrigation systems", in reality, farmers are at the mercy of the operating staff and have little surety of supply when they need it. Small, localised storage at the control of the farmers can increase productivity by reducing supply-demand mismatch. Mishra & Tyagi (1986) recommended the introduction of small auxiliary tanks in the Bhakra canal system arguing that these tanks would increase productivity by 20-30%.

6.2.3 Management of Multi-purpose Projects

In multi-purpose reservoirs the interests of the various components are usually at variance with one another. It is often felt that the power generation objective gains predominance because every unit of water utilised for this purpose earns a monetary return. Water released through turbines at peak hours may meet peak demands, but these timings are rarely suitable for irrigation needs.

For flood control, the reservoirs must contain as little water as possible, ready to meet a sudden inflow. For irrigation and power generation, containing as much water as possible is the desirable strategy. If a dam were full and ready for irrigation and power supply after the rains, it would find little room for retaining a sudden inflow of water at this stage. The dam is forced to release water which creates a flood. "Multipurpose reservoirs imply a compromise, and flood moderation usually gets neglected, unless a specified flood space is earmarked. Most of the complaints voiced about reservoirs, including the aggravation of floods lower down, is a result of this position." (Rangachari, 1999:66) In "protected" areas like those of the DVC system, the public perception is that dams, even though they are capable of moderating a flood, are not used for that purpose. In the areas recently included in the flood map of the country (CSE, 1991), in States like Himachal Pradesh, Rajasthan, Gujarat and Southern India, the reasons for the occurrence of a flood have been attributed, at times, to panic release of water from dams.

6.2.4 Flood Control and Management

Very few dams were constructed specifically for flood control. Only the case of the DVC system, which in the 1950s was expected to set the future model of flood control, will be noted here.

Half of the dams included in the DVC plan have not been built. The capacities of the completed reservoirs were less than that planned, since land acquisition was not completed owing to local objection. The capacity has been further reduced over the years because of siltation. The flood outlet capacities of the spillway gates, which were fixed on the basis of inadequate data, are now considered deficient (DVC, 1998: 64-65). Although the very purpose of the DVC was to establish a unified operation of all development projects on the Damodar River, another reservoir, built and controlled independently by the upstream State, was added at a later date. This, the Tenughat reservoir, has a very large flood surplussing capacity. There is little co-ordination, or even a real-time information exchange arrangement, between the operating agencies of the DVC and the Tenughat project, which adds to the vulnerability of the lower reservoirs and the downstream river reach. No flood cushion is provided at the Tenughat Dam. In brief, as it stands, the Damodar Valley system is highly deficient in flood moderation capacity.

Even though moderated, floods still occur. But their effect is not moderate anymore. Silting and sandbar formations in the riverbed have gradually reduced the drainage capacities of the rivers downstream of the dams. Hence floods too have become more frequent with the ageing of the dams. The groundwater level has increased reducing the flood cushioning capacity of the soil and flood water remains standing for a longer time. Some areas in the Lower Damodar belt remain waterlogged for several months a year. The drainage problems have developed only in the course of time. Once the area was protected after the construction of the dams, it was open to development. Not only residential houses but also industries were established in erstwhile flood belts. Construction of embankments, service roads, bridges etc, as part of the development process, further reduced the area's drainage capacity. As a result, flows that were moderate in the earlier scale are, at present, high flows, and at times, floods. The increase in habitation makes losses severe.

If the performance indicator used is in terms of flood moderation statistics, then DVC can be considered a relative success. But if the indicator is in terms of occurrence of floods, their duration, and damages caused by them, then the performance of the DVC as a flood control measure is highly questionable. The government recommends the same set of structural and non-structural measures for the lower Damodar area, which is supposed to be protected by the DVC, that are also intended for unprotected flood prone areas. This measure reinforces the public opinion that no change in status has been brought about in the erstwhile flood prone areas by the large DVC dams while the official plea is that the remainder of the proposed dams were not built. People complain that this is an excuse for inaction, "Neither the dams are built nor a solution to our problems is sought." (Dey in BMY, 1998:78-80)

Besides, heavy rainfall in the downstream areas also causes floods. The dams are not intended to contain such floods but their occurrence of raises doubts about the effectiveness of dams as a flood control measure.

The problems of loss of capacity of reservoirs, narrowing of the riverbed, and development in the flood belt are likely only to increase with time. The nature of these problems indicates that they are not specific to DVC but may be repeated in the case of other dams with a flood control objective. If large dam strategy aspires to remain a strong candidate for flood control, its proponents should think of effective ways of coping with these increasing problems.

6.3 Technological Options

Theo van Robbroeck (1997:1), former Honorary President of ICOLD, voiced the general belief amongst dam developers when he wrote, "I challenge them to advance reasonable arguments that their so-called alternatives are able to meet more than a small fraction of future demands." There is enough material in this chapter to meet the challenge but a more meaningful purpose is what is really needed. In the WCD hearing in Colombo (1998) K. R. Datye described the right perspective as:

> The debate seems to be focussed on the issue of large vs. small dams. However it needs to be recognised that there are important concerns which underlie the debate, that is, shift to a sustainable system of resource management capable of providing for the livelihood of everybody including the poor. . . . This will result in a redefined role of external inputs, including exogenous water. . . . Local surface and aquifer storage acquire much more importance in this perspective and much of the upstream storage of large systems can be cut down substantially to overcome the problems of submergence, rehabilitation and associated social problems that large systems create . . . There is an associated change in the energy perspective as well.

The ultimate purpose of this inquiry is how best to integrate all available opportunities. To begin with, it is possible only to identify the options. In the previous sections I have shown that the existing institutional set-up does not provide a level playing field for all available opportunities: large dams find favour and options become neglected opportunities. In this section I will introduce these neglected opportunities showing their richness and development potential. Even some large dams are included in this list as they were designed in some significantly different ways that did not find the kind of favour they deserved.

6.3.1 Water Appropriation Techniques

Types of Techniques

Varieties of water appropriation techniques, which are distinct from modern canal, well and tubewell irrigation, are tautologically, water appropriation options. These include a whole range of techniques with different names: from tanks, ponds and rainwater harvesting, to *kuhls*, *bundhis* and *bandharas*; roof top harvesting, check dams and *johads*; percolation ponds, *tankas* and *baoris*, techniques to prevent soil erosion, saline water ingression and for groundwater recharge. Some of these are used for agricultural purposes alone, some only for drinking water, others for both purposes. Some of these have a long tradition, some units have been constructed under modern extension programmes.

It is not wise to introduce these systems by their local names. Some proponents of these options do so hoping that they will establish thereby the richness of the alternatives. In fact multiplicity of terms has reached such a stage that two people often do not understand each other when they are actually talking about the same technique. Sengupta (1993) categorised some 50 different traditional water appropriation systems found in South Asia as (a) diversion works, (b) storage works, (c) regulation of spread and (d) conjunctive use and integrated design. Each of these categories has wide varieties. For example, traditional techniques that appropriate water from diversion include *kuhl* and *bandhara* in hilly areas, *dong* and *thingel* in flood plains, the *sailabi* and *haveli* system of inundation, *zings* in snowy mountain, *surangam* near dripping caves and *ela* in hill slopes with a gentle gradient, apart from the more well-known canals, *kalvai* and *pyne*. The world is rich in varieties of traditional water appropriation techniques. Some of those may be used to enrich the stock of options in India, just as methods found in India may find application elsewhere.

Modern researches in dryland cultivation techniques have added several other techniques to this rich heritage. Against the popular notion, the other options are indeed a rich repository of techniques. For example, the Technology Mission (GOI, 1990: 5) cited a long list of structures and treatments under the simple title "rain water harvesting":

In-Situ Harvesting : nadi, tanka, sandfilled reservoirs, ponds, roof top collections/hill top collections, platform, oorans
Storage of water in aquifers (natural underground reservoirs): percolation tanks, khadins, sub-surface dams/barriers, injection wells
Soil conservation methods which help in increased groundwater recharge also: gully plugging, contour bunding, afforestation, contour trenching, land levelling and bunding of fields
Enhancement of surface runoff collection, catchment treatment
Evaporation control: chemical films, hydrophobic coating material.

Only the in-situ harvesting techniques create surface storage so that, when the potentials of large and small storages are compared only a part of the possible options is taken into consideration. Storage is certainly not the ultimate goal of water appropriation. The right approach to water management should be comprehensive control of groundwater, surface water, soil moisture and rainfall, which some Chinese engineers and agronomists describe as "managing four waters". It does not matter if they do not include open storage, the other techniques very well meet the ultimate purpose of water appropriation: crop production and drinking water supply.

Current Extent and Scope of Extension

In order to understand the distribution of the water appropriation options it is necessary to look at the following table showing the distribution of net area sown in different States.

Table 6.1 Area Irrigated in 1992 –93 by Sources

State		Percentage of net sown area Irrigated by						Rainfed	Net Sown Area (m ha)
	1	Modern Sources		2	Traditional sources				
		Govt. canals	tubewells		surface sources	wells			
Punjab		33.0	57.7		2.4	0.3		6.7	4.14
Haryana		39.1	35.6		0.9	-		24.4	3.47
U.P.		18.8	41.4		2.6	2.9		34.4	17.26
Bihar		13.0	22.6		9.9	1.1		53.3	7.16
Manipur		-	-		46.6	-		53.4	0.14
Tamil Nadu		14.6	3.0		11.1	17.7		53.6	5.81
J&K		18.1	0.1		24.3	0.1		57.4	0.73
A.P.		16.5	3.7		8.5	9.8		61.5	10.47
W.B.		13.1	12.5		8.8	0.4		65.2	5.49
Orissa		14.9	4.7		4.7	8.5		67.2	6.30
Nagaland		-	-		29.4	-		70.6	0.20
Gujarat		5.8	5.8		0.3	15.7		72.4	9.58
Rajasthan		8.4	2.8		1.4	13.8		73.6	16.94
M.P		8.6	2.5		3.9	9.4		75.6	19.54
Arunachal Pradesh		-	-		24.0	-		76.0	0.15
Meghalaya		-	-		22.4	-		77.7	0.20
Assam		2.7	-		18.5	-		78.9	2.71
Karnataka		8.4	2.3		5.2	4.5		79.7	10.79
Himachal Pradesh		1.2	1.0		15.1	-		82.8	0.57
Sikkim		-	-		16.9	-		83.1	0.09
Goa		5.4	11.2		-	-		83.5	0.14
Maharashtra		5.2	n.a.		n.a.	9.6		85.1	18.02
Kerala		4.6	2.9		7.4	-		85.1	2.25
Tripura		7.8	0.9		3.6	0.8		87.0	0.27
Mizoram		-	-		12.5	-		87.5	0.06
Total		11.9	11.1		4.5	7.8		64.7	142.65

SOURCE: GOI, 1992-93:Tables1, 2).

Data for later periods are still not available, nor is the official system of categorisation satisfactory (Sengupta, 1993). Still from it some idea of the distribution of options can be obtained. With the exception of the three northern States, Punjab, Haryana and U.P., agriculture in all other States is predominantly rainfed. Rainfed farming practices are not devoid of water appropriation works. Some of the techniques listed as options in the foregoing text are already in use in rainfed areas. Many others can be extended.

Some of the options listed above are classified as sources of irrigation, and areas served by them are included in the official statistics for irrigated areas, under heads like "tanks", "private canals", "other sources" etc. These are the so-called "traditional irrigation systems". Table 1 shows that traditional surface irrigation sources are still quite an important source of irrigation in several States. According to the statistics of the Ministry of Water Resources, as much as 10.81 m. ha out of a total of 40 m ha of gross area irrigated in India by surface water sources, are irrigated by these traditional systems and not by government (modern) canals. The Ministry of Agriculture's estimate of the same area is a little lower; Table 1 compares only the net area irrigated. As already mentioned, there are some discrepancies between the two sets of data available, one from the Ministry of Agriculture and the other from the Ministry of Water Resources.

The vast rainfed area as well as the area served by traditional irrigation systems can only benefit from the development and application of the other water appropriation options. It is imperative for the development of the country to develop these sources with a sense of urgency. The proponents of large dams would agree up to this point. Sharp difference arise when the applicability of these options is proposed for areas suitable for large dams and canals. The Position Paper of the International Commision on Irrigation and Drainage (ICID) (1999) states:

> *Micro river basin development basically is useful in rainfed areas, which cannot be served by canals starting from dams or by groundwater facilities. It is ICIDs position that micro-development schemes ought to be considered and conceptually developed for areas that will remain rainfed as part of an integrated evaluation process that progresses toward an optimised river basin development scheme.*

It is a position that has been adopted without looking at the options; the facts fail to support such a position. Comparison with the old data shows that in numerous cases of large dam construction in the country the existing networks of traditional irrigation systems in the command areas were systematically destroyed. Many engineers may not find this improper, believing that a less efficient irrigation system was replaced by a more efficient one. Testimony to the contrary exists Section 6.8(a).2 revealed that in the late 19th century some bottom-up development works had begun in some corners of the country. The traditional systems were not destroyed but were enriched by the use of modern knowledge. After large dam construction and hydropower generation techniques become available in the 20t century even these were used to enrich the system. For example, one of these systems, the Tambaparni irrigation system, at present irrigates 35 000 hectares not only through its channel systems but also by the use of 179 tanks in its command area. Three reservoirs have been constructed at its upper reaches, two of them are for power generation.

Table 6.2 Distribution Network of Tambaparni Irrigation System

Anicut (Barrage)	Name of the Channel	Canal		Tanks	
		Length (km)	Area Irrigated (ha)	No.	Area Irrigated (ha)
1st	N.K.C. (north ch.)	18.51	650	14	301
	N.K.C. (south ch.)	8.64	344	-	-
2nd	Nadiyunni	11.55	996	-	-
3rd	Kannadian	33.95	4154	16	905
4th	Kodagan	29.04	1218	17	1210
5th	Palayan	42.46	1821	59	2024
6th	Tirunelveli	29.14	1022	22	1572
7th	Marudur kilakal	17.92	1202	15	1949
	Marudur melakal	19.84	1843	15	3322
8th	South Main Ch.	33.87	1090	15	4074
	North Main Ch.	36.32	1331	6	3877
TOTAL		281.24	15671	179	19234

In Annex 4 there is a description of how this design was developed through a bottom-up approach. The performance of the Tambaparni multi-purpose system is far from being poor. Instead, it has the best farmers' organisations in the country and has evolved excellent co-ordination between water released for power generation and water used for irrigation.

Tambaparni is not a solitary example – a couple of similar cases exist - but far more prevalentare cases where the pre-existing water appropriation systems were simply destroyed either because of ignorance or because of a misplaced emphasis on modernisation. The bottom up approach can be pursued everywhere in areas suitable for canal irrigation. Systems like Tambaparni are not an alternative to large dams in the technical sense but they are options to the current approach of large dam construction. Unfortunately they are not promoted by the current proponents of dams.

There are other reasons that make these options more suitable water appropriation techniques even for those areas where canal irrigation is possible. Rainwater is the purest form of water. Though harvesting procedures collect some impurity, the quality of water is still better than that carried by canals travelling long distances. In view of the increasing pollution of Indian rivers, increasing the collection of water close to the point of precipitation is desirable. Also, maximum use of rainwater for vertical leaching (Sengupta, 1995) is much cheaper than horizontal leaching and chemical treatment for desalination. Encouraging rainwater harvesting as extensively as possible is a desirable strategy in view of increasing pollution and salinity.

Almost 90% of the drinking water needs are met from groundwater. The rapid development in groundwater based irrigation in many States has become alarming. As many as 144 districts have been declared "dark" and "grey" zones in the country, yet there has been no let up in the depletion of groundwater aquifers. Although 50 000 habitations out of a total of about 1.4 million in the country are claimed to be covered every year by the Drinking Water Mission, the number of problem habitations has not declined over the years. For sources of drinking water, it is essential to look at small storage structures, which help in two ways: directly as rainwater harvesting, and indirectly through recharging of groundwater.

Productivity

It is a common belief that the productivity of areas serviced by canals and tubewells is much higher than that of rainfed areas, areas irrigated by traditional systems. Dhawan's (1992) article is frequently quoted in this context. But how great is the difference? Chapter 2 describes how, after 50 years of development of not only thousands of dams but also of massive expansion of tubewell irrigation along with neglect of traditional techniques of water management for rainfed areas, the relative contributions of rainfed and irrigated areas to the foodgrains production of the country has changed from around 60:40 to 40:60.

The nominal change in share of contributions can be explained in two ways, that productivity of both types has increased or that the performance of both is poor. In Chapter 3 several different reasons for poor were discussed; the assessment of a technology should be undertaken from the consideration of its potential not from its current performance. In order to show the actual potential of alternative options, some of the sterling performances need to be examined.

The overall performance of the watershed development programmes on rainfed areas is not very satisfactory, but some of the successful cases show what great potential lies here. One such case is included in the following box.

Tejpura watershed covers an area of 775 ha. A watershed development programme was conducted here in 1985-86. About 231 ha m of rainwater was stored in 5 check dams which resulted in the rise of the groundwater table by 3-7 m. This rise led to the increased digging of wells from 5 in number to the present of 315. Irrigated area increased from 3.8%to the present 100%, along with an increased cropping intensity of 209%from an initial 82%. As a result, productivity of crops and income rose 12 times over the base year. Degraded land of 128 ha was brought back to cultivation. Forage and fuelwood production greatly increased and milk production was doubled. Employment opportunities for the village poor were increased by more than threefold and benefit-cost ratio of the watershed programme was 2.7. After ten years not a single structure was broken. (Hazra, 1998)

The traditional irrigation systems should now be examined. Most parts of the Gaya district of Bihar are now drought prone. But every government report confirms that this (old Gaya) district, once served extensively by small storage works, was immune to famine throughout the 19th century when most parts of colonial India were ravaged by severe famines.

The Irrigation Commission (1901) observed that " ... the ahar-pyne irrigation under the zamindari system, unlike its counterparts in south India, was not in a bad state. So much so, that the major district, Gaya, served by this type of irrigation, remained practically immune to famines throughout the nineteenth century."

The District Gazetteer (1919) noted, "When the district has been affected so slightly by one of the greater famines on record and has suffered so little from similar visitations in previous years, an immunity from general famine can reasonably be claimed for it"
(For further details and references see Sengupta, 1993 87-88)

Impressive performances of some traditional irrigation systems have been noted even in more recent years. Khadins in the heart of the Rajasthan desert are still able to produce some crops even if the rainfall in a year is one-third of the normal (for details see Kolarkar & Bharara, 1988)

Instead of imagining what conditions might be while sitting in some high office can easily be confirmed by a couple of field trips that high yielding variety (HYV) seeds and fertilizers are used extensively for cultivation of crops over large parts of the areas served by traditional irrigation systems

There is a general belief that, unlike a canal irrigated area, the areas served by traditional sources of irrigation cannot be used for multiple cropping. Table 6.3 shows that this too is a belief without factual support. The table also shows that the intensities of cropping vary uniformly over States for all different sources of irrigation. Those States that have higher intensities of irrigation from modern canals also use traditional sources with considerable intensities.

Table 6.3 Percentage of Irrigated Area Cropped More than Once, 1992 – 93

State	Source of Irrigation						Total % of irrigated area cropped more than once
	Surface Water				Groundwater		
	Govt. Canals	Tanks	Other Sources	Private Canals	Tube wells		
Punjab	77.9		39.4		91.0	66.4	85.0
Tripura	80.8	66.7	55.1		95.7		71.03
Goa	64.9		-		50.0	-5.0	54.8
U.P.	41.6	8.7	34.9		42.5		41.3
J&K	61.9	24.0	27.0	24.3	57.1	31.0 0.0	40.5
Karnataka	34.2	16.1	17.0		32.3	26.1	27.7
A.P.	27.6	8.2	17.1		53.8		26.2
Tamil Nadu	27.4	15.7	15.4	33.3	32.5	27.0 28.8	25.5
Rajasthan	39.3	11.3	8.3		10.6	16.2	22.7
Gujarat	19.9	13.7	2.9		32.3	19.4	22.1
Maharshtra	19.5						21.7
Bihar	23.9	10.8	16.5		21.3	23.0 22.4	20.8
Manipur			14.5				14.5
M.P	3.3	3.5	2.6	0.0	2.2	3.0	3.0

(SOURCE Table 2, GOI (1992-93); Data for other States are not available.

Possible reasons for inter-State variations are many. water availability differs even in canals, soil and climatic conditions differ and cultural aspects may also play some role. Such factors will affect not just intensity of cropping but also productivity. Hence the validities of productivity studies undertaken across States (eg Dhawan, 1992) are open to question. The difference in productivities between the canals of Punjab and the tanks of Tamil Nadu is not solely the result of the two different technologies: there are many other factors involved. In order to compare the merits of two technologies, the data must be obtained from the same locality, for example, across the Tambaparni system the productivity of tank irrigated areas is higher than that of the canal irrigated areas.

Instead of using such information to score a point in debate, it is preferable rather to apply it towards a better understanding of the merits of different technologies. There are many isolated tanks in the areas adjacent to Tambaparni and and their productivities are much less compared to the neighbouring tanks that belong to the Tambaparni system. The reason is simple. The addition of the reservoirs and improvement of the canal system has immensely improved the water supply situation for the tanks of the Tambaparni system, which now perform much better that the isolated tanks in the vicinity The stored water in the tanks can be used by the farmers according to their needs whereas the direct beneficiaries of the canals of the Tambaparni irrigation system do not have this advantage and face supply-demand mismatch. Hence tank irrigated areas have higher productivities than canals only irrigated areas, though both are parts of the same system. To conclude: tanks and canals, traditional and modern irrigation technologies, are not in conflict with each other; nor is it meaningful to separate them by imagined territorial propriety These technologies stand to benefit from each other

Misconception - Small Scale

With rare exception, these traditional alternative options are described as small-scale structures suitable for rainfed areas alone. Government initiatives are directed at developing smaller structures independent of one another. McCully (1996: 209) defines the options as small. subscribing to the philosophy of "small is beautiful". In contrast, Paranjape & Joy (1995:8) argue forcefully about the need "to move beyond the sterile dichotomy of small vs. large projects and the tendency to view large and small as if they were mutually exclusive alternatives. . . . A series of small projects with environmentally unsustainable and inequitable water use have no intrinsic superiority over a large project". Sengupta (1993:10) argues that big/small, major/minor, traditional/modern are false dichotomies. He adds, "The actual distinction is that some systems demand extensive people's participation while others are amenable to centralised bureaucratic management." The former failed to receive bureaucratic and technocratic patronage, and were thereby relegated to become "options" in relation to official designs. Sengupta proposes the term "user-friendly", saying that the other dichotomies are invented for the "legitimisation" of ignorance and inaction.

> Dams of all sizes small, medium and large are an essential component of overall and integrated water management systems. . . . In a river basin, a judicious combination of large and small dams is required . . . The minor dams have a definite role to play in a basin, along with major dams.
> (ICID, 1999)

Misconception – Stand-Alone Structures

The traditional systems exist in a well-laid fashion appropriating and managing the water resources of vast areas, sometimes a whole river basin or a macro-watershed. There are numerous examples. System tanks, like those in the Tambaparni system, are used to divert river water into a series of tanks. When there are no rivers, natural drainage lines are used for this purpose; the surplus of an upland tank feeds the next tank down the line in a series called "chain tanks". The 19th century engineers were often amazed to find that not a single drop of water could meet the sea by escaping the chains of tanks in Ramnathapuram district. The *bundhis* of Madhya Pradesh or the *bandharas* of Maharashtra are some other well-known integrated structures (Sengupta, 1993: 57-69). The importance of integrated development is accepted in water management technology and river basin planning is inspired by this consideration. Even watershed development programmes consider the integral effects of all water appropriation structures within each micro-watershed. But this approach does not extend to large watersheds; the government programmes like the NWDPRA or the IWDP simply do not venture into watersheds larger than 4 000 ha. The World Bank sponsors larger watershed development programmes but ignores this essential principle of water management, and develops structures independent of one another (viz Put, 1998). No effort has been made to develop expertise capable of designing spatially integrated decentralised water management systems for vast areas

Some Other Incorrect Beliefs

The protagonists of large dams argue that a series of small works will submerge a larger total land area for the same capacity of storage. This is true, but only in a geometric sense. In rice cultivation practice, for example, the rice plots are submerged for months by constructing ridges, which probably constitute the smallest dams in use. But is this a submergence that can be compared with that of large dams? The depth of water makes a significant difference. By all evidence, the small storage works were once used extensively for cultivation of the submerged land. There still exist extensive areas where farmers reap two crops from the submerged area:- a water resistant variety of paddy in the rainy season and a high value cash crop from the subsoil-moisture-rich empty tank bed in the dry season. This practice still continues in central Bihar because the traditional storage system, still serving 0.2 m ha, is "neglected" by State engineers. Parallel to this, there are cases found in some other parts of the country, where, in a sustained effort lasting ten years, engineers were able to end this practice over a very wide area, after the tanks were transferred to the Public Works Department in the post-Independence period. (Sengupta, 1991:110-113).

Another argument is, the shallower the storage, the greater is the proportionate loss from evaporation. This argument too is a volumetric fallacy. At the very beginning of this chapter it was indicated that traditional principles of water management tend to store water in various ways, not only by surface storages. The extensive water sheet of thousands of tanks stores water also in forms of subsurface moisture and groundwater recharge, both of which have a much higher efficiency in water use in comparison to gravity irrigation. The box, about the Tejpura watershed development confirms the contribution of tanks in this respect. In fact, the great majority of wells and tubewells in the country may be indebted more to traditional options than to canals, for groundwater recharge. Since 90% of drinking water needs of the country are met from groundwater, the neglected options, by their indirect contributions, may at present be meeting the major part of drinking water demand of the country, apart from also facilitating irrigation through tubewells.

Factors Arresting Development

What exists today is only a fraction of the potential of the alternative options. Rudimentary knowledge of the past is not enough for undertaking these works except in more hospitable terrain. With the help of modem engineering and some imagination it is possible to extend these systems over a much wider area, increase their water supply and improve the technology but very little has been done in this direction. An unfortunate trend of current extension policies is that the management aspect has received almost all the attention at the cost of technicalities. Successful extension and management of these techniques requires a considerable amount of technical and management input. which has yet to materialise. The handful of efforts that have been made will be briefly described.

Many NGOs and some engineering colleges are involved in watershed development. participatory modernisation, and similar programmes. Though most NGOs uncritically promote the package recommended by project authorities, some of the well-known NGOs, e.g. Sadguru Foundation. Tarun Bharat Sangh, Dhan Foundation, CASAD, PSI etc. have developed their own guidelines about site selection, appropriate structures and sustainable designs. The CASAD team has followed a systematic approach for the identification of locally available structural materials which are cost efficient but sustainable (Datye, et al, 1995). Technology development efforts by NGOs have sometimes been supported financially by the Council for Advancement of People's Action and Rural Technology (CAPART) and other funding agencies.

Universities and research institutes have contributed further through studies of the so-called traditional irrigation systems: Kallapiran & Ratnavel (1995) have shown that wide varieties of spillways are used in traditional tanks, meeting specific local conditions, Mohanakrishnan (1996) suggested structural alternatives to tank desilting; Sengupta (1989) discussed some ingenious techniques for dam safety; Anupam Mishra has added very valuable information about traditional catchment treatment methods for quality maintenance in systems of rainwater harvesting for drinking purposes; the Central Arid Zone Research Institute (CAZRI) pioneered studies (Singh & Kolarkar. 1983) of soil morphology for the selection of appropriate locations; the National Drinking Water Mission has used satellite images, taken some time after monsoons, to identify water bodies like tanks and lakes; Bharatiya Gyan Vigyan Samiti (BGVS) and a couple of other popular science movements have included identification of traditional irrigation structures in their resource literacy and resource identification campaigns.

Contributions of the leading engineering organisations of the government are restricted to sporadic efforts by the Technology Mission, CRIDA or National Institute of Hydrology. There is not a single organisation in the whole of the country for the systematic study and improvement of the engineering aspects of these techniques. The subject belongs to the Ministry of Water Resources but "... the one Ministry which should be most concerned, is not even distantly connected with watershed management." (Reddy, IWRS, 1999). Instead, technical contributions overtly directed to discredit the technological options are often associated with the CWC or CBIP in one form or other. It is difficult to justify this orientation. Canals and wells have a 5 000 year old tradition, but are now termed "modern" by receiving attention from modern science and technology. Many other principles used in the so-called traditional systems will enrich modern knowledge if they are understood and appropriated (Sengupta. 1993: 9-10).

6.3.2 Flood Control and Management

The overwhelming trust laid in large dams as a flood control measure has the restricted search for alternatives. Unlike the options for irrigation and power, the possible options for flood control and management are only at the stage of rudimentary conceptualisation.

Flood Adaptation Option

The idea that a better strategy can be developed by accepting that a flood is not totally avoidable is gaining currency amongst government officials (eg Navalawala, 1998) and critics (eg Mishra, 1999) alike. Floods are mixed blessings: on the one hand they help fertilise the soil, provide water for crops, support inland fisheries, and recharge groundwater aquifers; on the other hand, they destroy crops, roads, property and life. Some argue that "flood policy should be changed from flood protection to *flood adaptation*" (Haque & Zaman 1993, author's emphasis).

> Such an approach may still require some "limited" protection of important cities and commercial centres by building new embankments; however, the primary policy objective should be to encourage and assist the villagers to identify the best ways to protect themselves, their crops, and their livestock by developing improved measures of flood management and flood preparedness.

Mishra (1999) feels that it is better to admit the truth, and like doctors, enjoy the freedom of telling people that there is no cure for cancer or AIDS to date. "Flood adaptation", in that case, can be developed as a primary strategy. However, there is a danger. This approach has until now been used as an apology for inaction, condemning the people residing in flood prone belts to eternal misery. Haque & Zaman (1993:104) have categorically warned against such misinterpretation. "Living with flood" strategy must be based on a long-term development policy sustainable in flood plains. It will need serious reworking to chalk out a feasible development plan for the flood belts. Annex 5 includes excerpts from Mishra's forthcoming book, in which he has made some preliminary attempts at such a plan.

Dams As A First Step?

Large dams like the DVC and the Hirakud, do not eliminate floods. It is necessary to ascertain first whether they would be able to moderate floods for a long time, in the face of the reduction of storage, silting of the riverbed and the rise of the groundwater level in downstream areas. Only if suitable methods are found to cope with these problems, can such dams serve as a first step to flood adaptation strategy. Instead of recommending the same package of non-structural measures developed for the unprotected areas, it is worth exploring whether a suitable developmental strategy can be outlined for the partly "protected areas" still experiencing flooding and waterlogging.

Other Structural Options

Optional designs may also be discovered from the documents of the old debates. Before the DVC and the embankments were suggested, there had been continuous proposals for productive use of water in the characteristic delta region. In Bengal in 1925-26, a suggestion was made by C.A. Bentley, which could use the flood flows for soil fertility and malaria control. This was supported by Sir William Wilcocks, a renowned water technologist of that era (Wilcocks, 1930). In 1939, a scheme called the Damodar Hooghly Flushing and Irrigation Scheme, was passed by the Bengal Legislative Assembly (D.V.C., 1998: 58-59). The TVA model had such appeal that this approved scheme was coolly dropped without any investigation. The 1938 Flood Commission of Orissa headed by R S M G Rangaiya had put forward a similar argument in favour of spilling water, in excess of a pre-determined volume, onto surrounding land by high-level escapes, so designed as to pass only the finer grade of silt. (D'Souza, 1998). This too was overlooked in the late 1940s atmosphere of great expectations from large dams. Such designs are now worth exploring.

Network of Small Storage Structures

The network of small storage structures, discussed earlier, is another possible option. The total storage capacity of several thousands of small tanks in a region can easily compare with the flood cushioning capacity, of any of the large dams, if not of the whole of the reservoir capacity.. A network of tanks and watershed development activities also moderate flood flow indirectly, through regeneration of vegetative cover. In fact, drought and flood are related: when vegetative cover is damaged, not only does drought occur but, at the same time, precipitation penetrates the ground more slowly. As a result, more water from the catchment reaches the streams, which become swollen. All water and soil conservation measures which make dryland agriculture more productive and secure are also effective in reducing floods. The construction of such a network of tanks in the catchment area of Damodar and its tributaries has been suggested by the flood-affected people of Lower Damodar as a measure that needs immediate attention (Dey in BMY, 1998:78-80).

> The Flood Advisory Committees of the district of Gaya, in its resolution passed in 1949 noted: "The Committee is of the opinion that the fundamental reason for recurrence of floods was the deterioration of the irrigational system in the district. . . . The existing irrigational arrangements which have been of the nature of a chess board, strewn over the whole district and were intended to impede untrammelled flow of water, have gone into disrepair "
> (Sengupta, 1993:71)

6.3.3 Power Options

Small Hydropower

Though this is included in "non-conventional" sources of energy in India, it has a history predating the large hydropower. In the post-Independence period, power sector development was the monopoly of the government, which directed all its efforts towards large projects. Small hydro potential remained untapped for decades. Technology was already available and finance too could have been obtained from private sources, but the government maintained its rights over water resources development, without doing anything. Only recently, after liberalisation of the economy, has this option received some support.

Technology improvement has just begun and the manufacturers are slowly moving away from simple miniaturisation of equipment. The cost may gradually come down to about a half as cost effective simplifications are developed. Even at present, cost is not unfavourable in comparison to mega projects. Cost is site specific: estimates vary between a high of Rs70 million per MW for the Northeastern region to Rs30 million per MW for the projects sanctioned by IREDA. Suitable designs for hilly regions, including socially oriented programmes like a portable micro hydel generator, are also being developed. The Power Ministry has proposed a new classification for sharing the responsibility with the Ministry of Non-conventional Energy Sources. A total potential of 8 821 MW capacity made up of small hydel schemes (up to 25 MW, to be dealt with by the MNES) has been identified up till now Of these, the Central Electricity Authority has identified 6 782 MW in 1 512 potential sites, and the Ministry of Non-conventional Energy Sources has identified 2 039 MW in 2 679 potential sites. Until now only about 175 MW has been tapped; in contrast, the installed capacity in China is about 15 000 MW.

Other Renewable Energy Sources

Contrary to the common notion, renewable technologies are not experimental fancies of scientists in laboratories but technologies that are already commercially viable or are on the verge of commercialisation and large-scale implementation. In India, three sources, with a total potential of about 64 000 MW, have already shown enough promise. These are shown in Table 6.4·

Table 6.4 Other Renewable Energy Sources

Source/Technology	Potential Availability (MW)	Potential Exploited (MW)
Wind Power	45 000	970
Biomass/Gasifier	17 000	220
Power from Municipal Wastes	1 700	3.75

The wind power potential has been revised to this level only recently, following identification of 177 sites in 13 States. The first demonstration wind farm was established during 1986; the demonstrations were successful enough to attract private sector investment. Against a target of 100 MW, including from the private sector, the achievement in the Eighth Plan was 860 MW. The capital cost of wind power generation is estimated to be Rs35 - 45 million per MW, which is not unfavourable. Capacity utilisation is poor if wind generators are installed in areas with poor wind conditions.

Another fast-growing energy source is Biomass Power generation, which includes biomass combustion programmes, biomass gasifiers and co-generation programmes. This is a suitable technique for villages which are far removed from power grids and for which electrification is uneconomic. In 1989 the Indian Institute of Science installed a 5 kW biomass gasifier on an experimental basis. The system had provided electricity to 43 households for lighting, 8 street-lights, a 3 hp pump for drinking water and a flour mill. In 1994 it was replaced by a 20kW system to meet irrigation and drinking water needs. The Eighth Plan had set a target of 2 MW for experimentation, but a more than 20 MW equivalent capacity has been established. The capacity installed up till March 1998 includes: 14 MW gasifier generation, 69 MW biomass combustion and 82 MW co-generation (TEDDY, 1998-99:118). Efficient designs of biomass gasifiers are still in the experimental stage and not yet commercially available.

Although several technological options are available for obtaining energy from urban and industrial wastes, in India there is no successful large-scale operation as yet.

Several other sources, such as the Solar Energy Programme, solar power, fuel cell technology, hydrogen energy, ocean energy etc are at different stages of research and development. The potential of some of these sources is immense; estimated potential of ocean thermal energy conversion (OTEC) from India's Exclusive Economic Zone is 180000 MW. In 1994, the world's first 100 MW ocean thermal power plant was established 46 km offshore at Kulasekharapattinam , in Tamil Nadu, on an experimental basis.There is still a large technological gap in the way of realising this source However, within a 25 year perspective for the power sector, technological breakthroughs in areas like this must also be taken into consideration. Some believe that the cost of electricity from an ocean thermal power plant will be less than from a coal-fired plant (Ramesh et al, 1997:170).

Required Policy

All renewable energy sources are site specific and the magnitude of energy availability and its potential depends on the local site conditions. Designs suitable for Indian conditions are developing fast. Within a very short time considerable progress has been made in the development of renewable energy sources (including small hydropower). Starting from a meagre 25 MW capacity in 1993, within just five years, the country has attained a capacity of 1 365 MW by April 1998 It is not unreasonable to expect that, on the basis of the established techniques, it is possible to attain 10 000 MW renewable electric capacity by the year 2010. With some push, like the promotion of research, policy assistance, etc, an even higher target may not be an impossible achievement At the rate of some Rs50 million per MW, such an expansion programme will require some Rs500-1000 billion. Unlike the major projects, which are in the public domain, private participation is permitted here. Also, the relatively low investments needed enable the participation of numerous private investors; the scope is not confined to multinational companies alone as in the case of mega projects. But the Ninth Plan Outlay is only Rs38 billion, which may prove to be too meagre to facilitate the necessary research and infrastructural inputs.

The erratic and unpredictable nature of many renewable energy sources is the main reason for doubting their dependability. Those working in this area indicate (Paranjape & Joy, 1995:141-2) that this state of belief persists because of an erroneous direction of research which has tried to raise the user quality of individual renewable source to levels comparable with that of fossil fuels. Instead, renewable energy sources should be seen as part of co-generation systems which combine and integrate two or more energy sources into a single energy system such that the limitations of each individual source are offset by their integration. Examples of such integration are: coal-solar, biofuel-solar or coal-biofuel-solar, wind-hydro co-generation systems. Natural gas instead of coal is also a more benign conventional energy source. No frontier area breakthrough in efficiency is required for such co-generation systems. Technology is available for all components of the system individually; what is required is to optimise their integration, and, over time, adapt the designs to optimise their energy payback periods.

Long-term policy

The long-term perspective pertains to questions of both irrigation and energy. Agriculture is primarily an energy production programme: it converts solar energy into biomass by way of photosynthesis. It also consumes some energy in the forms of inputs of human and animal power and now commercial energies. With the new agricultural techniques, consumption of energy in general and of commercial energy in particular, is rapidly increasing. By an estimate, the use of commercial energy in the Green Revolution agriculture has increased from a level of 10.72 peta calories in 1970-71 to 73.01 peta calories in 1987-88 (TEDDY, 1998-99:150). The share of mechanical power in total farm power has increased from 3.6% during 1950-51 to 80% in 1995-96 (TEDDY, 1998-99:152)

> A study by Sekar (1999) shows that conventional and non-renewable sources of energy, such as chemical, electrical, diesel and mechanical energy, accounts for 69% of energy consumed in agriculture, while human and animal energy, biomass energy and farmyard manure contributes just about 31%. At the same time 90% of the village population meet domestic energy needs primarily from non-commercial sources, firewood (55.64%), agricultural wastes (30.67%) and animal wastes (8.7%). This makes a mockery of the oft-cited argument that India needs a massive development of power sector to catch up with the advanced countries in standards of living. The high commercial energy consumption in agriculture is not an indicator of a high level of development when the standard of living has remained poor.

Such energy guzzling growth is not sustainable, which has led to the search for alternatives to energy intensive irrigated agriculture, along with alternative sources of energy production. The necessity of a paradigm shift to organics was made as early as 1976 by the National Commission of Agriculture. Organic agriculture too has passed the stage of experimentation. A considerable amount of organic food is produced in India and is exported to the developed world, after rigorous scrutiny and certification.

A comprehensive plan for power sector development will require combining these various options in a feasible manner. Sant & Dixit (1998), appointed by the Government of Madhya Pradesh, have prepared such a plan for the Narmada Valley Task Force. In Annex 6 there are some excerpts from this draft as examples of sequencing of options.

6.3.4 Approach To Development

Much of the search for options began not from opposition to large dams but from criticism of the development policies. Many Indians feel that the current policies are leading the country on a course from which no further development is possible. Shripad Dharamadhikary (n d.:146) of the Narmada Bachao Andolan has voiced this concern as:

> *The (energy and water[15]) crisis is extremely serious. And the response of "more of the same" is going to lead to absurd and unsustainable solutions. . . . The process would have to stop somewhere. The question is, Will this be a conscious choice? Unless there is a clear break from the process, a fundamental shift in the development paradigm, the future scenario is bound to be thrust upon us catastrophically and will be grim indeed. And in the case where a resource as critical as energy (or water) is in short supply, it is bound to be cornered by the rich . and powerful sections of the society.*

Far from being opposed to development, as is often alleged, critics of large dams like Dharamadhikary feel, if a critical resource is in short supply, the rich will corner it. Datye et a (1999:35) expresses this concern as: "It is clear that subsistence agriculture cannot generate economic and energy surplus needed to balance the economic and energy exchange and thereby ensure the viability of the rural economy."

Not only do these authors suggest several optional courses but they also show that these options are able to bring in a qualitatively different kind of development. The irrigation alternatives recommended are not small but user-friendly (Sengupta, 1993). Small hydropower is not mass production but production by the masses and is the realisation of Gandhian ideal (Naidu, 1997). Demand management requires extensive user participation. Datye, et al (1995:1) developed the low cost techniques of water delivery in order to attend to problems of equitable distribution Technology is seen only as a means for achieving the fundamental goals like equity, sustainability and participation. Patrick McCully (1996: 209) warns against a technology fetish, calling attention to the basic objective. "Just because a technology is small, however, does not guarantee that it will not have undesired social and environmental consequence."

Applications of the alternatives introduced in this chapter are usually guided more by these concerns for development than by opposition to large dams. In fact, conscious efforts are made not only to promote these technologies but also to attain a different developmental goal. Sukhomajori and Pani Panchayat, the two oft-mentioned success stories of alternate technology, espouse alternative methods for the distribution of water rights, promoting greater equity that, in turn, secured participation Chakriya Vikas Pranali is a grassroots movement directed towards strengthening ecology-economy interaction through community participation (Chopra & Kadekodi, 1999). Mukti Sangharsh Chalwal, which built the Baliraja Dam, opposed the State irrigation policies of increasing monopolisation of water, determined by the market forces and the growing scarcity of water for others, leading to drought-like conditions (Singh, 1997:212). Shah et al (1998) developed their Total Watershed Planning and Biomass Optimisation Strategy for dryland development to promote employment and participatory growth The technologies listed above should be regarded as instruments in use by these visionary developmental experiments.

> Many critics oppose both the means *and the ends* of dam builders - they are not interested in alternative methods of providing water for huge irrigation schemes which dispossess small farmers for the benefit of agribusiness, alternative energy sources to feed the wasteful habits of cities and industries, or alternative ways of wiping out floods on which rural people and ecosystems depend.
>
> McCully (1996 208)

6.4 Summing Up

6.4.1 Current Approach of Water Resource Development

A whole range of surface water appropriation technologies, which were serving the irrigation and drinking water needs of extensive areas, received very little attention during the Plan periods. These included some techniques, whose immense potential of which had already been established. Although the technology was already in existence, the government just did not develop small hydropower. Private parties, both individuals and corporate bodies, were debarred from developing river valley areas for either irrigation or power. The strategy that was chosen was irrigation development based primarily on canals and tubewells, only large units for hydel power, and multi-purpose river valley projects. From fewer than 300 large dams existing at the time of Independence, the number of dams constructed and under construction has gone up to above 4 000. To what extent has such a strategy paid back? The marginal contribution of major and medium irrigation projects to the increase in foodgrains production in the post-Independence period is about 10%; the area irrigated by large dams contribute at the most, 22% of current foodgrains production. This is substantial only if there is no exaggerated notion about their role in development. Large dams qualify for being one of the important factors for post-Independence growth, while falling far short of being THE most important factor. During this period the country has added about 22 000 MW of hydropower generation capacity. This too is not insignificant, but is not the major source of power. For flood control, large dams have been used only sparingly. In this area, their effectiveness is not beyond dispute, but dams are still the best known option. However, it is beginning to be suspected that dams are merely exporting floods outside the traditional flood prone area.

The current target is to complete most of the storage potential by 2025 and the addition of a massive capacity in hydel power within the next 12-13 years. Inter-basin transfer possibilities are being explored There are several stumbling blocks in the achievement of this target, as much as 67% of possible storage projects not yet taken up and 48% of unused potential of hydroelectricity lie in the Brahmaputra-Barak basin. Projects here may effect flood control but there is hardly any scope for irrigation. Another 36% of hydropower potential is in the Himalayan belt of the Ganga basin. This region has plenty of groundwater, and surface storage for irrigation is not a high priority. In addition, difficult locations, technological problems, possible diversion by China in the future and defence considerations may restrain construction of dams in the Himalayas. Inter-States problems have restrained or curtailed several major projects. The cost of creating irrigation potential through major and medium irrigation projects has increased rapidly since the 1970s. States have taken up too many major and medium irrigation projects against the available finance and completion of even the ongoing projects is now a problem. Unrecovered costs now account for more than double the State Plan outlays on irrigation. Progress in hydropower generation has slowed down drastically during the last decade primarily owing to financial, managerial and tariff related issues. The country has already failed badly in the attainment of targets set in the last couple of Plans Private sources of financing has been sought but have been obtained to only a meagre extent. By pursuing just the same old course as proposed, the prospect of achieving of even close to the set target does not seem to be very bright. More than ever, it has now become imperative to have a serious look at possible alternatives for continuing the pace of development.

Two kinds of options need attention: one is managerial - extracting more from the existing capacities, the other is technological. In the last 50 years, substantial capacity has been added in the irrigation and power sectors and considerable additional output can be extracted from these at nominal cost and without any additional problems like that of inter-State considerations or displacement In the 1980s, attention was drawn to the neglected water appropriation technologies for various reasons. By now quite a lot has become known about them. New technologies have been found in the power sector India happens to be one of the first few countries to adopt a comprehensive action plan for renewable energy capacity addition. Programmes initiated for the development of rainfed areas, watersheds, small hydropower, and non-conventional energy sources have enriched knowledge about field application methods. The following subsection summarises the situation of options introduced in previous chapters.

6.4.2 Options Available

Managerial options are immense. Several million hectares of created potential in major and medium irrigation in India is still unutilised and the backlogs are accumulating. Several million hectares are waterlogged and affected by salinity/alkalinity. Water-use efficiency is presently estimated to be only 38 to 40% for canal irrigation and about 60% for groundwater schemes. The productivity level of irrigated agriculture in India is just average, far behind what has been achieved in some countries of the world. Performances of existing power plants are miserable. Price structure is irrational leading to unduly high demand. There is considerable scope for electricity conservation by using energy saving equipment. Small hydel and pumped storage sites are plentiful for meating peak demand for a long time. Floods still occur in the "protected" belts, the incidence of which can be reduced by improvement of dam operations, and the adverse impact of which can be contained by better management of protected areas.

Technological options too are many. Most states of India are primarily rainfed. The vast rainfed area can only benefit from the development and application of alternative water appropriation options. The present approach restricts application of these alternative systems to the "rainfed" areas, which is not right. More than 10 m ha are still irrigated by different options, whicht need improvement. With the help of modern engineering and pursuing the bottom-up approach, it is possible to extend these systems to extensive areas that canal irrigation cannot reach. The alternative principles may be applied to even modern canal systems, leading to increased performance. In some rare cases those principles were actually developed in a bottom-up approach, using modern engineering, to the extent of adding large dams and hydroelectric projects. These are dams indeed, but designed in some significantly different ways that class them as "options" Alternative designs such as these may even permit some of the current projects, besieged by submergence and rehabilitation problems, to proceed smoothly. Traditional irrigation and modern water harvesting techniques, which are based on principles different from storage and runoff utilisation, would add to utilisable water resources of the country Encouraging rainwater harvesting as extensively as possible is a desirable strategy in view of the increasing pollution, salinity and drinking water shortage in the country

Since Independence and till ten years ago, small hydropower development was totally neglected Now, private sector participation is desired, but policy support is still insufficient Cost is not unfavourable in comparison to mega projects. Several renewable energy technologies are already mature or are on the verge of commercialisation and large-scale implementation. In India, three sources, with a total potential of about 64 000 MW have already shown enough promise. For a long-term perspective, technological breakthrough in several other areas must also be taken into consideration.

The potential of the technological options cited is not just unfounded imaginations In the course of the last 50 years, rainfed cultivation technology has demonstrated that it responds very well to productivity increase measures. In fact, after 50 years' development of not only thousands of dams but also massive expansion of tubewell irrigation, the relative contributions of rainfed and irrigated areas to the foodgrains production of the country has changed from around 60:40 to 40:60. Starting from just 25 MW capacity, within a period of five years, renewable energy sources attained a capacity of 1 365 MW. In the performance improvement area however, the result is poor. Though umpteen number of programmes have been adopted, in irrigation, drinking water and power, success is very limited. Since potentials in these fields are based on hard facts, non-achievements can only be characterised as failures. Programmes have not been designed carefully and have not been implemented with determination. Options to dams in flood control are embankments. This is not only a worse option, but also an unwarranted measure. Still, this option is pursued more often than dam construction for this purpose.

6.4.3 Key Issue: The Decision-making Process

Rainwater harvesting, watershed development, traditional irrigation systems, small hydel, and embankments for flood control are principles and techniques of water resource management. If this repository of techniques is added to the existing knowledge base then the planners and designers have much wider latitude to choose from. Water resource planning can only improve after such integration because old designs are not excluded from amongst the possible applications. Properly speaking, these are opportunities, not necessarily options. The question of options arises only in contexts where choices have to be made because of resource (physical, financial, etc) constraints. Choices made because of financial constraints need only prioritisation, not rejection of any option. But water resources available in an area can be committed to only one project. The current issue is whether this repository of techniques, known popularly as options, is effectively integrated into the existing decision-making process? The answer is negative.

Private initiative is not permitted for water resource development in river valley areas that are suitable for dams and canals. Recently, this structure has been relaxed for power generation, but not for irrigation and drinking and industrial water supply. Only government departments have the right to plan and design water resource development in such areas. Options are considered only at the investigation stage of schemes, by only a few officials and there is no rigorous study of all possible options. After this stage onwards, only one proposal is considered and there no further effort is made to weigh other possible options. Designs based on large dams find favour at the investigation stage as the officials are usually far more knowledgeable about dam and canal technology than other options. Even if an attempt is made towards a new area, it may be rejected at later stages by approving authorities like the CWC or the TAC. Familiar designs stand better chances of being sanctioned and receiving financial support, from the Planning Commission and the World Bank. The distribution formula of Central Government assistance is such that a State continues to receive the greater share resulting from the spillover of major/medium irrigation projects. Designers are, therefore, keen to make such projects

Once a technology is established, the existing institutions hinder the evolution of a competing one even though the latter is technologically more efficient. Familiar designs stand a better chance of proposal, approval and financial support. Call it "inertia", or "path dependency" according to the New Institutional Economics, this is a general problem in the field of technology choice. Market competition may ultimately establish the superior technology if there is a deserving option though most individuals hesitate to venture, rare entrepreneurs do step in to show the way. But in those spheres of an economy where entry rights are regulated by institutions, market competition does not work. In the power generation sector, the permission granted to private entrepreneurs has already paid rich dividends in technologically mature spheres like wind power. In the irrigation sector, there is no opening up. Even in the power sector, privatisation will effect only new constructions; performance improvement option for the existing works is still a government activity

The only way out from this stranglehold is a determined push by apex institutions. In fact, most of the healthy changes in the Indian economy have been brought about in this manner. A CSS scheme introduced HYV seeds and radically improved the food production scene; political leaders of some of the State governments have initiated effective participatory processes, external agencies, particularly the World Bank, were the major agencies behind the starting of most of the performance improvement programmes in the irrigation and power sectors, as well as of the non-conventional energy programmes, small irrigation system development programmes are being promoted now, once again, under the CSS schemes

In fact, one or other of the apex institutions has already recognised to the potential of these options and works have already been initiated[16]. But unlike the well-designed CSS of earlier years, these works are now largely populist programmes, without much scientific and considered input. Programme formulations need a lot more attention to achieve even moderate success. In order to justify World Bank financing, performance improvement programmes are taken up on a grand scale and some of these are declared as exploratory. Apart from the question whether this scale of project is necessary for exploration, very little has been culled and disseminated from these programmes as "lessons learnt". Other criticisms regarding this programmes are: surface irrigation options are distributed across different departments; information exchange is limited; coverage is still poor in spite of increased interest; available finance is thinly distributed; technology improvement measures are scanty; development programmes are so designed that these structures remain small forever and are never able to contest the case of major and medium projects; users' associations do not have any legal rights; programmes have conflicting goals - canal and tubewell extension programmes adversely affect the options; there is no political determination for revising price structures, privatisation measures in the power sector are slow and little effort is directed towards involving people in the demand management of electricity.

On the positive side the Planning Commission and the World Bank deserve credit for introducing these forward-looking programmes. In constrast, apex institutions in the water resources area, both at national and global levels, have shown very little initiative. The Ministry of Water Resources, the one Ministry which should be most concerned, is not even distantly connected with watershed management. Instead, ministerial statements make it seem as if the Ministry wants to keep away from these opportunities, which have, unfortunately, been termed "options". It is understandable that development of wind power or solar energy is not among the tasks that can be taken up by water resources institutions, but what is not understandable is what directs some experts to invent territorial divisions, earmarking such techniques to "rainfed" areas, when there are plenty of examples to the contrary. Hoping that this attitude will be given up in a reasonable time, we will make a few recommendations for the integration of these opportunities within the decision-making processes of the water resources institutions.

6.4.4 Research, Investigation and Improvement

A considerable amount of research and investigation is necessary in the areas of (a) technological possibilities and (b) performance improvement factors.

It may be an anachronism to use the term "non-conventional" for irrigation and drinking water systems, some of which have a long tradition, but the case is parallel to that of energy resources - investigations of these water systems are not quite conventional in modern water resource engineering. Besides, the researche has to be non-conventional, avoiding mere repetitions of the old designs, which would be devoid of any input of modern knowledge. Successful extension and management of these techniques require considerable improvement. Until now, the management aspect has received most of the attention at the cost of technicalities. Even a suitable typology has not yet been developed. There is no expertise that can treat these units through spatial integration, as designs of decentralised water management. Important alternative principles of water management that will find application in other systems, may be learnt from these systems.

There is a parallel need for designing long-term development policies sustainable in floodplains. Excessive confidence in the capacities of large dams as flood control measures has restrained clear assessment of their flood control capabilities. Only very recently have some water resource experts begun to admit openly that floods, like any other natural disaster, cannot be fully contained. This admission is the pre-requisite for the development of flood management policies. If earthquake-prone areas can be managed, and fast progress is being made for coping with the ravages of typhoons and cyclones, development policies can also be developed and pursued for flood-prone areas. People living in flood belts need not be condemned to eternal misery, as is the current understanding of "living with floods". Since large dams are indeed able to moderate floods they may have an important role to play in "flood adaptation". The present attitude asserting that dams have successfully controlled floods, stands in the way of designing the next step for the development of partly protected areas. Other structural measures for flood adaptation - instead of control - were proposed in the past' those too need investigation.

There is a tendency among the irrigation engineers to shift the responsibility of water resource development onto other departments. Problems of agricultural extension or input delivery are not the only reasons for low productivity; a considerable part of the responsibility lies with the irrigation departments: reservoirs do not fill up; water availability is insufficient; main system operations are erratic; water supply, directed primarily to meet power generation objectives, fails to meet the water demand of crops in time; performances differ from project to project; basic data, essential for managerial intervention, are not collected for every project; poor performance is the Achilles' Heel of the Indian economy; a great many large dams, as well as the options, may not deserve a case because of poor performance. But exceptions are there. Impressive cases do exist in the options area, and important lessons of management can be learnt from them. Not all dams have the same performance - there may be some that have performed much better than others; efforts must be made to learn from them instead of developing perfunctory performance improvement measures.

6.4.5 Decision Making and Extension

Capacity Building

The CWC has already made certain efforts, like the issuing of guidelines, for improving the project selection and planning procedures. These efforts are in the "conventional" areas. By now several performance improvement programmes have been conducted generating valuable experience Well-judged directives will help improve the designing of new performance improvement programmes, which need to be made for every single dam. Such technical guidelines are also necessary for designing rainwater harvesting and watershed development structures. Who else is in the best position to do that except some apex institution in the water resources area?

Division of works between departments and sections, though necessary, need careful development of procedures for avoiding fragmentation. Whether the currently existing divisions are conducive to balanced development needs review. There is little dispute that water resource planning has to be integrated, taking into consideration all possible opportunities. Ignorance of possible alternatives, both traditional and modern, prevents effective integration. Systematic steps are necessary to familiarise the personnel with the varieties of neglected opportunities. In the 1950s, when most engineers were not familiar with the new technology, the predecessor of the CWC took the lead in promoting large dams Today too, the CWC can take the necessary steps in promoting knowledge about further options. Creating awareness about available technologies continues to improve the productivity of various production systems. Networking of available data would be a useful step in this direction

Although theoretically the planning process must consider all options, there are practical limits Options are numerous, almost infinite, if the smallest possible variations in designs are considered. Preparations of even elementary plans involve some cost in resources and manpower. In practice, a balance is struck between costs and benefits, showing only some widely differing options through sensitivity analysis and similar procedures. The water resources department does not follow this approach, current practice of proposing only one design effectively leaves the choice of options to a small group of people within the departmental staff. This practice must be stopped. The Investigations Wing of the irrigation departments must be asked to report, in some suitable format, a comparative analysis of some widely differing options. This is a standard procedure in perspective planning exercises. The final choice of design must be made by a larger decision making body; in fact, the decision making procedure should involve the stakeholders.

Participation and Information Sharing

Although participatory programmes have also been introduced also in major/medium irrigation projects in India, they do not entail the involvement of beneficiaries in the planning and implementation process. If this practice is ever changed and potential beneficiaries are involved even from that stage, this is likely to result in a bottom-up approach to development. Such an approach would not only be able to identify the existing local irrigation structures, but would make way for the utilisation and improvement of those structures. In turn, the bottom-up approach earns peoples' co-operation. All over the world the PIM programmes indicate the desirability of involving farmers right at the designing stage, but in Indian programmes, farmers are involved in planning and designing, at the most, at tertiary (watercourse and field channels) levels if at all. It must also be noted that involvement of beneficiaries at the planning and designing stage automatically result in sharing of information; scrutiny of designs and estimates cease to be restricted within the government establishment. Extensive scrutiny helps to avoid mistakes, checks unsupportable claims, and thereby, allows projects to be completed smoothly.

The way the Indian society has moved has made such involvements imperative. The Panchayati Raj system has been introduced for decentralising the planning process. The technical capacities of this system are being developed. The Right to Information Bill may be introduced soon for making governmental functioning transparent; in due course, officials will have to work within this set-up. Instead of transparency being thrust upon them, it will be wiser for the apex bodies to start reorienting the functioning of departments, and training their personnel in how to use these human resources. Many officials do not realise that these are excellent helps if only they know how to utilise them. With peoples' participation, information collection is often easier, verifications is possible on a large scale, regular monitoring is cheap and two-way exchanges of information improve performances. The usual attitude of the technocrats is to smell antagonism in people. The PIM programmes were directed against this attitude and have indeed been somewhat successful in clearing the atmosphere of suspicion on both sides. This participation needs to be extended to the planning and designing stage as well.

Selection Criteria

The issue of selection criteria has been discussed in detail in another section of the India Country Report. It need only be added that the listing of items of costs and benefits requires care for the proper assessment of options. Different technologies have different requirements; also, certain benefits are provided by only some of them, not others. For a fair comparison, the specific characteristics of each option must be taken into consideration. This needs care.

As has been seen, the so-called options to dams are indeed, various opportunities that are not always in conflict with dams, but are usually neglected by the protagonists of dams. Mere improvement of selection criteria, without proper assessment of all options, cannot bring about healthy change. Options exist only in specific contexts, for designing and selecting specific projects. Not only dams and canals, but many other different opportunities need to be combined to make different options to choose from. On the other hand, two different designs of dams may be mutually optional.

> *There is no rule that the alternative to a mega-project must be another mega-project ... the range of possibilities must include other mega-projects and various mixes of options ... The choice between these various possibilities must not be arbitrary. It must be based on a rational procedure such as least cost planning.*

(Reddy, 1998.)

One may wonder whether the bottom-up approach in planning and designing is in conflict with least cost planning. That is not at all likely. Such an approach will often use the existing structures for the delivery system of the new project, as was the case of the bottom-up approach discussed in this report (Annex 4). This approach saves considerable part of the cost of construction. In the colonial period, only the renovation works on traditional systems underwentthe test of financial criterion. Apart from the financial savings there are other gains too: land acquisition and rehabilitation problems would be fewer; existing organisations would instantly become beneficiary organisations in the large projects.

If a careful selection is made, in some settings a network of small storage may be suitable, in another only a large dam, and in a third a mixture of the two. It is then expected that in its appropriate setting, each option will perform better than the others; only the better performing units will then portray a good performance for each of these technologies. Providing a level playing field for other opportunities will only help large dam technology perform better.

6.4.6 Future of Large Dams

All performance improvement options not only accept existing dams but also, implicitly, are directed towards increasing their viability. Technological alternatives like a combination of dams, canals and tanks, admit dams. If suitable solutions are found for some rising problems, dams may prove to be an important component of flood adaptation development. On the other hand, rapid development of soil moisture conservation techniques, rainwater harvesting and non-conventional energy technologies may reduce the importance of large dams for further development. Problems of drainage, waterlogging, salinity, and recurring loss against O&M costs, may even require abandoning or decommissioning of some existing dams. The future of a technology depends not only on its potential, but also on its comparative performance. Large or small dams, if built without adequate preparatory work, can fail to deliver expected results. Poor works, either of dams or of alternative options, will only discredit the respective technology. All those who are trying to further the development process, either through large dams or through other options, should also guard against poor elements within their own camps as these only weaken their arguments, while pretending to champion the same cause.

The current performance of both large dams and their smaller counterparts are poor yet both of them may benefit from each other. Large dams may be made far more welcome by alterations of the design so as to reduce the adverse effects of submergence and displacement. The supply-demand mismatch, that is so common in centralised designs, can be eliminated, resulting in better performance. The smaller works have little future if they are to remain isolated forever: They await extension, improvement and enrichment of supply, which is possible only through the use of modern technology, including dams.

7. Some Agreed Conclusions

R. Rangachari, Nirmal Sengupta, Ramaswamy R. Iyer, Pranab Banerji and Shekhar Singh

7.1 An Overview: Large Dams in India

India has over four thousand "arge dams" as defined by (ICOLD). Many of these (a little fewer than half) are lower than 15m in height (the principal criterion) but are classified as large dams based on other ICOLD criteria.

At the start of the 20th century India had 42 large dams. By 1950 a further 250 had been added. the rest were undertaken in the second half of the 20th century. Half the large dams were undertaken in the period 1970 to 1989. An examination of the Statewise picture of the distribution of large dams shows that nearly half the large dams are in the two States of Maharashtra and Gujarat, and that almost three-fourths lie within the three States of Gujarat, Maharashtra and Madhya Pradesh.

The basic thinking behind dam-building in India was (a) that rainfall in the sub-continent was highly seasonal, with most of the precipitation occurring within a few months of the year and within that period the intensity being concentrated within a few weeks; (b) that precipitation was also highly variable between different parts of the country and from year to year; and (c) that it was therefore necessary to store river waters in reservoirs behind dams for the purpose of transferring supplies from surplus to deficit seasons/areas, and from years of good rainfall to deficient ones.

The average annual runoff carried by the rivers in India, estimated by the CWC at around 1 869 BCM, has been revised by the National Commission for Integrated Water Resources Development to 1 953 BCM The extent of total live storage created under the various completed schemes (large and small) so far is of the order of 177 BCM. The addition that is anticipated through the schemes under construction is of the order of 75 BCM, taking the total to 250 BCM. Of this, "large" storages, defined as having a capacity (gross) of more than 1 BCM, will account for 164 BCM live, taking both completed schemes and those under execution. The balance is accounted for by minor schemes and small storages.

Objectives

The principal concern in undertaking these projects was to provide irrigation for protecting agriculture from the vagaries of the monsoon. Even "multi-purpose" projects had irrigation as a major aim. Some projects were taken up mainly or wholly for hydropower generation, and a few for industrial and domestic water supply. In some, flood-moderation was among the principal aims.

Investments

As "large dam projects" do not figure as a separate category in accounting, it is not possible to give figures of investment for such projects. Instead, the category of "major and medium irrigation projects", could be used as a proxy. (The classification of projects into "major/medium" and "minor" is at present determined by the extent of culturable command area covered.) Not all major/medium projects may involve dams (large or other), but many of them do: and the number of dams built for hydroelectric power without any significant irrigation component, and thus falling outside this classification, is likely to be small. In 50 years of planned development, a sum of about Rs91 943 crores (Rs919 billion) at current prices was invested for irrigation from all categories of schemes This figure is equivalent to Rs231 386 crores at constant (1996-97) prices. "Major and medium" projects accounted for Rs52 606 crores (Rs132 390 crores at 1996-97 prices) and "minor" schemes for Rs29 162 crores (Rs73 387 crores at 1996-97 prices).[17]. A further sum of Rs5 419 crores (or Rs13 386 crores at 1996-97 prices) was spent in "command area development" schemes for promoting the use

This is a working paper prepared for the World Commission on Dams as part of its information gathering activities The views conclusions and recommendations contained in the working paper are not to be taken to represent the views of the Commission of the irrigation potential created by the projects. Flood management accounted for Rs4 857 crores (Rs12 222 crores at 1996-97 prices).

Contribution of Dams: Irrigation

What has been the contribution of large dams to the country? Taking irrigation first, India's "irrigation potential" (ie the area which had the potential of being irrigated – a somewhat problematic concept) increased from 22.6 m ha in 1951 to about 89.6 m ha by 1997, marking a fourfold growth over a period of 50 years. The production of foodgrains increased from 51 million tonnes in 1950-51 to almost 200 million tonnes by 1996-97. About two-thirds (66.7%) of this increase came from the irrigated area, which is around one-third of the cultivated area. The increase in the production of foodgrains was the result of a combination of several factors, such as HYV seeds, chemical fertilizers and pesticides, credit, extension, support prices, and so on, but clearly irrigation played a crucial role, and some of that irrigation came from large dams. Taking the "major/medium" category (which accounts for 36.8% of irrigation) as a proxy for large dams, it can be said that 36.8% of the increase in the production of foodgrains in the irrigated area (which in turn is two-thirds or 66.7% of the total increase), ie 24.5% (66.7% x 36.8%) of the total increase, came from areas irrigated by large dams. This still leaves open the question of how much of this increase can be attributed to the dams themselves. One view is that excluding the effects of the other inputs, 10% of the increase can be attributed to dams. Others are of the view that this is an underestimate, as irrigation is a precondition for the use of other inputs. The CWC puts the quantum of increase attributable to large dams at 30%, but the details behind that number are not available. Leaving the numbers aside, it can be stated that large dams have made a contribution to the development of irrigation and therefore to food production and food security.

Contribution of Dams: Hydropower

Hydroelectric power generally forms part of the purposes of dam projects, along with irrigation, flood control, water supply, and so on, but there are a few cases where the only or most important objective in view is hydroelectric power. There are also many "run-of-the-river" schemes (ie, without the building of storages on the river) for the generation of hydroelectric power. At the time of Independence (1947), the total installed generating capacity was 1 362 MW, including 508 MW of hydropower capacity. The installed capacity in March 1998 stood at 89 000 MW inclusive of a hydropower capacity of 21 891 MW.[18] About two-thirds of the installed hydropower capacity is attributed to storage-backed schemes (ie, dams) and one-third comes from run-of-the-river schemes.

Contribution of Dams: Flood Moderation

Generally speaking, large dams have indeed moderated floods to some extent, particularly when a flood-reserve capacity is specifically allocated, proper reservoir regulation instructions are laid down, and adherence to them is independently monitored. Even in multipurpose reservoirs without a prescribed flood-reserve, the available storage space at the time of a peak flood flow can be used to impound the flood waters to the possible extent, but in the absence of an earmarked reserve space it may become necessary to release the impounded waters in the event of further inflows, and this could lead to increased flows lower down and create difficulties.

There has been considerable human settlement and economic activity in the floodplains lower down, because of which even the reduced peak flows below the large dams tend to cause serious flood damages. Hence, appropriate structural measures for flood moderation need to be coupled with the requisite non-structural measures.

Contribution of Dams: Other

Public water supply is not often a stated objective of large dam projects, but in many cases reservoirs and canals are in fact made use of for this purpose. In some cases, this objective has been explicitly added at a later date. Whatever the reason, this is welcome and is in accordance with the prioritisation of uses in the National Water Policy (1987). Certain cities and towns depend on nearby reservoirs for their drinking and municipal water needs; some also get a part of their water through long-distance transfers.

There are a few projects which meet industrial demands for water. No compiled data are readily available for dam-based storage meeting the industrial need for water, but this is an important function, sometimes the primary function, of some dams.

As regards navigation, this has not so far played a significant role in the planning of dam projects, except in the case of the Damodar Valley Corporation; even there it did not develop as originally envisaged.

Large dam projects also lead to certain incidental benefits not included among the declared objectives. For instance, degraded catchment areas may improve as a result of being treated in the interest of reducing the siltation of the reservoir; the new forest created as "compensatory afforestation" may grow into a new ecological system; the large body of water created may become a wildlife habitat and contribute to biodiversity; fisheries may develop in the reservoirs, offsetting to some extent the impact of the project on the existing fish population; the reservoir may become a centre of tourism and recreational activities; and so on.

Some Problems

Most large dam projects, particularly those undertaken in recent decades, have been characterised by certain problems, such as substantial environmental and social costs, the thin and sub-optimal spreading of resources on a large number of projects, inordinate delays in completion, large increases over the sanctioned project costs (both because of delays and because of initial underestimation), projects spilling over from Plan to Plan and needing large provisions, a persistent gap between the created irrigation potential and its utilisation, failures to achieve the projected benefits in full, inequities and injustices in the incidence of costs and benefits and in the distribution of the benefits, and so on. There have also been complaints about corruption and of collusion among project planners/managers/politicians on the one hand and consultants/contractors on the other. These are doubtless generally prevalent problems in the country, but dam projects (like other large projects) seem especially prone to the incidence of these managerial, social and political ills because of their size and complexity and the magnitude of the financial resources involved. A further problem is the failure of most of these projects to generate adequate revenues for the state exchequer, largely as a result of low water rates and poor collection.

Controversy

In recent years there has been a fierce controversy regarding large dams. Being moved by massive human displacements and poor rehabilitation performance, some activists, fighting for dam-affected people, as also some experts and professionals assessing the planning and performance of projects, have raised doubts about the desirability of large dams. Awareness of the many adverse environmental and social impacts of dams first led to doubts about specific dams and then developed into a questioning of large dams in general as a viable technology for equitable and sustainable development. The supporters of large dam projects argue that these dams confer many benefits, that without them growing needs of food, water and energy cannot be met; that any harm that they may cause can be anticipated and remedied or mitigated; and that some of the adverse consequences attributed to dams really arise from certain "political economy" factors prevalent in the country

Those who question the acceptability of some or all large dams contend that the benefits of many large dams are overstated and the costs understated; that they do far more harm than good; that their impacts and consequences are rarely assessed in advance and cannot be fully foreseen, much less remedied; that many adverse impacts are irremediable; and that insofar as certain "political economy" factors are in fact operative in the country, these have to be taken into account while undertaking large projects. They argue further that future needs can be met without recourse to large dams, through smaller structures and through other methods including demand-side management. The rejoinder to this by the supporters of large dams would be that small dams, local watershed development, water harvesting, etc, are all complementary measures that can meet only a small part of overall requirements, and are not substitutes for large projects. This is not accepted by those who advocate alternatives. Unfortunately, the controversy has become emotionally charged. Extreme positions held strongly at either end of the spectrum tend to dominate the debate, drowning the voices of the reasonable.

In this context, apart from considering the overall balance of the good and bad aspects of dams, it will be necessary to ask whether all or most large dams are viable and optimal; whether the other approaches/techniques suggested hold promise of meeting the future needs of food, water and energy; whether they actually have fewer adverse social and environmental impacts; and whether they are really *alternatives* that obviate the need for large dams, or at least some or many of them. It has also to be determined under what conditions large dams can be considered viable and optimal and what processes are required to establish this.

The issues referred to in the foregoing paragraphs, as well as others such as the environmental and social aspects of dam projects, have been discussed by different members of this Team in the various chapters of this Report. The responsibility for each chapter rests with its author or authors. This chapter seeks to present a set of conclusions acceptable to the Team as a whole, and not summaries of the earlier chapters.

7.2 The Legal and Institutional Framework

There is an implicit assumption that rivers are resources of the state to be dealt with by the government *for* the people. This fails to recognise that the people could have concerns and interests of their own, and that there could be conflicts between these and the aims and purposes of the government.

The "eminent domain" claimed by the state over land and water tends to prevail over the rights of the people.

The actual operation of the Land Acquisition Act, dating back to the 19^{th} century, under which private land is acquired by the state for a public purpose, and which is the principal instrument of displacement in the implementation of large dam projects, has been beset with problems in many cases. The affected people can question the quantum of compensation, but it is very difficult for them to challenge the "public purpose" claimed by the state, or to argue that alternative ways of achieving that public purpose should be considered. Major changes are necessary in the Land Acquisition Act and the related procedures.

Until recently, there was no statutory requirement of a public hearing in relation to the environmental clearance of such projects. It has now been introduced but has not yet become a well-established procedure.

Some State governments have tried to provide project-affected persons with benefits in the command area through legislation, but while these acts are on the statute book and contain some enlightened provisions, it cannot be said that they have been fully put into practice.

The Official Secrets Act creates a veil of secrecy around governmental actions, keeps the people at a distance, denies not merely information but even physical access to areas, and in general renders all talk of "participatory" or "people-centred" planning meaningless.

A new dimension has been added to the legal and policy framework by the persistent efforts of the Judiciary to expand the human rights jurisdiction of the courts and extend the scope of judicial review of executive action. As a part of this "activism", the Judiciary has been encouraging what is known as "Public Interest Litigation" (PIL). Many individuals and NGOs have played an important role in these developments.

It seems likely that in future the third tier in the constitutional structure, created by the 73rd and 74th Amendments, namely, the village *panchayats* and the city *nagarpalikas* (municipalities/corporations), will come to play an important role in relation to water resource development. However, the processes of decentralisation are still evolving, and the role of the third tier is as yet only incipient.

Twelve years after it was adopted, the National Water Policy 1987 still remains a set of general statements and has not been effectively translated into detailed sub-policies, programmes and action plans.

An effort to codify the set of principles and practices that have been evolving on the subject of the resettlement and rehabilitation of people displaced or otherwise affected by large projects in the form of a National Rehabilitation Policy has not reached finality so far.

The Policy on *Hydro Power Development* (August 1998) makes a case for large hydropower projects without any reference to options and alternatives that some have put forward.

Outlays on projects and other new developmental activities are classified as "plan" and operation and maintenance as "non-plan". This division, together with the mounting establishment costs, and the inherent tendency on the part of the bureaucracy, the technocracy and the politicians in India to be more interested in the construction of new projects than in the efficient running of completed projects, leads to the under-provisioning and neglect of maintenance.

If and when "private sector participation" in large dam projects becomes a significant reality, a crucial question will be how the human and social aspects, which have presented great difficulties even in public sector projects, will be taken care of in private ones.

Planning has by and large tended to proceed on the basis of discrete, individual projects. A truly integrated, holistic planning for a basin or a sub-basin would involve *inter-disciplinary* planning for the basin or sub-basin, marrying land use and water use, harmonising diverse water uses on the demand side and integrating *all* "development" from local rainwater-harvesting and micro watershed development into "mega" projects (and surface water and groundwater) on the supply side, while at the same time fully internalising environmental, ecological, human and social concerns, and fully associating the people concerned ("stakeholders") at all stages. That kind of basin planning has not really been seriously attempted in India.

The basic criterion for the approval of projects has been the Benefit-Cost Ratio (BCR). The BCR as actually operated is an unsatisfactory criterion, and is liable to distortion. Dissatisfaction with the manner in which irrigation and multi-purpose projects were being dealt with led to the establishment of the Nitin Desai Committee. The report of this Committee (1983) made recommendations for a change-over to a better appraisal system involving a proper socio-economic cost-benefit analysis which would lead to the determination of an economic internal rate of return. This system remains unimplemented.

Partly as a consequence of the abandonment of the earlier financial return criterion, and partly because the pricing of irrigation water in many States is so low and the recovery so poor as to make it virtually free, most large dam projects are loss-making propositions insofar as the state exchequer is concerned. This situation aggravates the resource shortage of the States.

The primary, controlling discipline in project preparation at the State level, and examination at the Central level, is engineering. Other disciplines, concerns and points of view are to some extent brought in through consultations and comments, but there is no *inter-disciplinary* planning in the proper sense of the term.

There is and can be no integrated, "holistic" planning under these circumstances, despite instructions and exhortations to that effect.

One major feature of project planning has been the dominance of irrigation. Even "multi-purpose projects" often have only two components, namely irrigation and hydroelectric power. The integration of other purposes has not been a standard feature of project planning. There could be conflicts between two different uses (eg, between irrigation/power generation and flood moderation, between irrigation and maintaining minimum flows), but these are not always explicitly recognised and built into project planning.

Project decisions do not represent carefully considered choices out of a number of possible answers to a given need or problem. Only one unique project is proposed for approval. *Within* the ambit of a project, there may be multiple possibilities at various stages, and some of these may be covered in the processes of project preparation, but *alternatives* to the project are not usually considered. Also, there is no conscious principle or policy of "minimum environmental impact" or "least displacement", and choices based on such considerations are unlikely to be presented.

One of the factors that militate against holistic, integrated planning is the fragmentation and compartmentalisation of responsibilities at the administrative level. Even within the area of water resources proper there is a compartmentalisation of different components or aspects such as major/medium projects; minor irrigation; command area development; groundwater, watershed development; rainwater-harvesting; water management; and so on. Different Divisions/Departments/Agencies tend to deal with these matters with little co-ordination, much less integration.

The processes of appraisal and decision-making are not rigorous enough, as evidenced by the post-clearance history of scope changes and modifications in several projects, and the unsatisfactory investment criterion employed.

Civil society (in the sense of the people concerned, ie, beneficiaries and those who are likely to be adversely affected, and the community in general) plays little or no role in the planning and implementation of such projects. The activity is essentially governmental. It is only in recent years that a consciousness of the importance of "stakeholder participation" has begun to emerge

In the absence of institutional arrangements for consultation and grievance-redressal, the processes of displacement, resettlement and rehabilitation often generate serious dissatisfactions leading in some cases to confrontational situations

The monitoring system is weak, and there is no effective mechanism to ensure that wherever sanctioned costs are likely to be, or have been, exceeded, the Revised Cost Estimate (RCE) has promptly brought in the TAC/Planning Commission for a fresh appraisal. There is also no established system of a post-completion evaluation. Very few projects, other than those that receive World Bank assistance, are subjected to such an *ex post facto* reappraisal.

Where the approval of a project is conditional, there is no effective mechanism for ensuring compliance with those conditions and taking appropriate measures in the event of non-compliance.

7.3 Financial, Economic and Distributional Aspects

The *Report of the Committee to Review the Existing Criteria for Working Out the Benefit Cost Ratio for Irrigation Projects* (the Nitin Desai Committee, 1983) recommended the replacement of the existing quasi-economic methods by comprehensive economic appraisal techniques. However, the essential structure of project appraisal has hardly changed since 1964. The quasi-economic criterion of a ratio of annual benefits to annual costs, both evaluated at market prices and comprising many rule-of-the-thumb items, continues even though the internal rate of return is also reported and costs now have a broader definition.

The Committee on the Pricing of Irrigation Water (Vaidyanathan Committee), which submitted its report in September 1992, recommended the re-introduction of a minimum financial return as an essential criterion, along with social benefit-cost criteria, for sanctioning all investment proposals.

The recovery rate (percentage recovery of working expenses through gross irrigation receipts) fell from 93% in 1976-77 to 46% in 1980-81 and further to a meagre 9% by the end of the 1980s. The irrigation sector had become a huge fiscal liability with annual operational losses exceeding Rs3 000 crores in 1993-94.

The cost of creation of irrigation potential in major and medium irrigation projects shows a sharp increase in the capital cost per hectare between the First Plan period (1951-56) and the Annual Plans of 1990-92, from Rs1 200 to Rs66 570 in current prices, and from Rs8 620 to Rs29 587 in constant (1980-81) prices.

Actual expenditures on O&M have been much lower than the norms and even declined during the 1970s. Further, establishment costs as a proportion of O&M expenses rose in the 1980s while the proportion of maintenance and repairs fell sharply.

There is enough evidence to show that in aggregate terms: (a) the actual area irrigated by major and medium projects falls well short of the projected area and the discrepancy may be increasing, (b) actual yield figures are often well below anticipated yields, (c) there is divergence between assumed cropping patterns and actual and (d) there is some evidence of over-optimistic price assumptions.

In the case of both irrigation and hydropower projects, costs are often underestimated and benefits exaggerated so that the requisite BCR is shown to have been arrived at.

Interim evaluation studies done for 12 command area development projects indicate that, according to the original project proposals (without CAD), the B-C ratios (based on data of evaluation studies) are less than the cut-off rate of 1.5 in 8 of the 10 projects (relevant data for 2 projects were not available). If CAD is included, then another 6 of the 11 projects fail to reach the qualifying ratio of 1.5.

Turning to the general question whether or not the benefits from large scale canal irrigation clearly outweighs the direct costs of providing the irrigation, the conclusion seems to be that, by the early 1990s, major and medium projects may have become unviable if irrigation benefits alone are considered.

There is an ad-hoc attitude in the identification of projects and competition between States for developing projects with a view to establishing their respective rights over the waters of inter-State rivers.

According to CWC data, losses from Irrigation and Multipurpose River Valley Projects rose from Rs424 crore in 1980-81 to Rs945 crore (1985-86) and then to Rs3 124 crore in 1993-94. The Vaidyanathan Committee (1992) pointed out that the CWC figures underestimate the actual losses. Quick but incomplete estimates made by the Committee for the year 1986-87 showed that losses were in the region of Rs1 526 crore compared to the CWC estimate of Rs1 379 crore. The immediate causes for the mounting losses, as seen from various reports, are: (a) rising costs, (b) unrevised water rates, and (c) shortfalls in area irrigated and delays in completion.

Water rates have remained remarkably "sticky". The rates are fixed at very low levels and are not revised even to account for inflation. Even this meagre amount is not collected and arrears in collection are allowed to accumulate. There has also been no rational basis for the determination of rates; in many cases, water-intensive crops actually pay less per unit of water. Correlation between gross receipts and productivity has been absent across States. Cost coverage, of course, has not been a consideration at all.

The Expert Committee on Rise in Costs of Irrigation and Multi-Purpose Projects (Naegamwala Committee, 1973) and the Planning Commission"s Working Group for Sixth Plan (1980) identified 10 factors causing cost escalation and time overruns. Of these, 8 are largely attributable to faulty planning:

(i) proliferation of projects resulting in thin spreading of resources,
(ii) lack of thorough investigations before starting work,
(iii) delays in taking decision,
(iv) non-availability of essential inputs,
(v) change in scope of projects during implementation,
(vi) lack of construction planning and monitoring organisations in states,
(vii) lack of detailed plans and estimates for the distribution systems and structures thereof: and
(viii) failure to update estimates and inform governments of the rise in cost of projects.

The cost per unit of hydropower is low because only a small part of the capital cost of multi-purpose projects is apportioned to hydropower. However, this is notional. If the combined financial viability of the project is studied, the gains from power are unlikely to compensate for losses from irrigation unless hydropower generation is extremely large and its pricing has a significant margin over costs

In the case of irrigation projects, neither the earlier financial criterion nor the subsequent quasi-economic criterion raises the question of distribution. The Desai Committee had recommended the inclusion of distributional effects for project appraisal, but this has been ignored.

The operational losses from public irrigation projects are, in fact, implicit subsidies which the State Governments provide to the beneficiary farmers. The inequity involved in such large-scale subsidisation of beneficiaries has often drawn sharp reactions from various committees The PAC (1983 136) saw "no reason why the big landowners who are the principal beneficiaries of the irrigation facilities, should continue to be subsidised any longer though it may be justified in the case of small and marginal farmers and share croppers". Further, apart from operational losses, capital expenditures are not covered at all. As capital expenditure involves long-term borrowing, and as irrigation projects yield almost no income, inter-generational distributional issues also become important, as the tax burdens over future generations are likely to be heavier and/or future development expenditures are likely to be curtailed.

Insofar as intra-project distribution is concerned, dams, by their very nature, lead to submergence and displacement in the catchment area, which is hilly, and the irrigation benefits flow to the command area The burden of costs and the enjoyment of benefits therefore fall on different sets of people (geographically separated). The benefits accrue to farmers, usually the larger or more dominant ones, who are able to influence, in many cases, the actual distribution of water. Another intra-project issue is the unequal distribution of benefits among the upper, middle and tail reaches of canals Finally the problems of project-affected people have become a central issue. Wide differences exist regarding the number of persons displaced by large irrigation and multi-purpose projects. In an overwhelming majority of projects, the compensation paid covered only a small part of the costs borne by the displaced

Summing up:

- There has been enormous lethargy and resistance to change in the governmental system. Even now, despite the Desai Committee recommendations of 1983, the shift to full economic appraisal has not taken place.
- The appraisal exercises were often not taken seriously. The appraisal criterion adopted was faulty, and this tended to evoke the response of underestimating costs and overestimating benefits. The entire appraisal process degenerated into a formality.
- One reason for this is that the benefit-cost analysis has never been used as a tool for assessing alternatives and has therefore never been central to the planning process. The ratio enters the picture only as a criterion imposed by the Planning Commission for the inclusion of a project in the Plan. However, there may have been a change in recent years towards more realistic benefit assessments and the inclusion of many cost elements which were previously ignored.
- Water rates have been extremely low and have borne no relation to either benefits or operational costs. In general, they not only do not make a contribution towards the servicing of the large capital costs, but they do not cover even the O&M costs.
- It is necessary to discuss the appraisal procedures and criteria and the financial accountability systems openly and purposefully with a view to developing more enlightened and professional decision-making and management systems that examine alternatives, so that scarce public resources are put to the most beneficial uses.

7.4 Environmental, Social and Equity Aspects

In India, large dams have had many costs and benefits. However, though the benefits (except for some incidental or unanticipated ones) have in general been identified and assessed, a large part of the costs, especially the environmental and social costs, have been ignored

Till 1978, there was no formal requirement to assess the environmental or social impacts of large dams, either in order to assess their viability or to attempt to prevent or minimise adverse impacts.

Over 2 500 large dams were initiated in India prior to 1978. Consequently, for these 2 500 plus large dams, no assessment was required to be done of their social and environmental costs or viability nor was there any attempt to prevent or minimise most of the adverse impacts

Apart from there not being any acknowledgement of the social and environmental costs, most of these dams were also not required to internalise the costs of preventing, minimising or mitigating most of the adverse impacts.

Environmental Impacts

For some of these projects, there was an attempt to assess at least two of the environmental parameters: rate of sedimentation, and possibility of waterlogging. These aspects were assessed primarily because of their impact on the life of the dam and on agricultural productivity in the command, respectively.

From 1978, the Government of India started insisting that all new dams be assessed for their environmental impacts and that they obtain environmental clearance prior to construction. However, despite such a stipulation, the 1 800 large dams subsequently taken up for construction continued to adversely impact on the environment, though to a lesser extent. The reasons for this are summarised below

The guidelines for conducting environmental impact assessments (EIA) of river valley projects were developed, in 1978, by the Department of Science and Technology (DST) and published, in 1985, by the Ministry of Environment and Forests (MoEF). These guidelines were very sketchy and did not prescribe a comprehensive assessment. Despite this, and the fact that knowledge and science has progressed much since then, these guidelines have still not been amended.

In many cases, even the minimal assessments required by the guidelines are not completed prior to project constructions. Often, State Governments start construction work even before the environmental clearance is received. In a few cases, they manage to obtain clearance before the completion of the required assessment, with the stipulation that the assessment will be completed by a stipulated future date and that safeguards will be implemented *pari passu* with construction work. In both instances, the basic purpose of an environmental assessment is defeated and the project is presented as a *fait accompli*, because the government does not have the political will to abandon a project for which considerable costs have already been incurred.

The process of environmental assessment is often hurried mainly because it is started when the project preparation is at an advanced state, rather than when the project is conceived. By the time the project comes to the MoEF for environmental assessment, considerable momentum has been generated for starting construction. Any delays in granting environmental clearance, which are necessitated by the need to properly scrutinise the project, are looked at askance and considerable pressure is brought upon the MoEF to clear the project quickly.

The situation is exacerbated by the fact that the consultants who prepare the environmental impact statements, on which the assessments are mostly based, are hired and supervised by the project authorities. Consequently, these statements are not always reliable.

Also, the MoEF prescribes no standards for gauging most of the adverse environmental impacts, thereby making the final assessment of environmental viability excessively subjective and arbitrary

To make matters worse, the conditions invariably prescribed at the time of clearance are often disregarded once the clearance is given. There is little ability within the MoEF to enforce these conditions, short of revoking clearance, which is almost impossible to do within the prevailing political and administrative system.

There is no system of assessing the actual (as opposed to the anticipated) environmental impacts of completed projects. Therefore, the actual environmental impact of large dams remains a matter of speculation. There is, consequently, little opportunity of evaluating the efficacy of the methods of assessment, prevention and mitigation of such impacts. There is also little ability to evaluate whether the financial and economic costs that such impacts and their prevention or mitigation have incurred, are as anticipated and, if not, how a more realistic assessment of such costs would affect the economic viability of projects.

Clearly there is a need to prescribe a comprehensive environmental assessment for all dams and to insist that standards are formulated such that there is an ability to assess the environmental viability of proposed large dams. The process of assessment must be objective and scientific and the costs of prevention, reduction and mitigation must be calculated in full. The residual adverse impacts that cannot be so prevented, reduced or mitigated must also be taken into consideration before assessing the economic viability of proposed dams.

There must be a system by which the onus is on the project authority to periodically establish that they are respecting the conditions of clearance. Environmental clearances to projects must automatically lapse if the project authority cannot establish this.

There must be a constant assessment of the efficacy of assessment, prevention, reduction and mitigation techniques and the adequacy of the financial costs allocated for the purpose.

This whole process should be transparent so that it can bear public scrutiny.

Social Impacts

Large dams also have many social impacts, both beneficial and adverse. Many of the beneficial social impacts, in terms of enhanced supply of water for irrigation, domestic, municipal and industrial uses and the generation of power for industrial, domestic, agricultural and other uses, are assessed in financial and economic terms and form the basis of the justification of a dam.

In a few cases, flood control is also an explicit objective and forms a part of the dam''s justification. However, some level of flood control occurs as a result of many dams even though it might not be an explicit objective and the resultant beneficial social impacts are, therefore, not assessed as part of the project''s benefits.

However, large dams also have many adverse social impacts, the costs of many of which are either not reflected at all or inadequately reflected in the BCR. The assessment of some aspects of rehabilitation, mainly the rehabilitation package offered, is required to be done as a part of the environmental assessment process, but only since 1978

The most significant social costs of large dams are borne by those who are forcefully displaced from their homes because of the dam. Only the financial costs of relocating and resettling them or, more often, compensating them, form a part of the financial analysis of a dam.

For most of the earlier projects, there is little or no reliable information on what happened to the displaced people. This is mainly because most of them were not rehabilitated in any meaningful sense, but given mainly cash compensation and left to look after themselves. In retrospect, it is impossible to trace them and find out what happened to the rest of their lives or, indeed, to the lives of their children and grandchildren.

In some of the recent projects, there has been a tendency to provide a more comprehensive rehabilitation package and, occasionally, to provide even land for land. In a few of the very recent projects, it is proposed to provide land to the landless and, in at least two cases, even to adult, unmarried, sons and daughters.

However, even in the progressive rehabilitation packages, a large number of needs are not provided for, or inadequately and inappropriately provided for. The vast majority of the packages cannot be considered progressive, at least from current perspectives.

Apart from the adequacy of the rehabilitation package, a greater problem is its implementation: even the inadequate provisions of a package are not implemented in full. In many projects, there are complaints that many of the promised benefits did not materialise. Where land was given, it was reportedly often of poor quality. The promised infrastructure, people complain, is missing or of poor quality and even basic necessities like water, shelter and economic survival are not always provided for. It is difficult, from whatever perspective is taken, to find many success stories

Part of the problem of implementation is owing to the faulty processes of rehabilitation. The planning and implementation is top-down, bureaucratic, with little or no involvement of the affected and other concerned people. There is no transparency in the system and corruption is reportedly rampant. The minimum empathy and sensitivity that project-affected people deserve, given their plight, is reportedly hard to find. Rehabilitation of project-affected persons is generally treated as a marginal issue that does not deserve focussed attention.

Unfortunately, even the economic benefits flowing from a dam seem to have certain adverse social impacts. There are no specific government guidelines regarding equity aspects of large dams and the costs and benefits of dams are generally not equitably shared, with some people paying a bulk of the costs while others corner the bulk of benefits. Unfortunately, a disproportionately large number of those who pay the costs are members of scheduled tribes and castes, or other disadvantaged sections of society.

Even the distribution of benefits is not equitable. Irrigation benefits are mostly appropriated by farmers with large landholdings and, among them, by those who are at the head of the distribution system rather than at the tail reach. Electricity is also disproportionately accessed by the urban rich and the rich farmer, as opposed to the urban poor and the poor farmer. Though such a distortion is not inherent in a power project, in actual fact it occurs.

Consequently, dams have not only helped to maintain the current inequities in the Indian society but, in some ways, have exacerbated them. Despite this, no class-benefit analysis is required to be carried out on proposed dams and no equity standards have been laid down, to which proposed dams must conform before they are considered socially viable.

Though today there is much greater soul searching about the adverse social impacts of dams than there is about the adverse environmental impacts, such soul searching has not led to a revaluation of the cost of dams on society. It has not yet led to the laying down of government policy directives incorporating standards of social disruption beyond which a dam, whatever its economic benefits, would not be considered viable. It has not led to a system by which more than just the financial costs of "compensating" social trauma are considered while determining the viability and optimality of a proposed dam. It has not even resulted in the acknowledgement of the fact that gross injustice has been done to those who have had to bear the costs of large dams in India. There is a need to do all this and to follow it up, even at this late stage, with a sincere attempt to rehabilitate the millions of "development refugees" created by large dams. And it is the time to consider stipulating that, until this is done, or at least well begun, no further displacement should be allowed

Conclusions

The process of planning for and assessing large dams must include a realistic look at the various alternatives and supplementary methods that are available for delivery the benefits large dams are expected to deliver. Each of these alternatives must be assessed in terms of the social and environmental impacts, and the alternative consequently chosen must not only be viable, but also optimal. The process must be participatory and transparent.

Where a large dam emerges as the best viable alternative, this must be after the costs of preventing, reducing and mitigating the adverse social and environmental impacts of dams have been realistically calculated and included in the benefit-cost analysis. Any residual adverse impacts must also be considered while conducting the final assessment.

There must be a strong institutional structure to ensure the proper implementation of the social and environmental safeguards, with the support of adequate policy and legal backing.

The monitoring of compliance with prescribed safeguards and conditionalities should also involve independent agencies and be open to the scrutiny of affected and concerned people

There must be a constant effort to learn from experience by assessing, periodically, completed projects and judging the impacts they have had and are having and how these compare with what was anticipated

7.5 Options

Two kinds of options have been discussed in connection with the controversy about large dams: one is managerial, the other is technological. Both of these need attention.

Managerial Options:

Significant additions to the irrigated area can be made without large new investments in major projects by:

- the fuller utilisation of the irrigation potential already created by major/medium projects and by minor irrigation schemes;
- the reclamation of waterlogged and salinity/alkalinity-affected areas in the commands of major/medium projects; and
- increases in the efficiency of water use in all sectors, and particularly in irrigated agriculture

The productivity level of irrigated agriculture in India is in general just fair, and well behind what has been achieved in some countries of the world. Increases in the level of productivity of irrigated agriculture can add substantially to agricultural production even without large new projects. The productivity of rainfed agriculture can also be significantly stepped up.

Both water use efficiency and agricultural productivity can be significantly increased through the transfer of the management of State-built and State-managed systems at a certain level to Water Users' Associations (WUAs) under the Participatory Irrigation Management (PIM) programme, with clear contractual obligations between the Department and the WUA, backed by a requisite system of legal rights.

In conjunction with large projects, recourse to community-managed systems with small local storages under the control of farmers, similar to traditional irrigation systems, will also reduce the dependence of farmers on the governmental machinery and help to increase productivity.

Insofar as the power sector is concerned, significant improvements in capacity utilisation and reductions in distribution losses will be equivalent to the creation of substantial new generating capacity. The requirement of additional hydroelectric power will diminish accordingly.

Rationalising the power tariff structure can reduce electricity demand, and the conservation of energy through energy-efficient equipment and technological innovations can augment supplies, thus minimising the need for investments in new capacities.

The addition of pumped storage schemes in existing reservoirs and the full operation of pumped storage facilities already installed will be able to meet peak demands without major new investments for quite some time.

For flood management, appropriate non-structural measures need to be coupled with structural measures. Though large dams are better structural options than embankments, remedies need to be developed for the subsequent problems arising from the dynamics of development. The incidence of floods in the "protected" belts can be reduced by the improvement of dam operations.

Technological Options:

Wide varieties of water appropriation techniques, including in-situ harvesting, surface and subsurface storage, diversion, regulations of spread, soil conservation methods that help in increased groundwater recharge, and treatments for the enhancement of surface runoff collection or for evaporation control, are water appropriation options. These can be used separately or in conjunction with other options including large dams.

Power generation options include small hydropower, wind power, biomass gasifier, power from municipal wastes, solar power, fuel cell technology, ocean energy etc. For a long-term perspective, technological breakthroughs in several other areas must also be taken into consideration.

Approaches such as rainwater-harvesting, watershed development, etc, need to be extensively adopted in the vast rainfed areas of the country. They also have an application in other areas in conjunction with canal or groundwater irrigation.

Such local systems, whether traditional or more recent, need improvement. With the help of modem engineering and by pursuing a "bottom-up" approach, it is possible to extend these systems to extensive areas to which canal irrigation cannot reach.

The principles learnt from traditional irrigation systems may be applied even to modern canal systems, leading to improved performance. It is also possible to design a new, modern project in conjunction and integrated with existing traditional systems, and on a "participatory" (ie people-centred) basis. This is also an "option". Such an approach may allow some of the current projects, now mired in controversy, to proceed smoothly.

For easing the projected water problems of the country, the "available" water resources can be converted into "usable" water resources not only by storing the "runoff" in reservoirs behind dams, but also by traditional irrigation and modern water-harvesting techniques.

Nearly 90% of drinking water needs are met from groundwater. The rapid depletion of groundwater aquifers in a number of states is particularly alarming in this context. Small storage structures would be of great use for meeting drinking water needs through rainwater harvesting as well through the recharge of groundwater.

The potential of the technological options cited is neither illusory nor minor. Even after 50 years of development of not only thousands of dams but also a massive expansion of tubewell irrigation, the relative contributions of rainfed and irrigated areas to the production of foodgrains in the country has only changed from around 60:40 to 40:60; in other words, rainfed agriculture still remains a significant contributor. Similarly, starting from a capacity of no more than 25 MW, renewable (non-conventional) energy sources attained a capacity of 1 365 MW within a period of five years. However, the performance needs to be improved. Programmes have not been designed carefully or implemented with determination.

An alternative to large dams for flood control are embankments, although this is not an option to be commended. Dams are rarely built for flood moderation alone, and as mentioned earlier, most dams do not contain a flood reserve provision, and even when they do, the cushion tends to be encroached upon by the demands of irrigation and power generation. What needs to be done is to put in place a proper flood management and disaster mitigation policy. This subject goes beyond the scope of this report

A Final Summing Up

Large dams have made important contributions to the development of irrigated agriculture, and have improved productivity and the production of food. They have also contributed hydroelectric power and enhanced the domestic and industrial water supply

They have also had significant adverse impacts, including social and environmental impacts. Specifically, they have displaced a large number of people and submerged large areas of forest and other lands.

Some of the adverse impacts of large dams are of such a nature that they can be neither prevented nor mitigated.

Most of the adverse impacts and some of the incidental benefits of large dams have not been recognised and assessed in the past.

The computation of the financial and economic costs of preventing or mitigating the adverse impacts of large dams would undoubtedly have an impact on their financial and economic viability.

This conclusion is borne out by a retrospective assessment of the economic and financial aspects of some large dams. This assessment showed that, when the costs of preventing and mitigating even a few of these adverse impacts were included in the overall costs of the large dam projects of the 1990s, these projects seemed to become, by and large, economically non-viable.

Also, since the early 1980s, the investment cost per hectare of irrigation from major and medium projects has escalated to such a degree that these projects have on an average become both financially and even economically non-viable.

This situation has arisen despite the fact that appraisal processes use too many rule-of-thumb entries and rely on data that are often questionable. These have not been challenged because the process is not transparent.

Further, if the costs of the residual environmental and social impacts that cannot be prevented or mitigated are also included, there would be an additional impact on the financial and economic viability of large dams.

If the costs and benefits of other, alternative, methods for achieving the objectives set out for large dams are assessed, as they should be, then some of these alternatives might turn out to be better options than large dams.

Also, the distribution of most of the costs and benefits of large dams seems to accentuate socio-economic inequities. This seems primarily owing to a lack of policy direction regarding the equity aspects of projects.

It is evident that past projects, in general, have not been comprehensively assessed in terms of their environmental, social and economic viability and optimality. The planning and assessment processes outlined in the earlier sections of this chapter are the minimum required to determine the viability and optimality of large dams and, consequently, their development effectiveness.

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Endnotes

[1] According to first post-Independence census of minor irrigation schemes (1986-87), there were about 500 000 minor irrigation tanks in India. The southern region consisting of Andhra Pradesh, Tamilnadu, Karnataka and Kerala, accounts for about 60% of the irrigated area under tanks in India (Mathur & Bharadwaj, 2000). See also Sengupta, 1993:44-45). Subramanian (2000) indicates that out of the more than 39 400 tanks in Tamilnadu, some nine% are "System tanks that get their water supply from semi-perennial rivers through a system of canals into a series of tanks in a chain" Another interesting feature highlighted by Subramanian is that the 10 711 Public Works Department (PWD) tanks (with a command of over 40 ha each) together account for a storage capacity of 4.8 billion cubic metres (BCM). The remaining 28 700 small tanks under Panchayat unions account for a further storage capacity of 5 BCM.

[2] The Ministry of Water Resources considers that a more comprehensive picture would emerge if it is also pointed out that during the last five decades about 14.5 million surface water, minor irrigation works, mostly diversion works and dams of less than 10 m height, were also developed In addition ground water development through over 10 million wells etc, was achieved. However these are not examined in detail in this chapter, as the focus here is on the "large dam".

[3] It is interesting to note that Delhi, which is on the banks of the river Yamuna, now depends on long distance transfer of waters from many river basins through storage dams. The Bhakra Dam on the Sutlej River in the Indus basin as well as the Ramganga Dam on the Ganga system already furnish a part of Delhi's needs. The Tehri, Renuka, and Kishau dams are expected to meet additional future demands Hyderabad, Chennai, Mumbai etc are in a similar position. The steel industry at Bhilai and Rourkela are similarly supplied through storage reservoirs.

[4] Mr B.D. Dhawan in his presidential address at the 57th Annual Conference of the Indian Society of Agricultural Economics, December 1997, pointed out that "Development of irrigation in India has been driven by one overriding compulsion, namely, expansion of food grains production for a large growing population. Critics of irrigation planning have not shown enough appreciation of it, which is unfortunate, for the compulsion is still there and would persist if we continue to dither in our population control effort."

[5] Statement of Minister for Planning and Irrigation Mr Nanda, in the Lok Sabha 3 September 1954 on "Floods of India, problems and remedies".

[6] Vaidyanathan, A (1999) considers that part of the problem lies in ambiguities in the definitions of "potential" as well as differing interpretations of the guidelines. Estimates of gross area irrigated rest on assumptions regarding likely water availability, the water requirements of crops ,crop pattern and the extent of losses in conveyance and application of water

[7] Private canals were not modern canals but indigenous systems of irrigation known as kuhls, pynes, etc.

[8] Several dams constructed before Independence, e.g. Mettur, Nizamsagar and Krishna Raja Sagar were masonry dams.

[9] Prof Dhawan is an ardent supporter of large dams and is an oft-cited authority in the literature favouring large dams.

[10] Comments on earlier drafts of this paper received from fellow members of the Study Team, as also from others including L.C. Jain, Medha Patkar, Himanshu Thakkar, Enakshi Thukral Ganguly and A. Vaidyanathan are gratefully acknowledged. Some valuable comments were also made at the Stakeholders Meetings at Chennai and Delhi (1 and 3 March 2000). All the comments have been duly taken note of and such changes and additions as deemed necessary and appropriate have been made. In this process again Himanshu Thakkar provided further useful comments.

[11] This applies to people with land. Those without land are displaced by the loss of livelihoods and the threat of submergence

[12] In this paper a distinction is made between "displacement", which is the uprooting of people from their homes, "resettlement", which is their location to their new sites of habitation, and "rehabilitation", which is the provision of all that is required to rebuild their lives to a minimum acceptable level.

[13] This section may be omitted by those who are familiar with the Indian conditions.

[14] The Policy on Hydropower Development, announced in August 1998, proposes to raise this limit to 25 MW

[15] The author had included only energy, as demanded by his topic. But water can be included just as well

[16] In fact only those options where programmes have been initiated have been included. If a thorough search is conducted other options may be added.

[17] All these figures are taken from the Ninth Plan, but there is a problem here. If the figure of Rs 132 390 crores is divided by 3 500 dams (the number assumed to be built after the commencement of planning), the investment per dam comes to less than Rs 0 crores, which seems too low even as an average.

[18] "Firm Power" may be much lower than the installed capacity, particularly in the case of hydropower projects operated as peaking stations.

WCD Case Study

Large Dams: India's Experience

Annexes

Prepared for the World Commission on Dams (WCD) by:

R. Rangachari
Nirmal Sengupta
Ramaswamy R. Iyer
Pranab Banerji
and
Shekhar Singh

Secretariat of the World Commission on Dams
P.O. Box 16002, Vlaeberg, Cape Town 8018, South Africa
Phone: 27 21 426 4000 Fax: 27 21 426 0036.
Website: http://www.dams.org E-mail: **info@dams.org**

Disclaimer

This is a working paper of the World Commission on Dams - the report published herein was prepared for the Commission as part of its information gathering activity. The views, conclusions, and recommendations are not intended to represent the views of the Commission. The Commission's views, conclusions, and recommendations will be set forth in the Commission's own report.

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The WCD Knowledge Base

This report is one component of the World Commission on Dams knowledge base from which the WCD drew to finalize its report "Dams and Development-A New Framework for Decision Making". The knowledge base consists of seven case studies, two country studies, one briefing paper, seventeen thematic reviews of five sectors, a cross check survey of 125 dams, four regional consultations and nearly 1000 topic-related submissions. All the reports listed below, are available on CD-ROM or can be downloaded from www.dams.org

Case Studies (Focal Dams)
- Grand Coulee Dam, Columbia River Basin, USA
- Tarbela Dam, Indus River Basin, Pakistan
- Aslantas Dam, Ceyhan River Basin, Turkey
- Kariba Dam, Zambezi River, Zambia/Zimbabwe
- Tucurui Dam, Tocantins River, Brazil
- Pak Mun Dam, Mun-Mekong River Basin, Thailand
- Glomma and Laagen Basin, Norway
- *Pilot Study of the Gariep and Van der Kloof dams- Orange River South Africa*

Country Studies
- India
- China

Briefing Paper
- Russia and NIS countries

Thematic Reviews
- TR I.1: Social Impact of Large Dams: Equity and Distributional Issues
- TR I.2: Dams, Indigenous People and Vulnerable Ethnic Minorities
- TR I.3: Displacement, Resettlement, Rehabilitation, Reparation and Development

- TR II.1: Dams, Ecosystem Functions and Environmental Restoration
- TR II.2: Dams and Global Change

- TR III.1: Economic, Financial and Distributional Analysis
- TR III.2: International Trends in Project Financing

- TR IV.1: Electricity Supply and Demand Management Options
- TR IV.2: Irrigation Options
- TR IV.3: Water Supply Options
- TR IV.4: Flood Control and Management Options
- TR IV.5: Operation, Monitoring and Decommissioning of Dams

- TR V.1: Planning Approaches
- TR V.2: Environmental and Social Assessment for Large Dams
- TR V.3: River Basins – Institutional Frameworks and Management Options
- TR V.4: Regulation, Compliance and Implementation
- TR V.5: Participation, Negotiation and Conflict Management: Large Dam Projects

- **Regional Consultations – Hanoi, Colombo, San Paulo and Cairo**

- **Cross-check Survey of 125 dams**

Table of Contents

Annex 1: A Review of Water Resource Management Expertise Developed in India

Written by Dr. N. V. Pundarikanthan, S.N. Kallapiran, P. Gomathynayagan and Dr R. Mohandoss (Centre for Water Resources, Anna University, Chennai, India.)

The first ever systematic academic programme was started in the School of Survey established by the East India Company at Madras in 1794. The curriculum was directed towards surveying and mapping. Then the School of Survey was upgraded to College of Engineering, Guindy at Madras and another College was started at Roorkee around 1860. Subsequently, a college each at Calcutta and Pune were started. They conducted courses called Upper Subordinates and Lower Subordinates to cater to the need of Public Works Department (PWD) which was in charge of all civil engineering works. In 1889-90, Herbert Wilson, a US Geological Survey engineer, visited India to learn about canal irrigation. This was followed by a visit by another engineer in 1902 and they paved the way for forming US Bureau of Reclamation (Sinha, 1992)

From the early part of the 20th century, knowledge about the design, construction, maintenance and operation of dams has been developed and spread as part of World Power Conference (Robbroeck, 1999). Due to frequent droughts and famines, construction of large dams was taken up to store and distribute the floodwaters. Therefore a major thrust was on hydraulics and dam construction.

Planners of higher technical education have recommended starting a few institutions similar to international institutions. Accordingly, five Indian Institutes of Technology (IIT) – Delhi (UK), Kanpur (USA), Bombay (USSR), Madras (Germany), and Kharagpur (UK) were started in the 1950s and 1960s. The names in parentheses indicate the country that helped to start and develop the IIT. These institutes, along with other universities, are undertaking basic, adaptive, and action research, in relevant fields that the country needs most.

UNESCO sponsored International Hydrological Decade in 1965, which was followed by International Hydrological Programme in 1975, had changed the area of interest to hydrological training and education. As part of these programmes and based on the recommendations of the National Committee, Post-Graduate Diploma Course in Hydrology was started at University of Roorkee and Indian Institute of Technology (IIT) Bombay in 1970 (Khepar, 1997). This was upgraded to a Postgraduate Course at Roorkee University.

In Tamil Nadu, where a large number of dams were constructed in the early Five Year Plan periods, the College of Engineering, Guindy offered a course on Advanced Hydraulics, Dam construction and Irrigation Engineering from 1956. As soon as the manpower requirement was reduced due to completion of most dam construction activities, the direction after 1974 was directed towards Hydraulics and Water Resources Engineering and the course was reformulated as Hydrology and Water Resources Engineering in1981.

As the gap between the water resources potential created and its utilisation was widening, the Second Irrigation Commission constituted in 1972 had recommended that emphasis should be given to the areas of on-farm water management. Command Area Development Authority (CADA) was created. Utah State University and Colorado State University, both of USA, conducted field demonstrations in Pakistan to develop procedures for improvement of irrigation efficiency. To fill the gap, Water Resources Development and Training Centre of Roorkee University (during late 1970s) and Anna University Madras (in 1981) started Master of Engineering Courses in Irrigation Water Management. This programme was received well by all States as well as other neighbouring countries. Now many Universities are offering this programme. Some Universities are offering this programme as a part-time course so that field engineers can also benefit by upgrading their knowledge base and using their expertise to solve many field-based problems.

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In order to provide training on multi-disciplinary subjects to personnel working in Government Departments, the Government of Maharashtra State established the Water and Land Management Institute (WALMI) at Aurangabad in 1980 with assistance from the World Bank. In Andhra Pradesh a similar institute - Water and Land Management and Research Institute (WALAMTARI) was started. With assistance of the USAID similar institutes were started and are functioning in the States of Gujarat, Rajasthan, Madhya Pradesh, Tamil Nadu, Uttar Pradesh, Orissa, Bihar and Kerala.

Anna University, Madras; M S University, Baroda; Mohanlal Sukhadia Agricultural University, Udaipur, and Mahatma Phule Agricultural University, Rahuri participated in a seven-year USAID programme, the Water Resources Management and Training Project (WRM&TP) starting from 1983. Later Patna University also participated in this programme. It helped the faculty members to be trained at local institutes as well as at US Universities and to reorient and motivate them to modify the curricula both for undergraduate and postgraduate courses.

During the implementation of WRM&TP, it was found that the Irrigation Departments were giving attention to only the hardware improvements, namely, system rehabilitation and improvement, redesign, etc., while the real need was for the software side, namely, operational planning and management. The Netherlands provided required input through its Project Management Unit (PMU) for the preparation of Operational Plan modules. WAPCOS and Louis Berger International Inc. have developed many modules in the field of irrigation management which could be used in the training institutes as well as universities. These modules have been included in the syllabus for the postgraduate programmes as well.

As the concepts of joint management of irrigation systems by the irrigation engineers and farmers and handing over of the system at distributory level to the farmers to carry out operation and maintenance become established, the Irrigation Engineers" profession has now become more demanding and multi-disciplinary than before. Jagdish Narain (1985) suggested diversification of undergraduate and postgraduate courses to meet the special needs of the user departments and industries, quoting that the USSR universities have separate undergraduate programmes in water resources, environment, etc. In this direction, MS University Baroda has introduced a Bachelor of Engineering course in Irrigation Water Management. The graduates coming out of this programme have found that their job opportunities are very limited, compared to regular civil engineers, which has badly affected this programme. The programme was reformulated and designated as Bachelor of Engineering (Civil and Irrigation Management).

The Ministry of Education, Government of India appointed an Expert Committee, to study the implementation of the recommendations of the Second Irrigation Commission. The Committee in its report (1985) has recommended having entry level training for one year for the new civil engineering graduates joining the Irrigation Department. In the case of diploma holders, the training proposed is for a six-month period at entry level and after a few years of experience (Narain, 1985).

In order to improve the linkage between the universities and Irrigation Department and to facilitate the transfer of knowledge, experienced engineers were drawn from user departments on deputation to teach the undergraduate and postgraduate courses. This helped the flow of knowledge from laboratory to field and vice versa. This practice is still in vogue in the University of Roorkee.

One way that universities are improving the quality of in-service personnel is by offering part-time undergraduate programmes through their evening colleges. Indira Gandhi National Open University is offering a Bachelor of Technology degree programme in Water Management through its distance education programme. The field engineers are permitted to do masters and PhD-level research as essential field data are available to them easily and they can identify and seek solutions to real field-related problems.

Earlier, the Universities and IITs focussed their research on floods, hydraulic structures, irrigation and its distribution systems, model studies etc for PhD-level research. With the advent of personal computers, research is now focussed on Irrigation Systems Studies, Computer Modelling, Computer-aided Irrigation Scheduling, Management Information Systems, etc.

Curricula in the Universities are continuously changing as strategies and practices change in the field and the curricula are ahead in many cases. In the pre-Independence era, when irrigation was not considered a main importance area, Irrigation was combined with Ports and Harbour Engineering and was taught as one of the subjects. In the 1950s Irrigation Engineering as well as Irrigation Design and Drawing were introduced. Up to the 1960s Irrigation was considered as a mono-discipline subject in Civil Engineering. With the advent of the Command Area Development Programme, the need for qualified personnel to manage water distribution below the Government control outlet of the Irrigation Department became necessary and a need for change in the curriculum of Civil Engineering was keenly felt. Irrigation Engineering had been changed to Irrigation Practices which included Soils and Agronomy aspects of crops. However, a civil engineer coming out of college now has had exposure on all aspects of Water Resources Engineering namely, Open Channel Flow, Surface and Ground Water Hydrology, Design of Irrigation Structures and can independently handle all works related to Water Resources Planning and Development. In the Postgraduate programme in Irrigation Water Management, Sociology and Agricultural Economics were taught as electives and the engineering aspects were given prime importance in the course content. Watershed Conservation and Management, Environmental Aspects of Water Resources and Environment Impact Analysis, Flood and Drought Estimate and Management, and Disaster Management are offered as elective subjects. Now the course syllabi are modified to form a real multi-disciplinary course and Sociology and Agricultural Economics are made compulsory subjects. The Engineering component now accounts for 40%, Agriculture, Sociology, Economics and Environment accounts for 35% and the Management component accounts for 25%.

Annex 2: Design, Construction and Operations Procedure of Large Dams

Written by Dr. N. V. Pundarikanthan, S.N. Kallapiran, P. Gomathynayagan and Dr R. Mohandoss (Centre for Water Resources, Anna University, Chennai, India.)

Multi-purpose irrigation projects, of which large dams form a part, are planned, designed and executed by the Irrigation or Electricity Departments, mostly as Engineering Structures conforming to the currently prevailing technical rules and standards of the Governmental agency. The construction of the structure had been undertaken for one or a few set objectives, say, creation of additional irrigation potential and generation of hydropower under a certain load factor. Structural soundness and realisation of designed objectives were the two factors that were the consideration of the planners, other aspects were generally ignored.

The Planning, design and construction process of Large Dams has undergone a vast change since Independence in accordance with the level of knowledge gained by the professionals in the field, by virtue of their experiences in construction, operational behaviour of the dams constructed, the advancement in technology, and so on. Even though many improvements have been added in the design aspects, there is no attitudinal change in the outlook of the planners. With regard to planning and design, Central nodal agencies like Central Water Commission (CWC), Central Board of Irrigation and Power have played a very dominant role in the present status of development in this country.

Reconnaissance Stage I

The different steps or stages adopted in the planning and designing aspects of Large Dams can be listed as follows :

1. Preliminary reconnaissance survey of the project area and collection of field data.
2. Hydrological investigations, collection of flow data of the river flows, peak flood details, dependability of water yield over a period of time.
3. Area to be benefited by the dam with the water availability, nature of crops to be cultivated, additional food production/cultivation aspects like stabilisation of existing irrigated area, increase in irrigation utility, crop yields and so on.
4. Material survey, its availability and cost with lead particulars.
5. Details of submergence of land due to storage created and the cost of lands to be acquired both for the canal and storage and the quantum of compensation to be paid.
6. Displacement of human habitats and displaced persons due to the reservoir and the rehabilitation and re-settlement aspects.
7. Environmental impact of losing rich forestlands like plantations, affected flora and fauna, rare wild species of animals and birds etc,

Based on the rough data collected on the above aspects, a rough cost/benefit analysis is made on the project proposal. If it is found economically viable, a preliminary Project Proposal is formulated and presented to the competent authority for perusal and decision. Once the preliminary project proposal is cleared by the administrative agency, the project authorities will take up the proposal for detailed investigation. This stage is known as the Preliminary Investigation or Reconnaissance Stage. It is relevant to state that points 6 and 7 listed above were not considered in earlier projects taken up prior to Independence.

Reconnaissance Stage II

It is the detailed investigation stage that is otherwise known as " Feasibility Study Report Stage". During this process, the Project formulation will undergo the rigorous exercise of a detailed field investigation, survey and collection of field data in all aspects by knowledgeable persons. The data so collected, will be screened for their reliability and acceptability by the Project Planning Cell. A near-realistic cost estimate proposal will be formulated based on this exercise. Such a proposal is known as the "Feasibility Study Report". This report should be capable of answering all doubts and " ifs and buts" that may arise in the minds of chief planners and administrators.

Based on the experiences gained in examining various Project Proposals, the Central Water Commission brought out a compendium of general guidelines for the preparation of Project estimates for major irrigation works during 1983. It identifies the following nine as the minimum surveys and investigations necessary for Project formulation :

- Topographical survey.
- Geological and foundation investigation
- Hydrological and meteorological studies
- Pre-irrigation soil survey and drainage.
- Special survey for hydroelectric projects
- Construction material investigation
- Communication investigation
- Collection of relevant data for drawing up programme for construction including coffer dam construction.
- Hydraulic model studies for setting up important features.

Project Clearance

Stage I :

1. The Feasibility Study Report will be scrutinised in the Chief Engineer''s Office by the Technical cell for its Technical Competence in all aspects concerned.
2. Similarly the proposals will be examined for their economic viability aspects by the Commissioner of Land Revenue (Formerly The Board of Revenue) and the comments will be forwarded to the Chief Engineer.
3. Re-formulate the proposal based on the comments of Items 1 and 2 above.
4. The Proposal will then be cleared by the Government after consulting the State Planning Commission and its Finance Wing.
5. Forward the proposal to the Government of India for Scrutiny, Approval and Allotment of Funds.

Stage II :

1. (a) The State Proposal will be taken up for technical examination by the Technical Advisory Committee (TAC) and by the Project Preparation Cell of the Central Water Commission (CWC) for according technical clearance for the Proposal.
   (b) Technical clearance of the Proposal by the CWC paves the way for administrative clearance by the Central Planning Commission.
2. Clearance of the Project by the Central Planning Commission is subjected to various considerations other than the technical such as socio-economical, Inter-State,

Regional and other aspects. Clearance of the Proposal by the Planning Commission qualifies for funding.
3. Inclusion of the Project Proposal under Plan schemes for funding by the Central Planning Commission.

Hitherto the Planning aspects were discussed but the lacunae in the set process have not been listed. The Procedure set forth is an engineering-oriented approach, which does not adequate consideration to other aspects of water resources development or consider other interests. Even in the agricultural aspect, adequate attention has not been given to considering water planning. Projects are designed mostly for mono-cropping pattern on duty consideration rather than on crop-water requirements based upon current trend of crop diversification aspects. Though the Projects have generated some benefits, both social and financial, for the huge investments made, they are not commensurate to the efforts put forth. Further, the opportunity costs in Project Planning and issues like displacement of human habitats, environmental impact and seismicity aspects have not been studied in depth and much needs to be improved.

The NBA (Narmada Bachao Andolan) of Ms Medha Patkar and Tehri Project of Mr Sunderlal Bahuguna are standing examples of a strong anti-dam lobby for the future of large dams in this country. In this regard, the well thought out suggestions put forth by an eminent, experienced administrator and researcher Mr Ramaswamy R. Iyer (1998a) merit special consideration in shaping the policy for future planning aspects. They are :

1. Treat mega-projects as a last resort only after considering other possibilities such as local water conservation, watershed development, small projects etc., after making a careful evaluation of all options.
2. Move from isolated planning to integrated and holistic planning for a basin or sub-basin.
3. Subject "mega" projects to the most rigorous scrutiny and clear them only after fully establishing techno-economic viability, environmental and social acceptability. Reject a project if it fails to qualify according to these norms.
4. Examine carefully if adequate financial resources will be forthcoming for the timely completion of the project, without imposing crippling burdens on the State budget.
5. Insist that the necessary studies and surveys, action plans on environmental and re-settlement aspects be completed before project approval.
6. Ensure and institutionalise fullest consultation and collaboration between people and NGO organisations representing them from the earlier stages of planning till its completion and operation.
7. Ensure imaginative humane implementation approach through appropriate training, orientation and monitoring. Establish a credible responsive and effective grievance redressal machinery. Build safeguards against the harassment of people and against corruption.
8. Keep equity and social justice in all facets of the project, say from Planning to implementation.
9. Keep the Project under constant review and institute corrective actions and remedial measures wherever necessary.

Construction

Most of the projects suffer from inordinate delays during construction. Projects are seldom completed in time as programmed. This is an indication of cost and time overruns over successive plan periods in the completion of Irrigation Projects in India.

Factors contributory to delay as experienced :
1. Delay in land acquisition and handing over site for taking up construction activity.
2. Delay in construction of coffer dams and diversion of river flows.

3. Delay in tackling foundations owing to lack of equipment, design finalisations for treatment of foundation rocks due to rock characteristics.
4. Delay in getting HT Power supply at construction site.
5. Delay due to lack of co-ordination between various Departments and agencies associated with the Project.
6. Delay in manufacture of spillway gates.
7. Time delay in erection of spillways and sluice gates due to lack of skilled labour and technical expertise.
8. Inadequate funding by the Government and delay in allotting funds which makes the Project Managers unable to act with vision and conviction.
9. Wilful suppression of the Project cost for getting Project clearance throwing the project out of gear because funds have to be obtained during execution.
10. Awarding work to incompetent contractors who lack financial strength and technical competence for extraneous reasons.
11. Unforeseen natural calamities like unprecedented flood damage, break out of epidemic in the Project site during the construction period.
12. Though trivial, a few more items may also be contributory for the delay other than the above, such as pump repairs, power failures, labour unrest, non-availability of adequate construction materials in time.

The reasons set forth for the delay in construction of Projects are based on past experiences where the works are undertaken by the Governmental agencies as per the Government rules in vogue. In these procedures, no operational freedom is permitted to the Project Managers to take spot decisions based on Project demands when situtions warrant. Timely decision making and operational freedom are the major casualties in the existing practise.

Many of these constraints could have been avoided if major works were awarded under contract to major construction companies, which enjoy command over equipment, labour, resourcesand technical expertise. In recent times such an approach is taking place in the construction of bridges and fly-overs in Chennai (India) with obvious speed of execution. Though the problems in executing irrigation projects are much more complex than bridges, such an approach will qualitatively change the speed of execution of the irrigation projects.

Dam Operation

Operation and regulation of water from the dams are regulated by a set of rules formulated by the State Government in accordance with the category of the Dam-Irrigation/Hydropower Generation. These rules, so set forth, are otherwise known as "Rules of Regulation". The Irrigation Department of Tamil Nadu brought out a publication "Compendium of Rules of Regulation" during 1984 which deals with all aspects relating to rules of Water Regulation of the reservoirs and anicuts in the State.

Rules of regulation, generally, address the following aspects:

The period or duration the reservoir will be thrown open for irrigation.

The mode of impounding river flows in the reservoir during normal and monsoon seasons considering the riparian rights prior to the construction of the dam. Minimum storage to be maintained to safeguard the riparian interests, to protect the fish life in the reservoir and so on.

Rules for operating the spillway gates to modulate the flood flows and to dispose the floods so as to maintain flood peaks downstream of the reservoir on manageable levels to ensure safety standards already set forth.

Rules set forth on the operation of effective communication system (wireless, telephones, etc) to enforce, effective flood patrolling arrangements throughout the river system.

Role, responsibility and authority of the controlling officer of the dam and his obligations.

Apart from these rules certain guidelines are set forth regarding the pre- and post-monsoon inspections of the reservoirs by senior officers and the actions to be taken on the preparedness of the staff in meeting any emergency situations during the monsoon. These guidelines will list the stock of materials to be kept at the dam site.

Renovation

Prior to 1986, the dam safety repairs were undertaken by the State Government in a need-based manner. No systematic arrangements for dam safety inspections and follow-up remedial measures appears to have been followed. No monitoring mechanism was available to overview safety aspects of dams.

The distress signals displayed due to failures of a few dams, like Valiant Dam in Italy (1963) Tetan Dam USA (1976), opened up the need for one exclusive international organisation to address the safety aspects of dams. The International Commission On Large Dams (ICOLD), has become the pioneering organisation in projecting the need for dam safety measures. The International Conference, on large dams held in New Delhi during 1979 expressed the need for more, and forceful actions in the field of dam safety. Keeping in line with the recommendations of the conference, the Government of India established a Dam Safety Organisation CWC in 1979 to assist the State Governments in various aspects of dam safety.

Subsequent to this, the CWC, after reviewing the dam safety measures followed by different States, set forth certain standards in servicing the needs of existing dams and other dam safety aspects. One of the primary conditions stipulated by CWC is the creation of a separate Dam Safety Organisation in each State to address the dam safety aspects. It also brought out a publication on "DAM SAFETY PROCEDURES" during 1986. As per the guidelines of CWC, the Dam Safety Organisation in each State should address the following aspects for formulating guidelines to ensure the safety aspects of dams:

1. Defining the scope and administrative set-up for the Dam Safety cell and its functions
2. Fixing priorities for review of dams
3. Hydrological safety of existing dams
4. Structural review
5. Seismological review
6. Assessment of seepage in dams
7. Operation and maintenance
8. Inspection
9. Emergency preparedness plans
10. Need for legislation.

The Dam Safety Organisation of CWC, brought out yet another publication during 1987, entitled "GUIDE LINES FOR SAFETY INSPECTION OF DAMS". This is an improved version of its 1986 publication.

As per the ICOLD standards, dams having a height of more than 15 metres are designated as Large Dams. The CWC has formalised the following two categories of classification of dams: one based on height and storage, and another based on hazard potential. Both are furnished below:

a) Size classification (Based on storage and height)

Sl.No.	Category	Storage in Hectare Metres	Height in Metres
1.	Minor	<125 and / 6	< 12 and /8
2.	Medium	/ 125 and < 6250	/ 12 and < 30
3.	Major	/ 6250	> 30

b) Hazard potential classification

Category	Loss of Life (Extent of Development)	Economic Loss (Extent of Development)
Low	None expected (Non-permanent structures for human habitation)	Nominal (Undeveloped to occasional structures or agriculture)
Significant	Few (No urban developments and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry or structures)
High	More than few	Excessive (Extensive Community, industry or agriculture)

Annex 3: Project and Programme Implementation

Excerpts from The Ninth Plan, vol. I, Planning Commission's observations (pp. 214-226).

Project Implementation

A recent review of 187 Central sector projects, each costing more than Rs100 crores by the Department of Programme Implementation (DPI) showed that

(i) As on February, 1997 as many as 118 projects were running behind schedule and the time overrun varied from one month to 200 months. A study of a few major projects indicated that the cost overrun, for reasons other than inflation and changes in the duty/exchange rate regimes, ranged from 40% to 75% of the original estimates. Past experience reveals that the factors responsible for time and cost overruns are:

- Poor project formulation due to inadequate field investigation, lack of adequate data, inadequate analysis of environmental and rehabilitation implications, changes in prices and exchange rate regimes, etc.
- Delays in clearance from various regulatory agencies in land acquisition and in procurement of materials. Such delays are primarily due to poor co-ordination and project planning, as these problems are not explicitly considered or taken into account at the planning stage.
- Changes in design or scope of projects midway through execution.
- Inability of the project management to take prompt decisions on various aspects of these projects even when the objective circumstances warrant such decisions.
- Management problems such as personnel, labour and contractor disputes, mismatch of equipment, etc.
- Inadequate and untimely release of funds.
- Unforeseeable factors such as adverse geo-mining conditions and natural calamities.

(ii) Time and cost overruns due to changes in design and scope midway through execution are quite frequent in large public sector projects. In the case of large surface irrigation projects, in particular, this problem is so acute that several projects had alarming time and cost overruns. To cite an example, an irrigation project in a State, which was initially designed in 1953 for flood protection and irrigation benefits to 5.7 lakh hectares, underwent drastic changes in design and scope, midway through execution, to include (a) hydel power generation, (b) an additional branch canal with a command area of 1.6 lakh hectares, (c) another main canal system taking off from the barrage with an aggregate command area of 3.25 lakh hectares, (d) extension of the embankments (flood protection) and (e) cost of watercourses as the project cost. Because of these changes, the project got delayed by more than 20 years and the cost escalation, as per the latest available estimate was 347.25%. It is also not clear if the benefit-cost ratio of the entire project will still be favourable, as the planned power generation and irrigation capacities have not been realised.

(iii) It is quite common in large projects, particularly in mining and large scale surface irrigation schemes that the project authorities have not been able to get possession of land in time for the construction of various components of the project. Generally, two factors are associated with the problem of land acquisition. First, more often than not, there is a significant difference between the land prices assumed at the time of project planning and the market rates, as a result of which the process of land acquisition leads to time and cost overruns. The second problem relates to the absence of an institutional mechanism for speedy disposal of disputes arising in the context of land acquisition. When such disputes acquire a high profile, as in the case of Tehri and Narmada dams, the projects get delayed indefinitely with adverse consequences to costs and benefits.

(iv) Because of the unrealistic approval procedure, many of the projects are delayed. At the other extreme, less stringent approval procedures encourage a tendency to get too many projects cleared without the requisite financial resources in sight. There is, thus, a need for striking a balance between these extremes.

(v) The implementation of projects will considerably improve if the planning and approval procedures become more scientific and rigorous. However, for effective project management, there is a need to keep track of the progress in implementation and take necessary corrective actions, as the progress may be affected by unforeseen factors. Thus, the monitoring and evaluation system must be strengthened and the implementing agencies must be accountable for non-adherence to the plan of work. There is evidence that effective monitoring of implementation and mid-course corrections by the project management have often led to timely completion of projects without any cost overrun.

(vi) Apart from rigour in planning and project management, certain procedural and institutional reforms would be required to reduce avoidable delays and thus cost overruns. Timebound clearances at different stages and effective inter-agency co-ordination would cut down time and cost overruns considerably. It is also not uncommon to find that where public sector units are the main providers of engineering design, equipment and material, non-fulfilment of contractual obligations by these has been a major source of delays in project completion. Appropriate rules and procedures must be framed to avoid such delays and alternative strategies to deal with such situations by the project management must be evolved. The project management must be made fully responsible for the inadequacies in tender documents that often lead to delays, avoidable litigation and cost escalations. Stringent penal clauses to deal with non-compliance must form a part of the tender documents and suitable laws must be in place for early resolution of legal disputes.

(vii) The project design should include the parameters which indicate clearly as to how the project output in the form of goods and services will be sustained during operation, how various assets will be maintained, and quality ensured.

Programme Implementation

The lessons learned from the experience of executing thousands of development schemes during the last 40 years can be briefly summarised as follows:

(i) There is inadequate analysis of available information during programme formulation. This happens primarily, because there is no established mechanism through which the programme agencies can have ready access to the relevant information regarding the target groups/areas or the findings of evaluation studies. As a result, avoidable errors at the planning stage creep in.

(ii) There is another lacuna which persists at the stage of formulating schemes/projects. While estimating the cost of schemes/projects, it has become a common practice to apply standard per unit cost. The unit cost varies from region to region because of variations in topography and because of the unique nature of some regions like the north eastern regions. Consequently, project costs tend to be underestimated and time is wasted later in prolonged correspondence to get additional funds sanctioned by the Central Ministries. This has become a perennial problem in the case of Centrally sponsored programmes.

(iii) The implementing agencies are often more concerned with the mere fulfilment of targets assigned to them than with the actual flow of benefits to the target groups.

The "top-down" approach in planning and implementation has led to formulation of schemes without assessment of the needs of the people. It was observed that in almost all the TSP States, the major part of the Tribal Sub-Plan funds was spent on the creation of infrastructure like irrigation structures and buildings for schools and health centres, most of which are not being used by the tribals for lack of complementary inputs.

(iv) For some programmes separate implementing agencies are created, whereas these are actually implemented by the existing line departments, which work independently for different components of a programme. This results in lack of focus on target groups, wastage of resources and lack of coordination among the line departments.

(v) Monitoring and Evaluation (M & E) of programmes are undertaken to introduce the necessary corrective steps in programme formulation and implementation. In spite of the existence of an elaborate M & E system in the country, the findings of M & E are not put to use for a variety of reasons. Firstly, the physical and financial indicators regularly monitored often do not reflect the actual performance of programmes. In an area development programme, for example, it was found that, while at the aggregate level the targets with regard to areas under forestry, irrigation and soil conservation were met, the primary objective of the scheme, viz, integrated watershed development was not achieved, as these activities were not integrated at the watershed level. Secondly whatever information is generated through the M & E system is not analysed with a problem-solving perspective to aid the implementing agencies to re-assess the original schedule of work. Thirdly, there is no mechanism through which the planners and implementing agencies can have ready access to information in a format that is useful to them. Publicity and systematisation of available information in a user-friendly format is needed to ensure the use of M & E in decision-making.

(vi) Lack of accountability of the implementing agencies either to the Government or to the people has been the single major cause for diversion of funds in development programmes. It is well known that implementing agencies and administrators can get away easily with time and cost overruns or non-fulfilment of targets by attributing these to factors beyond their control, and to many loose ends at the planning stage. Misappropriation of funds happens primarily because of lack of people"s participation in the implementation of programmes, lack of transparency in the operation of schemes and inadequacy of monitoring mechanism.

(vii) Several social sector programmes are formulated without addressing the question of sustainability of benefits.

The PEO evaluation study of the Accelerated Rural Water Supply Programme (ARWSP) in 1996 revealed that the facilities created under the programme have become defunct over time for lack of maintenance As a result, the number of no-source villages has been rising, even though more and more villages are being brought under the programme. But, in one village in a district of Maharashtra, the maintenance of a piped water supply scheme was being looked after by the villagers themselves successfully. Decisions on water consumption norms, sanitation rules and water charges are taken collectively in the Gram Sabha, the violations of which attract penalty. These villagers employed an operator with their own money and had reserve funds for exigencies. The PEO field teams came across other instances of successful management and operation of schemes by the people themselves.

(viii) When the Five Year Plans were launched, the Central and the State Governments faced a practical problem of integrating the Plans into the annual budgetary process. This was because planning is a long-term exercise, whereas government budgeting is a short-term annual exercise. Even so, the Central and the State Governments split the Five Year Plans into Annual Plans and integrated the Annual Plans into the regular budgets, which also came to obtain legitimacy as they were approved by the Central and State legislatures. By so doing, they solved only one problem, namely, getting the required approval of the legislatures for incurring expenditure under a Plan account. But this approval did not ensure regular flow of funds from the Central Government or the State Governments to all the implementing departments. Both the Central Government and the State Governments faced ways and means problems. In the case of Central Government this was overcome by resorting to ad hoc treasury bills, which came to be known as deficit financing but no such corresponding financial facility was available for the State Governments. Whenever the latter faced financial problems, they used to take recourse to unauthorised overdrafts from the RBI. The funds start flowing only in the middle of the calendar year in small amounts and the flow picks up by the end of December. Even so, not even the second instalment due for a planned project is received by the departments. Invariably most of the allocated money reaches the departments either in February or March. This untimely flooding of funds creates a pressured situation and leads to unduly hasty expenditure. To begin with, the project implementation work is affected by piecemeal tasks for want of funds and, after reaching the last month of the financial year, the implementing departments are not in a position to absorb the entire amount. Consequently, some funds lapse.

(ix) Success stories are localised and have not been replicated on a wider scale, partly because of inadequate physical, financial and human resources of the organisations involved, and partly because of the weakness of the existing social institutions in promoting and sustaining the processes and methods adopted in the successful interventions

Annex 4: Thoughts on Alternatives; Water Resource Development: A Bottom-Up Approach

Excerpts from Nirmal Sengupta"s book: Managing Common Property : Irrigation in India and the Philippines, Chapter 5.

The Tambaparni River is the southernmost perennial river in peninsular India. It originates in the Western Ghats, and after traversing a distance of 120 kilometres towards the east, through a narrow but rich alluvial valley, empties into the Gulf of Mannar. It has seven major tributaries. The catchment area of the river alone is 2 500 km^2. and that of the tributaries, an additional 3 300 km^2. Average rainfall in its catchment area varies from 1 100 mm in the west to below 600 mm in the east.

The Tambaparni area has a long history of irrigation activity. It is difficult to say when exactly irrigation works had begun. But considering its similarities with comparable systems in Sri Lanka it seems possible that these works had begun some 2 000 or 2 500 years ago. One finds support for this assumption in existing folk beliefs. There was gradual but certain improvement in technology over these years, particularly during the period of the Nayakas who ruled this area for about three centuries before the British. It was during this period that an extensive development of the irrigation system took place. At that time there were seven weirs (anicut) on the river.

The area was annexed by the British in 1801, but any major alteration in the existing design had to wait until 1867. In this year the construction of an additional anicut (the eighth anicut at Srivaikuntam) extended irrigation facilities to the lower reaches as well. By 1874 the Srivaikuntam anicut was fully functional, but the actual inflow into the Tambaparni River was found to be much less than estimated. Therefore, the anicut faced a water shortage right from the beginning. This led to the restriction of extensions in the upper reaches by official order, which was later extended to the whole of the Tambaparni system in 1921. In addition, the South Main Channel from the Srivaikuntam anicut was impounded into a massive tank at Kadamba because the sanctioned amount was already exhausted. Thereafter, irrigation below the Kadamba tank was only indirect.

A suggestion for the construction of a reservoir at the upper reaches was made quite early. Along with a hydroelectric project at Papanasam, it was finally approved in the 1930s and commissioned in 1943. A second reservoir, on the Manimuthar tributary, was commissioned in 1957. A third reservoir at Servalar has been constructed recently. In addition, the old anicuts have been retained thus allowing age-old organisations to persist. Indeed, the Tambaparni system has no parallel in the whole country in terms of matching the restraint shown here in dealing with the pre-existing technology and organisation while undertaking development and rationalisation programmes. In some ways it compares well with the Japanese model of modernisation - integration from below.

At present the Tambaparni system consists of three reservoirs in its upper reaches. Thereafter the river is diverted by permanent anicuts at eight places from which eleven channels lead off; the channels are used for direct irrigation as well as for feeding tanks. Altogether the system feeds 179 tanks fully and 2 more partially. These tanks have a total capacity of 87 million m^3, irrigating 19 234 ha. Direct canal irrigation benefits another 15 671 ha.

Table A.1 Layout of Tambaparni Irrigation System

Ani -cut	Name of the Channel	Length (km)	Total ayacut (ha)	Direct ayacut (ha)	Indirect ayacut (ha)	No. of tanks	Average ayacut per tank (ha)
1st	N.K.C. (north channel)	18.51	951	650	301	14	21.5
	N.K.C. (south channel)	8.64	344	344	Nil	Nil	nil
2nd	Nadiyunni	11.55	996	996	Nil	Nil	nil
3rd	Kannadian	33.95	5 059	4 154	905	16	56.6
4th	Kodagan	29.04	2 428	1 218	1 210	17	71.2
5th	Palayan	42.46	3 845	1 821	2 024	59	34.3
6th	Tirunelveli	29.14	2 594	1 022	1 572	22	71.5
7th	Marudur kilakal	17.92	3 151	1 202	1 949	15	129.9
	Marudur melakal	19.84	5 165	1 843	3 322	15	221.5
8th	SRIVAIKUNTHAM ANICUT:						
	South Main Channel	33.87	5164	1090	4074	15	271.6
	North Main Channel	36.32	5208	1331	3877	6	646.2
TOTAL		281.24	34905	15671	19234	179	107.5

Papanasam and the Servalar reservoirs are under the control of the Tamil Nadu Electricity Board. The canals, weirs (anicuts) and the tanks are under the control of the Irrigation Department (earlier Public Works Department). The interests of the farmers as well as their organisations probably suffered the least in the course of modernisation. On the contrary, modernisation promoted them to a considerable extent. Many of the villages showed considerable organised activity. In this area irrigation associations, often called *oppidi sangham*, are frequently found; the best of them has celebrated its centenary. Most of the 8th anicut tanks have their oppidi sanghams. References to them are found even in late 19th century records, but it is not known whether they existed even before the 8th anicut was built. The tanks now fed by the anicut existed even earlier. Farmers" willingness to participate even in the construction of the anicut is recorded. The potential beneficiaries of the 8th anicut had themselves collected Rs30 000 for aiding construction. By 1867 prices it was a huge contribution. The government did not use it for the desired purpose on the grounds that the beneficiaries might, in future, use that as a plea for a reduction in rent. Instead a road was constructed above the anicut with the funds collected.

The traditional institutions for systematic and equitable water distribution (eg *neerpaichy*, *kandavettu*) were used under the new system too. The associations engage and pay water distributors from their collected funds. At the same time the organisations also adapted themselves to contingencies that arise by introducing modern organisational forms complete with election, meetings, and record keeping. They also made a transition from participation through contribution of labour to that of finance, now engaging wage labourers for the maintenance works. Some oppidi sanghams were willing to go further, by taking up the tasks of distribution of high yielding seeds, fertilisers and pesticides. The government officials in charge of distribution were not co-operative.

Before the reorganisation of districts in 1986, the entire river fell in a single district. It was the only major river in India to have such a feature. The highest level of executing authority, being available in the district headquarter, was subject to frequent pressure from the people and the district civil administration. Allocation and operational rules became, in this process, transparent. Detailed allocation rules between and within the channels were published in a government gazette during the

1930s. These rules included restrictions on the erection of temporary anicuts other than those explicitly sanctioned; on bailing of water or prioritising of direct irrigation over tank filling; on dates of closure of each channel for annual repair, etc. There were allocation regulations notified for each of these channels which lent support to old practices and organisations. Some of the unusual features were: (a) protection of customary rights of appropriation of *inam* villages in the command area, (b) permission to erect temporary dams in canals to divert water into intakes located at higher levels, and (c) detailed rotational regulations recorded for allocation among different parts of the canals by dates and number of days.

Since the construction of the two reservoirs, the PWD has been in a position to regulate the flow in the river. In addition, all the channels except the two from the last anicut have been remodelled in the period between 1964-78, reducing the number of sluices. As a consequence, the need for rotation was reduced. During the summer season, however, the PWD releases water to different channels in turns. In all cases, the quantum of release and the date of release can now, after the construction of the reservoirs, be decided in advance. The date is circulated through newspapers, radio and word of mouth. The different units in each channel wait in order to receive the surplus after the previous units have received their share. To make use of this water the farmers here have advanced the cropping season here by two months before the rainy season. The cropping season is now called "advance *kar*"[1].

The system is not without problems. Tail-enders do not get enough water. For example, in 40 years, as many as 10 proposals were mooted to reduce the dependence of the downstream tanks on Kadamaba tank. These proposals included: providing a permanent siphon, cutting the sill level of the head sluice, construction of a bypass channel, etc. But all these were dropped subsequently because of the objections raised by the ayacutdars of the Kadamaba tank against the encroachment of their customary rights. The silted tanks do not retain enough water to feed their ayacuts. The channels are not properly maintained, are choked with water hyacinth and need cleaning every year. Unauthorised extension of the irrigated area and conversion of ayacuts into sugarcane plantation in some parts have increased the demand of water. Movable shutters were provided by the irrigation department but those have plenty of leakages. In order to receive their share of supply smoothly during periods of serious water scarcity, some villages have to guard diversion points upstream, which may be as many as a hundred. Conflicts are common during these and other times. Political leaders force the departmental staff to release water out of turn in channels they favour.

Annex 5: Thoughts on Alternatives Towards a Development Model in Flood Prone Areas

Excerpts from Chapter 3 of the forthcoming book: Living with the Politics of Flood, (in Hindi and English), by Dinesh Kumar Mishara (Barh Mukti Abhiyan, Bungalow no. 3, NML Flas, P. O. Agrico, Jamshedpur, Bihar, India 831 009).

"The plants, the trees and the creepers which bow before the might of winds and the rivers and raise their heads only when the wind or the river subsides, are never destroyed." Why cannot we have flood tolerant houses and flood tolerant crops? Why don"t we ever try to convert the floodwater into a resource instead of dealing with it as a problem?

On the bank of the Balan River in the Jhanjharpur block of the Madhubani district, in Bihar, there used to be a village called Partapur. The village had one major and three small tanks in it. The biggest tank was linked to the river by a drain and the entry point at the river was blocked by mud. When the water level of the Balan used to rise during the rains, the villagers would open the drain and the river water would gush towards the main tank. After the main tank was filled, the river water was led to other smaller tanks through link drains. Once the tanks were filled, the inlet drain was closed again only to be opened next year.

The tanks had a water spread area of about 14 hectares and the village agricultural land was around 100 ha; a sound ratio that provided supplementary irrigation to the pulse and oil seed crops and the needs of daily use of water. And then the water never used to dry up. The villagers had their own variety of paddy seeds that would tolerate submergence up to 1.2 to1.6 metres depth of water and the Balan waters would never rise beyond this height. Thus the villagers had paddy, plenty of fish in the tanks, pulses and oil seeds. Their wells would never dry up and they had time to relax. No wonder that the floods in the Balan were eagerly awaited.

If, in any season, the floodwaters rose extraordinarily, the villagers would move to safer heights within the village. This system of dealing with floods and irrigation was no way less scientific except that there was no aggression against nature and no large schemes were involved. Then the whole system was managed by the villagers and was entirely within their own control. Tapping river water from the top portion of the river flow meant that only fine silt, beneficial for the crops, could enter the channel and the coarse sand would not be able to enter the tank.

Almost all the villages in that part of the country had some arrangement worked out with the river, streams and tanks for irrigation.. . . The tanks in the villages in the Mithila region were an essential part of life; they were used for rituals, bathing, washing, fisheries, cattle and growing *Makhana* (edible lotus seed) besides being used for irrigation in the winter season. The villagers cleaned these tanks every year, as a routine, on the Sankranti day of the month of Vaishakh (roughly in the middle of April). The soil that was dug out annually was used for washing and also as manure in the fields. All these tanks are in a dilapidated condition now.

A free Kosi used to flow in various channels spread over a vast area. There was a flood moderation of sorts because the river water could spread over a large area. These small channels like the Dhemura, and the Goraho, the Harisankhi, the Lagunia and the Tiljuga, etc were bunded during the winter season and the water was taken to fields for irrigation. The problem lay in the areas that were subject to deep sand casting and erosion, but there used to be some social security. The neighbouring villages/families used to help the victims by offering their lands to them on a temporary basis for making houses and cultivation.

As the situation stands today, the flood water stands for a longer period in the countryside and it easily takes the month of November to get the fields dried and start the sowing operation for the Rabi crop.

With the snow melt in the Himalayas, by the end of May, many rivers start receiving water and this water even spreads into the countryside. News about floods in Assam and the north-east start pouring in in the month of May. It would be ideal to develop crops that could be harvested during this period and the water requirement of which should normally be met from the moisture content of the soil, since irrigation in most of the flooded areas either does not exist or is very costly.

In some parts of north Bihar, people resort to multiple cropping as they sow green gram, maize and paddy simultaneously in the months of February/March. Paddy is at risk in the case of early floods but the other two crops are harvested before the rains. The farmer never returns empty-handed to his home.

Some attempts have been made in Bihar and eastern Uttar Pradesh to cultivate Rabi crops in the areas to which the accumulated water recedes at the time (*chaurs*), areas most suited for sowing, with positive results. Some experiments with a new variety of paddy in Rabi season (like Gautam) have yielded good results. There is a need to consolidate these efforts.

In the case of repeated floods, the paddy seedlings get drowned and spoiled. It takes about three weeks to sow the seeds again and rear them to transplantation level. This delay has its impact on the output. In Bangladesh, the farmers are reported to prepare emergency seedbeds on the floating bamboo platforms and anchor them to some strong object. In case the transplanted paddy is drowned, re-plantation becomes easy with the use of floating seedbeds.

People in the North-east have made use of bamboo in an admirable way in the construction of floors, roofs and walls. They have used bamboo as stilts to support their houses. Small floods pass under the floor of the structures without causing any damage. Lofts provided within the homes provide space for storing essentials that include fodder and fuel. Bamboo floors are plastered with mud and that is how the space for cooking is carved out within the home. Goats and piglets are kept in the verandahs of the houses. Because the floor is made of bamboo matting, spraying of small quantity of water clears all the dirt from the floor. All the important papers are carefully preserved by the people in the bamboo stalk itself and a cap is securely placed on the top.

Bamboo cultivation should be encouraged wherever possible in the floodprone areas. Not only does it prevent colossal damage to the human settlements, it will come to the people's rescue after the floods for constructing their houses. Any other tree, which can withstand submergence, at least partly, would be useful in the flooded areas because the wood is also needed for fuel.

Some raised grounds within or near the village will be of great use for the people and cattle to move to under emergencies. Such raised grounds were customary in the North-east. But embankments along the rivers are replacing them fast. Following the 1987 floods, in Bihar, the government announced it would build such raised mounds in the villages. In the Kaziranga National Park, in Assam, the Indian army has constructed raised platforms and elephants and rhinos take shelter on them. This is a commendable step and should be extended to other flood-prone areas also, for the benefit of cattle.

The flood victims take shelter on some high ground; be it the embankment, the breach of which has displaced people, or the road, the railway line, raised ground or hillock or any such place and it takes little time before the place becomes filthy. One can easily imagine the plight of women under such circumstances because there is hardly any place available where they can get some place of privacy. If a latrine could be devised at very short notice at these points it would be a great relief, at least, to the women coming to the camp site. Terracotta squatting pans are made by some organisations in Orissa and Maharashtra. These are cheaper to make and affordable and can be manufactured locally and put to immediate use. This toilet can take care of the privacy part of the sanitation system. In the stilted houses of the North-east, there is provision for latrines on the raised floor and the pigs are kept on the ground floor to the scavenging part of it. In some of the Assamese houses floating latrines made of braced banana stems are tied to one corner of the house.

Pollution of the drinking water sources is the major problem in flooded area. Most floods are accompanied with rain. Rainwater is safest to drink. Can the engineer devise some cheap method of collecting rainwater in such places for consumption by the flood victims? . . .If there is safe water to drink, most of the post-flood ailments are automatically taken care of.

A good thing about the floods in our country is that their period is almost defined. Can we have our annual holidays of schools, colleges and other educational institutions during this period? The students of the medical and veterinary colleges can be deployed in the flooded areas for treating minor ailments. Give them credit for their involvement. This is a practice in Assam and some other States where the flood victims do get medical assistance at the time of their need.

Cattle are often ignored in any planning for meeting floods and extra care is required to meet their needs.

In the areas where floods continue over a longer period, floating postal and banking services can be provided to the affected people by rotation through boats. Floating banking services have, in fact, been provided until recently in the Sunderbans.

Natural floods are possible only if the drainage mechanism of the country is not tampered with, which would mean that no obstruction has been put in the flow path of the water. This also means that the structures like embankments, roads, railway lines and canals etc. are not built and the flood plains are not encroached. This may not be possible because it is difficult to imagine life without proper means of communication. But it always possible to provide for smooth drainage through these structures and thus give least resistance to the flowing water.

Sometimes, engineers mention the release of water, in a regulated manner, over the structures like embankments etc. They call this "controlled flooding" in their own terminology. Controlled flooding resembles, to an extent, the technique of detention basins and, in its refined form, comes very close to the Wilcocks' narration of Burdwan. Should this technique be developed sincerely, the onus of dealing with floods will shift from the technical staff to society, which, in turn, will find its own way to tackle floods.

It is essential, therefore, that inundation maps of the area are prepared for every possible breach along the embankment length and also for every depth of flooding within the embankments. For the sake of convenience, this mapping can be done at an interval of every 3 km on the embankment. Thus if the eastern Kosi embankment is 126 km long there will be roughly about 40 points for which inundation maps will have to be prepared.

Once this is done, it will be possible to identify the locations that could act as flood shelters. The necessary infrastructure will have to be developed here providing all the essential facilities like drinking water, sanitation, food, fodder, first-aid, etc. for the persons and the cattle that are likely to come to these centres. This will prevent people from running helter skelter for help. A large number of primary schools, mostly stilted structures, were built in West Bengal following the floods of 1978 and are reportedly put to good use during the floods. In normal times they operate as schools.

All these efforts will go to waste if not supported by a well-built system of warning about the possible flood or a breach. The use of electronic media, the TV and the radio, is of immense importance, and loudspeakers have also been used for flashing massages. Lot of temples and mosques have loudspeakers installed in them and the priests or the Imams can be influenced to issue warnings in emergencies.

When the floodwaters strike without much prior warning then the first thing that a householder has to do is to move his family and cattle to some safer place and then arrange immediately for the essential commodities like food and some roofing cover. Food will be needed immediately and within hours of shifting, protection against rains will have to be ensured because it is not possible to remain in the open for a long time. Outside help rarely arrives in this stage of the calamity because in the given situation inaccessibility works both ways. It is essential, therefore to be prepared to meet any eventuality. This preparation can be effective and sustainable only if it is based on the local resources, ideas, virtues and lifestyle.

When the flood victims become accessible, a lot of interventions is possible. A host of NGOs, with vast experience in dealing with emergencies, comes forward to extend a helping hand. This part of the intervention is very well carried out and is equally well documented, especially by the NGOs. It is not intended to repeat that here. However, there is a lot to be learnt from the continuing experience.

"Living with floods" never means leaving the rivers totally to their own devices but it surely means a bare minimum of interference with the working of the nature.

There is a need to educate the people. This has to be preceded by committed action research concerning all the aspect of floods, irrigation and power production. The poor man"s wisdom has got to be recognised and studied thoroughly, and an in-depth study will have to be made into the coping mechanism of the flood victims.

The concept of living with the floods is yet to develop and no serious work has been done so far in the modern societies except talking about the floodplain zoning which, anyway, is an age-old concept and nobody seems to be serious about it.

Annex 6: Thoughts on Alternatives Towards an Efficient and Low Cost Power Sector

Excerpts from Draft Chapter on Energy prepared by Girish Sant and Shantanu Dixit for Narmada Valley Task Force appointed by the Government of Madhya Pradesh (MP). (PRAYAS, Energy Group, Amrita Climic, Karve Road, Deccan Gymkhana, Punne, India 411 004.)

The resources of the valley should be utilised on the principle that "Development of the valley should be with the national perspective, meaning that the resources of the valley would be fully developed, to the extent possible to meet the needs of the (whole nation), *with the needs of the local people getting the first priority*. Further, this would be done in a manner so as not to be inconsistent with the interests and constitutional rights of the local people, and with the principle of sustainable development."

Energy Needs of Local People

Cooking Energy Needs:

Fuelwood, agro-residue and dung are the main sources of cooking energy in the rural areas. The village surveys presented in the TF meeting dated 21 - 27 August 1998, indicate that cooking needs of the village can be easily met from the resources available in the village, if irrigation facilities are available in the village. This observation is in accordance with many other studies on rural energy needs. Further, with proper management of available resources and use of efficient equipment (such as an efficient Chulha) there is substantial scope for reducing the burden on the resources. Availability of cooking energy can be a problem in unirrigated areas if green cover has been seriously depleted. This issue is closely linked with water use and irrigation facilities, hence is not considered in more detail here. This issue was not a major concern while the Nasmada Valley Development Project was being prepared, hence is not considered in more detail here.

Pumping Energy Needs of the Local Populations:

The need for water pumping (per ha of irrigated area) can be substantially reduced by adopting judicial water application practices. Only 10 - 15% of the incremental biomass generation due to the additional water availed through such lift can meet the energy needs of such lifts. The user response has shown that farmers are willing to contribute this biomass towards cost recovery, if they are assured a reliable delivery. In other words, the agricultural sector can generate the fuel required for the biomass based power plants, in quantities sufficient for meeting its own needs. Achieving this energy self-reliance is a high priority as it will *substantially* reduce the demands on the grid and need for the subsidy.

In short it can be said that the cooking and irrigation energy needs of the local population can be met through changes in water use, irrigation and biomass policies.

Power Requirements of the Grid

The second component of the energy need is the power need of the State (ie of the grid). . . .At a broad level it can be seen that the Indian power sector is trapped in a vicious circle. A vicious circle of high demands on the grid, insufficient revenues, and difficulty in finding resources continues, resulting in neglect of cost-effective options that have low social and environmental impacts. Breaking this vicious cycle needs a fundamental change in the policy approach. We will have to transcend the constraints of the present institutional, political and governance system to achieve this. Components of this approach are:

(a) maximum utilisation of cost-effective options that have low (or positive) social and environmental impacts;
(b) achieving optimum efficiency in supply (generation and distribution), as well as utilisation (end-use efficiency) of electricity;
(c) creating structures and mechanisms to ensure public participation and rational decision-making that is based on the above principles.

As far as the needs of the grid are concerned, the first priority is to utilise the cost-effective options to increase the efficiency of the existing system.

A three-step approach to break the vicious cycle and re-orienting the power sector in line with the above principle can be envisaged. This section elaborates these steps. These steps are distinct but the implementation of all three should begin simultaneously.

Immediate Steps

It is essential that urgent actions are taken to tackle the immediate problems being faced by the sector such as growing financial losses and increasing power and energy shortages. The immediate steps to address these crisis are:

(a) Tariff rationalisation and measures to increase transparency and accountability
(b) Supply-side efficiency improvement.

Today the power supply to irrigation pumpsets (IPS) is based on the flat rate, ie tariff-based on connected load rather than actual consumption. In 1994-95, the agricultural sector paid just Rs0.21/unit, while industrial sector paid Rs2.27/unit. Such a lopsided tariff structure has led to severe distortions.

The unmetered electricity (flat rate tariff) is a barrier to efficiency improvement. The consumers have no incentive for preventing wasteful use of electricity and even water (in water abundant areas). The table below shows the increasing share of IPS consumption in the total consumption in MP. Table also shows the average hours of pump use for the last few years. The 1996-97 consumption amounts to an average pump operation for 10 hours daily for 250 days a year! Many studies have demonstrated poor end use efficiency in the agricultural sector. It is possible to reduce the IPS consumption by 30-40% with use of a good quality, properly matched pump and piping system. Further, it is easily possible to achieve 15-25% savings by judicious use of water. As a result of the above inefficient use, agricultural consumption is increasing very rapidly. The land quality is deteriorating due to excess water use and State Electricity Board's financial situation is deteriorating due to the subsidy.

Increasing Power Use by Agricultural pumps.

	Agricultural use (% of total)[1]	**Hours per year**[2]
1992-93	22.3	1,296
1993-94	29.7	1,923
1994-95	32.8	2,217
1995-96	35.1	2,456
1996-97	36.6	2,476

Notes : 1. The percentage of agricultural use to the total power use in the State.
2. Average hours of pump usage (calculated as electricity use per kW connected load)

Farmers using diesel pumps effectively pay the equivalent of Rs 3/- per kWh, while the IPS users are not willing to pay even Rs 0.5 per kWh. Such subsidy policy further aggravates inequity and is regressive in nature.

Another lacuna of this tariff structure is the lack of accounting for electricity generated, distributed and consumed. Since the agricultural consumption is not metered, it cannot be estimated accurately. This along with technical and commercial losses (Transmission and Distrition (T&D) losses), implies that a high proportion of electricity generated remains unmetered and hence not accurately accounted. In 1996-97, nearly half of electricity available in MP was not metered.

To avoid such ill effects, it is essential to rationalise the tariff structure and meter all consumers, including agricultural consumers. The survey by people of "Sulgaon" (a water-rich area) has estimated this saving at 25%. Such saving will reduce the subsidy burden on MPEB. It is known that over 2.2 million houses having a single point connection use more electricity than expected.

Another drawback of a such lopsided tariff structure is the declining revenue from the industrial sector. The industrial tariffs are often set so as to cover subsidies to IPS, which has resulted in the industrial tariff being too high. Madhya Pradesh State Electricity Board (MPEB) data show that captive power plant capacity in the State has been increasing rapidly in recent years. With the strained financial situation, MPEB (can ill afford to lose its revenue-generating industrial customers.

We need to immediately improve the transparency and accountability of the power sector. The esults of the energy audit (metering from EHV to LT feeders) showing energy loss in each segment should be made public. The person in charge of that segment/area should be responsible for reducing these losses. This will help us reduce power theft, which is a serious problem.

In short, tariff rationalisation, coupled with metering, transparency in energy audit and accountability measures can bring substantial benefits to the MPEB. These measures are required irrespective of the development paradigm we adopt and the benefits need to be articulated in the future plans.

The supply side efficiency measures (R&M of power plants and T&D improvements) have a large potential. These measures are known to be highly economical. The R&M measures effectively increase power plant capacity at one-fourth the cost of new generation. The same holds true for T&D improvement. Actions on these fronts have already been initiated, with impressive results. In 1996-97, a demand of 680 MW more than in 1994-95 could be met without significant addition in capacity, largely due to improved plant performance. These measures are still not fully integrated in capacity addition planning andas a result, their benefits are not clearly articulated in (future) plans. Hence, these measures should be explicitly made a part of demand-supply planning. This will give a boost to the ongoing action on this front, leading to significant additional benefits, especially through T&D improvements.

Intermediate Step

Apart from the supply side efficiency mentioned above, there are many avenues for efficiency at the user end. Similarly, there are several decentralised generation sources that are already cheaper than large power plants. These options usually have a low negative, or at times a positive, social and environmental impact. To tap these cost-effective sources, a comprehensive Integrated Resource Plan (IRP) should be worked out. Such an IRP will ensure that the most economical investments are made. The IRP should be prepared and implemented in the intermediate period of the next 3 - 5 years. This envisages :

(a) Listing of all technologies and resources (for generation and efficiency improvement; centralised and decentralised sources), working out their cost and potential;

(b) Working out the required management structure essential for utilising these resources;
(c) Transparency and public participation in the process so as to be able to receive the suggestions from people and remain accountable to people; and
(d) Making investment decisions to implement the plan.

Tariff rationalisation, awareness campaigns, metered tariff and incentive for renewable sources are essential but these do not replace the need for an IRP. The IRP is essential to identify, plan and implement the least cost options. The major steps involved are briefly described below.

Widening of Candidate Options:

To begin with we must widen our choice of candidate options to include efficiency improvement and decentralised generation options in addition to the large thermal and hydro options. Such options are identified in a host of research papers and similar plans prepared by agencies in India and abroad.

Evaluation of Options:

The next step in planning is to evaluate these options for cost-effectiveness and potential. While doing this, care must be taken to adopt a methodology that can account for the peculiar characteristics of each option, without a bias. A methodology to account for such differences, and to evaluate different options on an equal basis is well established. This method compares the life cycle costs (annualised cost over the entire life) at a common point (either at the bus-bar or at the user-end).

Estimating Potential of Candidate Options:

The achievable potential of any option in a given time span is largely a function of good programme design. In addition to utility supported efficiency programmes, other approaches also need to be considered. These include options such as efficiency standards and mandatory labelling. The utilities or government can create a "Market Pull" towards efficiency. Community participation in planning can also reveal large opportunities for energy conservation.

Developing Least Cost Integrated Resource Plan:

After an estimation of cost and potential of different options, the next step is to develop a least cost integrated plan. Maximum possible exploitation of the least cost options followed by the next costly source is planned until the expected demand is met. A more sophisticated approach of "Screening curves" can be used to evaluate the cost-effectiveness of different options. The "Screening curve" is a tool to compare the varying cost of generation projects (with the varying PLF) and the fixed cost of conservation and load management options along with fixed operating/saving period (ie fixed PLF).

Such an IRP can identify a set of options that can meet the power demand at a least cost. Actions to implement such a plan should be and can be taken simultaneously. Unfortunately, no utility in India has officially prepared such an IRP. But plans developed by researchers for Karnataka and Maharashtra show that nearly 60 - 80% of the incremental demand can be met through efficiency improvement, electricity substitution and decentralised generation. Moreover, such a plan is expected to be 30 - 40% cheaper than the conventional plans.

Moving Beyond Conventional IRP:

Some IRP studies also have limitations, they concentrate only on the technical efficiency improvement options. There are several instances in which, with little effort, electricity consumption can be reduced or eliminated without causing any hardship for consumers.

Identification of these cost-effective options needs public participation. To achieve this, the procedure followed during the IRP done by US utilities needs to be adopted. The cost and other utility data were made accessible to the public. Comments from people to identify low cost energy saving and generation options were invited and analysed. The North West Council conducted public hearings and read through a 3 feet high stack of public comments. Based on this and other studies, a draft IRP was prepared and it was made public. Public comments on the draft IRP were invited. More than 1,300 individuals and groups submitted their opinions in writing and 16 public hearings were conducted. Suggestions were analysed and many were incorporated in the final IRP. A IRP prepared in such a manner is sure to save a lot of money and many social and environmental ill effects associated with power development.

In some countries, the power sector regulators require that utilities consider energy saving on a par with power generation. While floating tender for competitive bidding, along with energy generators, offers to save power are also allowed to compete. Then in evaluation, the least cost offer (of generation or saving) is declared as the successful bidder.

Long-Term Steps

The IRP based planning can reduce the dependence on large centralised fossil fuel and hydro projects by as much as 60%. It can be argued that over time the potential for cost-effective efficiency improvements would be exploited and exhausted. Then in the next period the centralised projects may again become prominent, and we would again need all these large projects. This does not have to be necessarily true; we can take concrete actions now to avoid this situation.

Firstly, as time progresses, technologies currently in an experimental stage will mature and new opportunities will emerge.

Power generation technologies based on renewable sources are showing promising results. Such technologies will mature in the next few years, opening new opportunities and further reducing our dependence on fossil fuels and large hydro.

Inter-sectoral and institutional reforms necessary for improved irrigation and water use efficiency also have many implications for the biomass based power generation. For example, an institutional structure that allows farmers to pay for their electricity cost in terms of biomass would substantially increase the power potential and also reduce the demand on the grid (for power and subsidy) as mentioned above. Or the potential of small hydro would increase substantially when we start implementing water and land management in the upper reaches of the valley.

New developments such as hybridisation of generation sources would remove some of the critical shortcomings of the RE systems and could multiply the cost-effective utilisable potential. The small hydro can also be used as dispersed pumped storage for better load management: small storages/pumps used for irrigation can be used for this. This will further improve the economics of such schemes. Hybrid systems of solar thermal, pumped hydro and biomass power can be operationalised on a mass-scale in less than a decade. Such hybrid systems, along with the institutional mechanisms suggested by K. R. Datye, can address issues of sustainable agriculture and increased irrigation. He has demonstrated that by using the above techniques, it is possible to nearly double the power availability in rural areas.

But these technological and institutional innovations cannot occur in vacuum. An enabling environment in the form of financing, R&D facilities, and appropriate policies needs to be developed. If this work is done today we can reap the benefits in the coming 10 - 15 years. At present, most of the research on these technologies is being carried out in the developed countries. Many multi-national companies view these technologies as the key technologies for the future. These technologies have a large potential in the developing countries. But if we do not invest in these then we will have to continue importing equipment from the same countries (or even the same companies) from which we import the power equipment today.

To achieve these long-term goals, planned actions need to be taken today. A beginning can be made on many fronts. We should start with pilot projects for relatively mature technologies such as Gasifier and CFLs. As a starting point, we can aim for say one gasifier of around 1 MW capacity in each taluka. We can utilise private initiatives or co-operative/community based institutions to look after aspects such as operation and maintenance, fuel collection, educating farmers to grow and conserve biomass, managing distribution of electricity, billing, etc. Even this moderate transition step will have an enormous impact on rural MP. For example, if just 50 such projects become operational, they would add more than Rs100 million per annum to rural economy. Experience gained from such pilot projects will help optimise the technology and institutional structure. As explained earlier, our technical and financial resources are limited, they should be used for such projects rather than for projects that involve huge social and environmental costs.

Conclusions

For considerations of equity and sustainability (economic as well as environmental), a fundamental change in the policy approach is needed. Such a change should start with improving the supply-side efficiency (of the power sector) and removing the policy barriers to efficiency. Another step should be to plan for increasing the potential and use of cost-effective, renewable and efficient sources. This can be achieved by immediately planning and implementing an IRP (integrated resource plan). This can dramatically reduce our dependence on the socially and environmentally unviable projects. As a long-term strategy, resources such as biomass, small hydro and solar (thermal) can be developed. Hybridisation of such resources, improved institutional structures to enhance public participation and efficient use can further reduce our dependence on such projects.

The cost and resource implications of such a strategy are very positive; it can meet our growing needs. For this we need to urgently prioritise use of our limited financial and managerial resources. These need to be used for achieving the above-mentioned transition. This can minimise the financial and social costs of transition in the next decade or so. Moreover, though the above-mentioned steps may appear time-consuming, it needs to be recognised that in spite of huge efforts and resources, the conventional approach has been able to generate only 90 MW power from the Narmada Valley in the last 40 years.

[1] The rainfall pattern in this part of India is different from the rest. This is the only area that receives rain from the return monsoon. The cropping seasons are therefore different from those of the rest of India. The seasons are named *kar*, *samba*, *pisanam* instead of *kharif* and *rabi*.

Annex 7: Comments Received on India Country Study Stakeholder Meeting Draft

7.1 Comments from the Government of India

Introduction

Government of India: Ministry of Water Resources Central Water Commission: Comments on the Draft Working Papers on Laws, Policies & Institutional Framework for Options Assessment & Decision Making

(Draft Document prepared by Prof.Nirmal Sen Gupta, Madras Institute of Development Studies, Chennai For The World Commission on Dams).

Various Authors and MIDS and IIPA deserve appreciation for their detailed study for 'World Commission on Dams' focussing particular attention on the two main themes viz.,

- relevance on (Large) Dams in the development effectiveness including an assessment of alternative options for water resources & energy development;
- focus attention for system needs for planning, design construction, monitoring & operation of these structures.

Madras Institute of Development Studies (M.I.D.S.'s): Comments on the WCD India Country Report

General Observations:

The study of the nature undertaken has to bring focus on the '**Future Needs of India**' in due cognizance to the '**World Requirements - at large**' and compare as to how the 'explored' alternatives or options are sufficient (or otherwise) to meet the demand.

In a country like India where most of the annual precipitation occurs within 100 hours of the year and most of it flows out to sea, a macro-analysis on water should have focussed on 'Water accounting'. This is best accomplished by a study of the 'Annually Renewable water Resources', an indicator for water supply for various usages. A model evolved as the one annexed (Mohile.A.D., Chairman CWC - 2000) would be useful for considering the perspectives for future. (Water Vision). The horizon for projections could be 25-50 years. Given the setting, the following emerges:

India has roughly 16% of the worlds population concentrated on 2.45% of the land area and endowed with 5% of the world's water resources.

- The rainfall in India occurs in approximately 100 hours in a year during monsoon.
- Though the natural water resources of the country which is about 1953 km^3 per year & is somewhat comfortable. The Ganga-Brahmaputra-Meghna basin occupying 33% of the area contributes about 60% of these resources.
- The vast areas of peninsular India (except Western Ghats) and Madhya Bharat do not have the abundance of water availability.

- A **'water - vision for India'** is not merely an exercise in projecting the present into the future. The vision should be based on somewhat practicable objectives. The vision is bound to be optimistic and is bound to address what is desirable.

The water visions of different societies would differ depending on their present position and their concerns. In the developed world, particularly in Europe the visions are likely to aim at maintaining or restoring the water quality. However, in the developing countries, the basic problems of water for personal consumption, health and hygiene, food and livelihood have not been addressed fully. The visions for the developing countries are likely to be different from those of the developed world.

In India, the earlier strategy of water development is getting replaced by the twin strategy of improved management and faster development. The strategy of storage development and management of water distribution and use have to be strengthened, simultaneously. (Integrated Water Resources Development & Management, - **IWRDM**).

In this context, the main findings of a vision exercise having a mix of desirability and productivity is given below:

Domestic Water

The growth of the Indian cities are very fast on account of the natural population increase, migration from rural areas and geographic expansion of the urban areas. By 2050 the urban population may overtake the rural population. Providing water to the mega cities would be one of the important future challenges. The unaccounted water will have to be recovered through better maintenance and management. The secondary uses in urban areas which do not required high quality water would have to be made through local water harvesting, re-use of water, adoption of two pipe system etc.,

Reasonable access to clean drinking water to all

- 220 LPCD for Urban area
- 150 LPCD for Rural area

Full sewage treatment

Emphasis on cost effective action like oxidization ponds, duckweed plants, and reuse of partly treated sewage for irrigation.

Agriculture

Elements

- Food Security
- Target food production of about 455 mt by 2050, out of which 360 mt will be obtained from 90 mha of irrigated food crop area @ 4t/ha & 95 mt from 60 mha of rainfed crop @ 1.5t/ha.
- By 2050, net shown area as 145 mha, gross cropped as 225 mha, gross irrigated as 130 mha & gross rainfed as 95 mha.
- Rainfed area may not expand from now to 2050.
- Total rural population may not expand. The vision envisages comparative prosperity to rural population, with small holding as of now, though larger yields and irrigated farming.
- Much more equable and timely distribution through participatory irrigation management.

Water balance

The vision exercises done recently (1999) by the National Commission examined the practicability of these large withdrawals through water balance exercises. From these studies, some projections and water balance studies have been undertaken. These initial studies indicate the an appropriate future Option for meeting the future needs have to be a combination of, major , medium and small / minor schemes in various basins besides other measures of performance efficiency including water management.

It would be seen that large return flows would occur, particularly from agriculture and these would sustain the withdrawals to a considerable extent. It would also be seen that the proportion of returns, as a proportion of withdrawals will reduce markedly both in industries and in other sectors, due to waste management, reuse and recycling. These would make the problem of waste water treatment and the problem of monitoring the water quality, particularly of the ground water, as a very important future concern.

The over all hydrologic balances also show that by 2025 and 2050 there is likely to be a considerable reduction in the flows from the Indian rivers and aquifers to the seas. We would have to ensure that this reduction occurs mostly during the monsoon and the low flows in fact are improved. Ensuring that all withdrawals for uses are from the flood waters requires a large scale storage development. At present major and medium storages with live capacity of around 174 km^3., have been completed and those with 76 km^3., storage are under construction. Projects with possible live storage of 132 km^3. are under consideration. When all these are completed Indian live storage from major and medium projects should be around 380 km^3. considering that storage of around 30 km^3. could be available through various minor tanks and considering that some loss of live storage from sedimentation is inevitable, the total storage available by 2050 could be of the order of 400 km^3. This would have to be fully exploited to ensure large diversions for agriculture and other uses. There are possibilities of Himalayan storages in neighboring countries and the regulated flows from such storages may also have to be used to some extent for agricultural as also for in-stream uses.

Action required to achieve the vision

This vision is based on a precarious balance between demand and supplies and is also based on various physical and management actions. This physical and management actions in turn would require policy and institutional measures, legal measures, cooperation amongst nations, cooperation amongst nations, cooperation amongst States in India and a continued support of the people of India. Even in the present situation, a very large measure of cooperative goodwill is available for water development though it does not necessarily confirm to Basin development. However, non-conformity with the basic approach has had its local effects of adopting inferior solutions and of delaying developments. We may not be able to live with this in future.

In irrigation management a shifting emphasis towards management related issues, maximization of user satisfaction through joint action supported by changes in laws and procedures towards cooperative management of the systems seems to be the crucial issue.

Improved irrigation efficiency does not necessarily require reduction of canal seepage. The total irrigation efficiency of the surface and ground water use is to be viewed together in a basin considering the inter-relations and the flows. Large developments and conjunctive use and also changes to favour conjunctive use and joint monitoring and management of surface and ground water are required particularly in alluvial areas.

Improved methodologies of water distribution including "off-on" system which does not allow partial flow in canals and proportionate distribution as also canal automation through computerized control have to be resorted to.

In regard to flood control the emphasis needs to balance the software options like flood forecasting and long term hardware options like construction of reservoir.

A large scale programme for storage based hydro-development through multi-purpose reservoirs is required to be taken.

There is considerable scope for privatization in regard to Hydro Power Policy changes to favour privatization and to ensure quick availability of land and to reduce the risks of the private investors is required to be evolved. However, public investment in hydro power sector would also have to be continued at an increased pace.

In regard to domestic and industrial water supply, the emphasis would have to be in ensuring adequate supply as also adequate treatment, reuse and recycling. Pricing, financial sustainability and local decision making towards these through the "User pays - polluter pays" principle perhaps are the key actions.

However, the main series of actions which would promote the achievement of the vision seems to be in the realm of the policies and laws. It is essential that water policies are evolved in such a way as to reduce the decision making capacities of the "State" and increase the decision making capacities of the users in regard to the key decisions of water management and even water planning. The involvement and participation in watershed management. There seems to be enough scope of having independent bodies, somewhat similar to the French Water Parliament, for the basins of India where the stakeholders solve their internal conflicts without politicizing these as inter-State conflict or conflicts within sectors and evolve considerable policies within a financially sustainable framework. Each of the basin institutions can have a large measure of autonomy.

Similarly, legal changes may be required for avoiding the inter-State conflicts and to enable the Central Government by consultation and participation of the user groups to solve inter-sectoral and inter-regional issues without having to resort to adjudication as far as possible. This would require new institutes who would address all water-related concerns under a single umbrella at the central level, at the level of the States and in the various local self-Governments.

Legal and procedural changes also would be required to facilitate construction of large dams through speedier R&R procedures. The law and the procedures have to have a human face, the wishes of the affected persons need to be considered, there needs to be a social monitoring of the programme but repetitive litigations which delay the process need to be curbed.

Another essential action seems to be in regard to making the people aware to the status and issues in water sector, both through the process of creating public awareness through mass programmes and through the sharing of information. There may have to be a performance analysis in regard to water based on reliable information both within and outside the Government and the feed-back of such an analysis should be available for correcting water sector policies, strategies and field actions on a more or less continuous basis.

It is this informed awareness of the people and the opinion makers and the decision makers which would be the driving force for converting the vision into a plan of actions.

Large Dams as an option for future development

The Role of Dams keeping the option of river basin development ensures increased productivity. Large Dams vis-à-vis small dams are site-specific and are to be planned, constructed and operated so as reduce the wastage of water to sea.

Integrated Water Resources Development & Management (IWRDM) & Institutional Reforms

Managerial operations as well as integration of watershed small storages and tanks with diversion structures are important and these are given due importance. As such, to project these as conflicting issues is not quite warranted.

Institutional Mechanism/Reforms are required, in order to achieve an Integrated Water Resources Development & Management (**IWRDM**) is receiving adequate attention so as to enhance the overall efficiency.

7.2. Responses to Comments from NGOs

Madras Institute of Development Studies (M.I.D.S's) Study Report – Point wise comments on the Report

Sl.No.	Reference to Chapter/ Page/Para/Line	Comments / Suggested Revision
	<u>**Executive Summary**</u>:	
1.	Chapter 1. Para 4.	The subjective indication that "overwhelming importance of CWC (& its predecessor) had been instrumental in pushing thro' the large dams (1.5.2)". This is objectionable.
2.	Para 5.	An indication is 'cost rise' of projects since seventies'. Other indicators for alternative energy generation like price of 'Crude & Petroleum Products' would be meaningful for a proper appreciation.
3.	Page (iii)	A para on 'Large Hydropower Development' preceding the para 8 and 9 would provide a better appreciation. Shri.Rangachari's paper (page 11) can be seen & a summary para included.
4.	Page (iv) Chapter II Dams in India	Para 3 is not endorsable. The back-up sub-paras (2.3.1) and (2.3.2) are not conducive to a healthy exchange of views the para is directed on 'individuals', such as (persons of eminence) Dr.K.L.Rao who is kept in great esteem for his valuable contributions, by the whole Engineering Profession & people of the State. The Executive summary (para 3) slights the contributions made by the Engineering Profession to the Nation in achieving Agricultural self-sufficiency & Food Security & is better dropped.
5.	(iv) Chapter-II Dams in India Para 4. Last line	"Most of these benefits are obtained from small tanks, too (2.4.7) for village communities. (The underlined addition would be appropriate: *as these cannot cope up with the increasing demands for urban cities & towns.*

Sl.No.	Reference to Chapter/ Page/Para/Line	Comments/Suggested Revision
6.	(iv) - Chapter II Dams in India Para 5	Of these, inter-basin transfer is within the agenda of the Government. (Add a line) *This is contingent on large storages to harness monsoon flows of surplus river.*
7.	(v) Chapter III Performance Improve-ment Options Para 2. Last line	"Peak Demand can be met by small hydel & pumped storage facilities and also by peak management (3.2.4.)". Due to lack of storage, 'small hydel' does not ensure the peak demand requirements. Pumped storage projects need more energy for pumping during off peak hours.
8.	(v) Chapter III para 3 Ist sentence.	About 10% is the gap between created & utilized potential & specific programmes like CADA aim to bridge this gap. The points which are worth a mention while dealing with canal efficiencies are facts such as losses due to seepage, recharge ground water & lining of canals being an expensive preposition can be undertaken on a selective basis, only.
9.	vi)	Paragraph on 'Floods'. The para can precede with the following observations. "Floods have been controlled & attenuated in river basins where large dams have been constructed like Krishna, Cauvery, Sutlej, Beas, Damodar etc., Recurrent floods & consequent damages are annual on rivers like Gandak, Ghaghra, Kosi, Brahmaputra & Barak, where no large reservoirs have been constructed".
10.	vii) para on "small hydropower"	The report is silent on the contribution of large dams & large hydropower to the society at large. The para should be preceded with a coverage on 'Large Hydro'. It is the large dams & hydropower stations which has contributed for the over all figure of 22000 MW (Hydro), as indicated elsewhere. Agricultural power needs are almost

Sl.No.	Reference to Chapter/ Page/Para/Line	Comments/Suggested Revision
		matching with the contribution of Hydro to power

		sector, presently. It is the main reason for Ground water irrigated agriculture & hence consequent contribution to food security.
11.	viii) Chapter V Conclusion	The last sentence of para 1 is not a factual one. In water resources sector, constant reviews of the programmes, options and their accomplishment are a common feature. The latest is a review by the National Commission on Integrated Water Resources Development (NCIWRD). (1999).
-		Thus the conclusion that 'Apex Institutions in Water Resources area, both at National and global levels, have shown very little initiative' is unfair.
12.	Page 3. Para 1.3.1. Last sentence	Chapter I. A comment on 'Judicial award' is best avoided. Hence the last sentence may be deleted.
	Page 5 'Italics'	Recently, a few non-Governmental Agencies have handled some small developments and the study could attempt to collect data & provide their observation.
	Para 1.3.3.	P.I.M: The last two sentences need to be reviewed
	Para 1.4.3. sentence 1.	Options in so far as it is related to specialised spheres such as selection of an appropriate site for a dam, engineering considerations such as hydrology, hydraulics.
	Page.7 Para 1.4.3.	The updated draft NWP is worth-mentioning. The small scale surface irrigation techniques have their own role to play. However the efficiency of such schemes (a comparison of area submerged vis-à-vis area irrigated would provide an idea) are low in comparison to large schemes.
	Page.7 Para 1.4.4.	Geological surprises are inevitable during construction phase as one cannot open up the entire foundation to obtain a 100% understanding of the problems which may creep up.

Sl.No.	Reference to Chapter/ Page/Para/Line	Comments/Suggested Revision
		Under provision of spillway has been brought to light. Advancement in the science specially on 'Hydrology' was during seventies and the concept of PMP & PMF for determining flood hydrology came into vogue. Several old projects designed prior to this period thus needed a review adopting latest concepts. This applied to all disciplines with advancement of techniques where a review can suggest changes. Such revisions and cost escalations are reasonable and unavoidable.

	Page 8. Para 1.4.4. Comments in Italics	For planning & designs of large dams & other Engineering structures inputs from experts of specialised discipline are essential. We need to involve PAP/WRUs for R&R, Irrigation & Management etc., at tertiary level,
	Page 9 Sentence 3 & last Sentence	The para brings home in its last sentence, the political will, which tacitly implies popular wishes & demands & this being so, the pressure on the State Governments for construction of 'more' irrigation projects imply the successful contribution of these scheme to society. These aspects could be spelt out clearly & the projects are not thus restricted to the 'Departmental preferences'.
		It is indicated that CWC was 'instrumental' in pushing through large Dams.
	Page 10. Sentence 1.5.2	On the contrary, CWC is blamed for long delays in clearing the projects and holding up a large number of projects of different states like Polavaram, Inchampalli, Kishav, Ken etc., for want of adequate data, investigations or inter state Agreement. Thus CWC is not biased in hastening 'large dams' without sufficient ground work. They are recommended only after examining techno-economic viability.
	Page 12. Para 1.6.3	An useful additional indication would be 'several attractive sites are not developed due to Inter-State. International and satisfactory solutions to Environmental Issues'.

Sl.No.	Reference to Chapter/ Page/Para/Line	Comments/Suggested Revision
	Page 13. Para 1.6.6	Irrigation Projects are now based on 'Economic Returns' and B.C. ratio and not on commercial lines. "Public funds for public good".
	Page 13. 1.7 Power Sector	A para on over all hydropotential, the extent to which it has been harnessed, the ongoing projects and the directions as per National Hydro Power Policy (1998) would make the report comprehensive.
	Page 18. Inset on the "Sanctioned Rates for Water shed development Schemes".	There is an attempt to compare 'non-comparables'. The cost of creating irrigation potential is to be viewed in the context of 'cropping intensity' and 'higher potential of agricultural production' with minimisation of 'risk'.
	Page 19. Para 1.8 (a) 4 Last para	The last sentence has no relevance as the schemes of 'Irrigated agriculture' cannot be compared to 'Rainfed areas' development.
		The cited Annexure 1 indicates progressive changes in the nature of courses offered in water resources. It does

	Page 20 Para 1.8 (a) 6.	not reinforce the conclusions ('in italics')
	Page 21. Para 1.8 (c) Power	Discussions should also bring out the status of power potential (hydro) in the country (and also Nepal and Bhutan). This can significantly cater to increasing demand of energy. What is desirable is to harness the enormous hydro potential (replenishable & eco-friendly) and reduce the growing oil-import bill (at an alarming) rate.
		The contribution and performance of large hydro projects in the country (thro' costs & benefits) would provide a better picture while considering future 'options' or alternatives.
	Page 22. Para 1.8 (c).3.	A comparison of the costs of per unit Energy from various renewable sources without subsidy (including large hydro projects) would be useful for Decision Makers.

Sl.No.	Reference to Chapter/ Page/Para/Line	Comments/Suggested Revision
	Page 25. Para 1.9.7 Last sentence	The sentence should be amended to reflect that 'Bank is a partner for all the impacts (positive as well as negative) of accepted course of development.
		(Why presume the accepted course of development had only adverse impacts, which is not the case!)
	Page 36. Para 2.3.2 (& para 2.3.1 as well)	The paragraph does not enhance the credibility of the work as it attempts to insinuate on 'persons of repute' in the Profession. Also, the earlier contributors in the field of Water Resources.
		The para should be dropped.
	Page 39. 2.4 Objective & Achievements Para 2.4.1	(Aspects on Non-filling of Reservoirs) - sometimes, excessive demand on energy/irrigation during peak requirements may not allow the reservoir to touch its full level. The total water utilized for irrigation and power generation as a result of storage dams should merit consideration & not the number of times it touched FRL. In Beas, the reservoir is kept a few meters below to absorb floods. In certain cases, carry-over storages are planned to meet a successive drought year. These are case specific & will not allow the reservoir to fill to FRL every year.
		In fact, the figure indicates a vary disturbing trend, in our view. This should be driven home for discussions.
	Page 40. Fig.3. Growth of Storage capacity	While our population, urbanisation and demand for

		water, food & energy is increasing at a fast pace, the growth of storage is declining at an alarming rate. Who are the people responsible for this looming crisis which may result in Food, Water & Energy shortages in coming years and destroy our 'Food Security' or 'self sufficiency'.

Sl.No.	Reference to Chapter/ Page/Para/Line	Comments/Suggested Revision
	Para 2.4.2	An addition to the last sentence is appropriate. "Thus it is seen that largest dams provide multi-purpose benefits of Flood Control, Hydropower, Irrigation and Water-Supply, in almost all the cases". Table 4 needs to be updated.
	Page 41. Table No.4 (The table is erroneous)	Under Item 10 'area converted to irrigation' from rainfed, a multiplication factor of 2 is relevant, as most of the irrigated areas are under large irrigated projects or tubewell irrigation and are following multiple cropping. (The cropping pattern in Punjab, Haryana, UP Rajasthan & Delta areas of Mahanadi, Godavari, Krishna etc., may be studied). Besides food grains, contribution of irrigation in cash crops like sugarcane & cotton also needs to be given.
	Page 42. Para 2.4.3 (contd)	Replace " (or just 36.8 per cent ....sometimes claimed) by Another 45 Mha are irrigated using ground water using subsidised electricity to the tune of 22000 MW which equals the total hydropower produced in the country at cheap rate. Even present day generation cost of Bhakra is less than 15 paise & in respect of Hirakud only 10 paise, (justifying their sustainability nature). Mainly from the large projects like Bhakra, Beas, DVC, Rihand, Hirakud, Nagarjunasagar, Srisailam, Koyna, Mettur, Idukki, etc. Even the remaining 12 million Ha from Minor Irrigation Projects (<2000 ha), many schemes involves dams of heights more than 15m which are classified as 'Large dams' according to ICOLD definition. Therefore more than 90% of the increased food production from irrigated area is contributed by large dams. It is also corroborated from the statistics given by the Ministry of Agriculture that at present more than 90% of wheat crops are irrigated. It may be mentioned that storage reservoirs of live storage capacity of 177 BMC mainly contribute for Rabi Irrigation (wheat crop) in the non-monsoon season.

Sl.No.	Reference to Chapter/	Comments/Suggested Revision

	Page/Para/Line	
	Page 42. Para 2.4.4 5th sentence.	Add to the sentence ending with 22000 MW of hydropower generation capacity which is less than 25% of Hydropower potential.
	7th sentence.	Add to an average of 400 MW addition every year during the last decade, as a result of movement against construction of large dams.
	8th sentence.	Add at the tail-end of the para: Increased reliance of production of electricity by burning fossil fuel e.g., coal, diesel Naptha is pollution the air, land and water and CO_2 & SO_2 contents in the atmosphere leading to greenhouse effect and even, possible, acid rains in the coming years.
	Page 43. Last sentence	'Constant Price' comparison is misleading. It should be amended with suitable cost-indices, if a realistic comparison is the objective.
	Page 44. Para 2.4.6	Public Water Supply: Compiled statistics of this will be available shortly for a better picture.
	Page 48. Para 2.4.9	Discussions on Sardar Sarovar is sub-juidice & are best avoided.
	Page 51. Para 3.2.2	Para may be dropped. Reduction of power utilized for Agricultural pumping as an assumption is not practical. Thus the presumption 15000 MW of such released energy is not feasible. Since the Ground Water Irrigated Agriculture is dependant only on power & its contribution to food security is a sizeable chunk, it cannot be wished away with, arbitrarily. Rainwater harvesting, while plausible and is given emphasis, the percentage that it could substitute in place of Ground water needs an in-depth study. In the meanwhile, no planner could rely on this to remove Ground Water Irrigated Agriculture from the system to such a sizeable extent.

Sl.No.	Reference to Chapter/ Page/Para/Line	Comments/Suggested Revision
		The political compulsion that has a social bearing is the reason on the tariff for Agricultural usages & can be discussed in more detail.
	Page 52. Para 3.2.4. Peak management	Gas based generation is a worse option to hydro because of increasing import cost of Petroleum Products besides reliance from outside for subsistence.

	Sub. Para 2.	The assumptions which are generalised may not be true; CEA & Min of power may be consulted.
	Page 56. Para 3.4.1	The priorities in multi-purpose projects are in accordance with National Water Policy. It is not arbitrarily shifted in favour of hydropower at the cost drinking water-supply or irrigation. The Ist two sentences need amendment. Irrigation is not reduced to a 'by-project' in Bhakra Canal System, letting power production taking precedence; as there is a downstream re-regulating structure (Nangal Barrage) to even out water releases to Irrigation canals, the statement is to be deleted. Most of the planned storage-linked peaking Hydropower stations are with a re-regulating barrage structure downstream to even out supplies.
	Page 57. Para 3.4.2	It is only the moderated flood, which is less severe than the natural one, is released from large dams. An analysis of 'with' and 'without dam' scenario can illustrate that a larger flood could have caused more damages downstream. With the technological advances in hydrometry, inflow forecasts are feasible and the flood release can be better controlled in future from important storage structures which are planned with a 'forecasting Network' system.

Sl.No.	Reference to Chapter/ Page/Para/Line	Comments/Suggested Revision
	Page 57. Para 3.5.2	The statement on Tenughat Dam needs verification.
	Page 58. Para 3.5.4. & Para 3.5.5.	The statement "no change in status has been brought about in the erstwhile flood prone area by large DVC dams" is false & misleading. The Report needs correction.
	Page 60. Para 4.1.2.	Dhawan's study is based on data. Instead of arguing it out as unhealthy, if data is available to justify a review, that must be done.
	Page 62. Para 4.1.2. Last sentence.	The farmer always value the experiences gained from traditional systems & imbibes it. With PIM, the information flow would be meaningful.
	Page 65. Para 4.1.3.	During the drought in Nineties in Gujarat, all the shallow storages were dry & the sub-surface moisture also dried up. Non-reliability on small storages as a sufficient (or substitute) for irrigated agriculture in committed areas has been proved beyond doubt. Wherever feasible, these areas were brought under irrigated command, as development took place. To bring it as a conflicting issue

		is perhaps unwarranted.

Additional Comments from Central Water Commission on MIDS Draft for World Commission of Dams

Chapter 1

Para 1.3.1:
It is indicated that in water resources the right of government is paramount. River Valley areas suitable for dams and canals cannot be utilised for private initiatives.
In this regard, it may be stated that privatisation has received serious consideration of the Government and a Committee under the Honourable Minister for Water Resources with representatives from the States and other Ministries was formed in 1996-97 and they have given their recommendations regarding privatisation in this sector. The private initiative and participation, wherever feasible, as recommended by the Committee can be considered by the Government. But because planning and construction of the major and medium dams is a complex and involves higher technical and financial input, private parties have not come forward in a big way to take up such works. Even in case of power sector, where libralisation process has started about 8 years back, till now very few power projects with private participation have come up. Obviously, because return from irrigation projects, which require larger gestation period and returns on the investment are delayed, private enterprises are not interested in taking up of irrigation projects.

Para 1.3.3:
It is indicated that Participatory Management Programmes do not address the fundamental issue of private initiation and rights.
In this context it may be pointed out that in the National Water Policy, evolved in 1987, participatory management has been recommended and since then Government are encouraging the Participatory Management programmes in Watershed Development as well as Participatory Irrigation Management. And NGOs are playing a major role in this effort.

Para 1.3.4:
It is indicated that as most major rivers passes through several states or several countries, many major peojects have not made progress or severely curtailed because of unwillingness of the one or other state.
Here, only a negative aspect has been highlighted. It may be stated that through various interstate agreements and understandings between states, many projects have been completed on interstate rivers in the past to site excamples, construction of Bhakra Nangal, Hirakud, Chambal, Tungabhadra, D.V.C., Mahi Bajaj Sagar and Rajghat and Bansagar in the recent past have being implemented with interstate understandings. Even with neighboring countries, Indus treaty was signed with Pakistan, various Indo-Nepal projects were constructed and Chukha and other projects were taken up in Bhutan. The efforts and endeavor of the government has been always to resolve differences and disputes through negotiations and failing these negotiations only, disputes are referred to Tribunals for the adjudication.
However, proactive role of central government in managing the interstate River Valley projects, separate bill under the existing provisions of the Constitution is under consideration of the Government, at present.

Para 1.4.2 to 1.4.4:
It is indicated that investigations of schemes began either after a government directive to, or as a routine development function of the irrigation department, for several reasons designs based on

large dams found favour and Public Participation for information collection and verification is not welcome.

In this regard, it may be stated that various options and alternatives are considered while planning a water resources project. Wherever, conditions are favourable, major dams are planned and it is not correct to say that only large dams find favour. Location of dams depend on various site conditions viz, Hydrological, Topographical and geological. It is not correct to say that public participation for information collection is not welcomed. Participatory Management even at initial stage is also welcomed and beneficiaries are consulted while planning of projects.

Para 1.5.2 and 1.5.3:
It has been mentioned that CWC has been instrumental in pushing through large dams and construction work of state projects often start without waiting for all mandatory clearance including that of the Ministry of Environment.
In this context it may be mentioned that the projects report on major and medium irrigation projects received from the state government are apprised for techno-economic viability by CWC and only the viable projects are recommended by the T.A.C.(Technical Advisory Committee) to Planning Commission for clearance. It is therefore not correct to say that CWC has been pushing through large dams. As regards the construction of projects without mandatory clearance it is pointed out that no project is accorded investment clearance without mandatory clearance have been obtained from concerned Ministries since the enactment of the Forest Conservation Act. 1980. In the recent pas it is seen that number of medium project far exceeds number of major projects

Para 1.6.2:
It is indicated that cost of creation of irrigation potential through major and medium irrigation project is increasing rapidly since 70's.
In this, besides price rise due to inflation other features which have largely contributed to the escalation of costs are introduction of distribution system up to 5 to 8 ha block, to inclusing cost of R&R drainage system in command, compensatory environmental and forest works, cost of catchment area treatment work.
Further on page 18 of the report the cost of creation of irrigation potential under major and medium irrigation programme 90-92 has been given as 66570 pr ha. However from the projects cleared by TAC in the same period, the average cost per ha works out to Rs. 28,000 only and may be seen in Annexure I. The comparison given on the same page may not also given correct picture as in this comparison the O&M cost and the benefits that accrue from the projects have not been considered.

Para 1.6.5
It is indicated that the distribution formula of central assistance is such that state continues to receive greater share due to spill over of irrigation projects.
While making plan allocations during annual plan discussions requirements of on going projects are given priorities. Recently, since 96-97 CLA is also provided under the AIBP to some projects for the expeditious completion.

Para 1.8 (a):
It is indicated that the other surface irrigation system are distributed across different departments without any technical basis and the extension plans were as per the convenience of the departments.
It may be pointed out that this is as per the policies of the respective state governments. However central govt. have advised the states to have separate water resources department where all activities concerning department of water resources on basin wise are reconsidered by single department.

Para 1.8 (c) 2:
It is indicated that the private sector participation on the policy support is still in sufficient.

In this regard it may be pointed out that the recommendations made by the committee on privatisation under the Union Minister for Water Resources are under consideration and where ever required, policy support could be provided in the revised National Water Policy.

Paras 1.9.2 to 1.9.7:
The role of World Bank assistance have been given and it has been concluded that some current programme of the bank posed the most serious danger to the survival of irrigation options.
In this regard it may be pointed out that the World Bank has provided assistance in the recent past not only for the major project but also to medium projects in Orissa, Gujarat and MP. Similarly assistance has been given for water management under the National water Management Project. Recently, the World Bank is providing assistance for the water resources consolidation projects in Orissa, Tamil Nadu and Haryana. Under this programme the restoration of works and participatory management are the major components.

Para 1.10.3:
It is indicated that considerable improvement is needed in both of project and programme implementation.
In this regard it may be stated that monitoring of major projects was taken up the Central Govt. way back in 1974. From a modest beginning number of medium and major projects are now being monitored by centre. The monitoring is done by the CWC Headquarters and by the Regional officers of CWC. This is apart from monitoring of AIBP and CAD projects.
As is well known, major problem for implementation is finds and ways and means have tobe found to gentle resources for completion of projects. Government of Karnataka have floated Krishna Jal Nidhi Bonds for UKP II project and similarly, Sardar Sarovar Nigam has raised money through bonds for Sardar Sarovar project.

Para 1.11.3:
The need for uniform norm on resettlement have been pointed out.
In this regard it may be pointed out that a National Policy on R&R has been formulated and it is under consideration in various Ministries of Govt. of India.

CHAPTER 2

Para 2.4.1:
It is stated that average storage attained in different basins have been ranging from 54% to 90%. In this regard a statement of live storage built up during the past 10 years in some of the important river basin is enclosed.(Annexure II). As may be seen from this statement, the over all percentage in all the 12 basins varies from 74% to 96%. In all important river basin like Indus, Narmada, Tapi, Mahi, Krishna and Mahanadi and east flowing rivers the average storages varies from 87% to 96%. As such the picture is not as dismal as projected in the report.

Para 2.4.3:
It is mentioned that there has been marginal (less than 10%). Contribution of large dams to increase in foodgrain production in the post independence period.

A table showing the contribution of irrigation in food grains production from 1950-51 to 1993-94 is given. (Table 4 of the Report). In this table, the productivity level under rainfed have been considered as 0.4 tonnes/ha and 1 tonnes/ha in 1950-51 and 1993-94 respectively. At the same time, productivity level for the irrigated areas are considered as 1 tonne/ha and 2.33 tonne/ha in 1950-51 and 1993-94 respectively. On this basis the production under rainfed is shown to have increased from 31.59 million tonne in 1950-51 to 76.45 million tonne in 1993-94. The corresponding increase in productivity under irrigated areas is indicated as 18.31 million tonne in 1950-51 to 112.43 million tonne in 1993-94. Though substantial contribution of irrigated area in food grains production is shown, it is mentioned in the report that the major part (63.5 percent) of the increase in food production owes to the productivity increase measures, like introduction of HYV seeds in the mid-sixties, rapid increase in fertiliser use, promotion of agricultural research and education, systematic extension, supply of credit for agricultural purposes and price support through administered prices. Contribution of these factors is not restricted to irrigated area alone, but extends also to rainfed foodgrains production. Extension of irrigation facilities accounts for only about 30 percent of additional foodgrains production.

To presume that major part of increase in foodgrains production is due to productivity increase measures and not due to irrigation, is not correct. Though the productivity level in rainfed area are shown to have increased from 0.4tonne/ha in 1950-51 to 1 tonne/ha in 1993-94, in actual, at present the yield from rainfed area is about 0.7 tonne/ha. only. Use of high yield variety seeds, increase in fertilisers use, though has a role to play in improving productivity level, they have more beneficial impact if irrigation facilities are available . Use of high yield variety and increased use of fertilisers means high cost to the farmers. They generally prefer to use high yielding variety seeds, more fertiliser only if supply of water is assured, which is possible only by creation of irrigation facilities. As such assured irrigation facilities is single most important factor for sustaining agricultural productivity increase in productivity level is also a continuing process. It is expected that productivity level in respect of rainfed area are likely to increase from 0.7 tonne/ha as at present to 1 tonne/ha by 2025 AD whereas for irrigated areas the yield is expected to rise from 2.5 tonne/ha on an average to 3.5 tonne/ha during the same period. This clearly indicates that improvement in under productivity level is more in respect of irrigated area then in rainfed area. With the rise in population and corresponding increase in foodgrains requirements, it is imperative to bring additional area under irrigation so as to meet the food requirement of the growing population.

Paras 2.4.5, 2.4.6 and 2.4.7:

Doubts have been raised regarding efficacy of dams regarding flood control and mention has been made that the water supply, pisiculture, recreational facilities etc. could be obtained from small tanks. An attempt has been made to denegrade the benefits of major and medium dams. In this regard it may be pointed out that major, medium and minor dams are all complementary to each other and benefits derived from major, medium dams cannot be ignored.

Paras 2.5.1 and 2.5.2:

The target of the government regarding completion of the storages by 2025 have been given and doubts have been raised regarding fulfilling of this targets.
In this regard it may be stated that funds will be a major constraint in this regard. However, along with the creation of additional storages other options and measures like better water management improvement of water use efficiency and inter basin transfer etc. will all be considered for increasing the food production to meet with the demands of the growing population.

CHAPTER 3

Para 3.3.1:

It is mentioned that the considerable part of created potential in major and medium irrigation is not utilised and the backlogs have been accumulating and the gap between potential created and utilised has been increasing from plan to plan.
A statement (Annexure III) showing the creation of potential and its utilisation in various plan periods is enclosed. The various programmes undertaken by the govt. to reduce the gap between irrigation potential and utilisation are as under:
Command area development programme started in 74-75
National water Management Project started in the year 86 with the World Bank assistance.
Training programmes under taken by WALMIS
Organisational and procedural changes

Conjunctive use of surface and ground water
Participatory irrigation management
Formulation of various policies like National Irrigation Management Policy.

Para 3.3.2:
It is indicated that several million hectares of area are water logged and affected by salinity/alkalinity in various irrigation commands.
This aspect was analysed by the Working Group constituted by the Ministry of Water Resources on waterlogging, soil salinity and alkalinity. The Working Group submitted its Report in 1991 and estimated that an area of 2.46 million hectare has been waterlogged in the irrigation commands. The saline and alkali areas in the command areas are estimated to be 3.30 million hectare (Annexure IV). The Ministry of Water Resources alongwith the Central Soil Salinity Research Institute, Karnal, published a Manual on Reclamation and Management of Waterlogged and Salt Affected Areas in Irrigation Commands. This was circulated to all the State Governments for necessary action. Besides, the Ministry has held two workshops in December, 1996 and August, 1998, whose recommendations have been circulated to all the 23 States and 2 UTs. The Ministry is also organising a number of training programmes for field functionaries and farmers on identification and reclamation of water logging areas. States have responded and a number of projects are being referred to the Ministry for administrative approval.

With a view to have better insight and understanding on various issues related with identification and reclamation of waterlogged area, a study of five canal commands has been awarded to WAPCOS. The projects identified for the study are as under:

Ramganga Canal Command		Uttar Pradesh
Chambal Canal Command	-	Madhya Pradesh
Ukai Kakrapar Canal Command	-	Gujarat
Gurgaon Canal Command	-	Haryana
Nagarjunasagar Right Bank Canal Command		Andhra Pradesh

The study will make quick assessment of the waterlogging problem, identify causes and offer suggestions on preventive measures at Command Level.

Annexure I

Project cleared during 1990-92

	(Cost per ha.)
Bewar Feeder Project (Uttar Pradesh)	.25891.00
Mod Of Zaingir Canal (Jammu and Kashmir)	Rs. 11987.00
Bansagar Canal Project(Uttar Pradesh)	Rs. 21993.00
Watrak Reservoir Project(Major)-Gujarat	Rs. 25900.00
Gayanpur Pump Canal(Major)-Uttar Pradesh	Rs. 16893.00
Walan Medium Irrigation Scheme-Gujarat	Rs. 29944.00
Bagri Diversion Scheme Project(Major)-M.P.	Rs. 31734.00
Sindh River Project Phase II (Major)-M.P.	Rs. 31520.00
Bennithora Irrigation Project(Major)-Karnataka	Rs. 36201.00
Kamlas Nala (Sanjay) Project (Medium)-A.P.	Rs. 49595.00
Total	Rs281658.00.

Average cost of Irrigation per ha. = Rs. 28166.00

Annexure-III

Planwise Position of Irrigation Potential Created and Utilised

(Unit: m.ha.)
(Cumulative)

Plan	Potential created					Potential Utilised				
	Major & Medium	Minor			Total	Major & Medium	Minor			Total
		Surface Water	Ground Water	Total			Surface Water	Ground Water	Total	
Pre Plan upto 1951	9.70	6.40	6.50	12.90	22.60	9.70	6.40	6.50	12.90	22.60
I Plan (1951-56)	12.20	6.43	7.63	14.06	26.26	10.78	6.43	7.63	14.06	25.04
II Plan (1956-61)	14.33	6.45	8.30	14.75	27.08	13.05	6.45	8.30	14.75	27.80
III Plan (1961-66)	16.57	6.48	10.52	17.00	33.57	15.17	6.48	10.52	17.00	32.17
Annual Plan (1966-69)	18.10	6.50	12.50	19.00	37.10	16.75	6.50	12.50	19.00	35.75
IV Plan (1969-74)	20 70	7.00	16.50	23.50	44.20	18.69	7.00	16.50	23.00	42.19
V Plan (1974-78)	24.72	7.50	19.80	27.30	52.02	21.16	7.50	19.80	27.30	48.46
Annual Plan (1978-80)	26.61	8.00	22.00	30.00	56.61	22.64	8.00	22.00	30.00	52.64
VI Plan (1980-85)	27.70	9.70	27.82	37.52	62.22	23.57	9.01	26.24	35.25	58.82
VII Plan (1985-90)	29.92	10.99	35.62	46.61	76.53	25.47	9.97	33.15	43.12	68.59
Annual Plan (1990-92)	30 74	11.46	38.89	50.35	81.09	26.32	10.29	36.25	46.54	72.86
End of VIII Plan (Likely 1992-97)	33.82	12.24	45.73	57.97	91.79	29.22	10 81	41.99	52.80	82.02

Thus the net irrigated area is 37 percent of net sown area and 29 percent of total culturable area. As stated earlier, the ultimate potential due to major and medium projects has been assessed as 58.m.ha. of which 60 percent estimated to be developed by 1996-97. Total potential created by 1996-97 (as targeted) is 91.8 m.ha which is 81 percent of earlier assessed ultimate potential of 113 m.ha.

Annexure-IV

Status of Waterlogging Soil Salinity and Alkalinity in India in Irrigation Command

Unit : 000 ha.

Sl. No	State	Waterlogged area	Area Under	
			Salinity	Alkalinity
1.	2.	3.	4.	5.

1.	Andhra Pradesh	266.4	5	22.8
2.	Assam	-	-	-
3.	Bihar	619.7	224.3	-
4.	Gujarat	172.59	911	-
5.	Haryana	249	125.2	72
6.	Himachal Pradesh	0.2	-	-
7.	Jammu & Kashmir	1.5	-	-
8.	Karnataka	24.54	34.23	17.12
9.	Kerala	11.61	-	-
10.	Madhya Pradesh	73.12	-	35.79
11.	Maharashtra	15.35	5.35	-
12.	Orissa	196.26	-	-
13.	Punjab	200	490	-
14.	Rajasthan	179.5	70	-
15.	Tamil Nadu	16.19	48	92.3
16.	Uttar Pradesh	430	1150.80	-
	Total	2455.96	3063.88	240.01
	M.ha.	2.46	3.06	0.24

Source : Report of Working Group on Problem identification in Irrigated Areas with Suggested Remedial Measures – Dec., 1991 (MOWR)

Indian Institute of Public Administration (IIPA): comments on the draft for World Commission on Dams India Country Report

Large Dams in India – A Historical Perspective : R. Rangachari

This paper has brought out that:

1. Large dams have become a subject of controversy and growing international debate.
2. Dams were and are built all over the world to get over the problems of spatial and temporal inefficiencies of water availability and its demand.
3. Purposes are irrigation, water supply power generation, flood mitigation, navigation and many more.
4. India launched a belated action programme the world had gone forward leaving a gap between the industrial nations and poor developing countries.
5. Environmental issues and social issues were non existent upto 1970's.
6. World environment conference of 1972 awakened to bring social, environmental, economic impacts into focus.
7. At that time India was on the learning curve.
8. Rehabilitation package for Sardar Sarowar project had gone much forward in relation to such issues.
9. As development priorities changed and experience accumulated various groups argued that environmental benefits were not being taken into account.
10. Recent decade's proposals are being questioned – even on-going dams are being questioned.
11. Sardar Sarowar dam – the centre of controversy is likened by some as disaster and yet others as most desired.
12. The India case study before WCD will therefore aim at eschewing passion and sentiment but seek to look at the scene objectively in the light of Indian experience and the needs and aspirations of the Indian people wanting to economically uplift them in a hurry.

Observations:

1. The objective of the paper is to bring out clearly the role played by large and medium dams, in the developmental context (irrigation, water supply, hydropower, flood mitigation and thousands of other direct and indirect benefits) in India particularly after partition. This paper (and also all other papers) is written in context of the growing controversy of large and medium dams versus small dams.

2. The paper has brought out salient features of the historical perspective of large and medium dams only in the Indian Context. Number of large and medium dams at the time of partition and as on date are reported (Table 1.1) from CWC publications. Similar information available for minor irrigation (both surface and ground water) is avoided.

3. Paper may be made more comprehensive if similar information on number of small dams tanks, dug wells, shallow wells, deep wells, number of electric pumps, and number of Diesel pumps being used included and compared. The information in the table, given below may be useful:

Number of Dams:

Stage	Large > 15	Medium 15-10	Total (L&M)	Minor SW	GW DW+SW Million
1950	118	133	251	NA	3.86+5.38=9.24
1990 & beyond	2342	1949	4291	145 lakh (1993-94)	10.12+9.3=19.4 2

4 It may be noted that during last 50 years or so, in addition to 4041 L&M dams, about 145 lakh surface water minor irrigation works, mostly diversion works and dams of height less than 10 m. have been developed. In addition, ground water development mostly comprised of 10.16 million well mostly dug wells and shallow wells. Comparatively deep tube-wells is negligible small as compared to DW and SW. More than 2/3[rd] of these wells are energized.

5 Development of dams in India in respect of L&M&Small (including minor SW+GW) need to be compared with the rest of the world. It would be worthwhile, to compare similar figures (as given in table 1.1 above) in context of USA, UK, Canada, Russia, China, Japan, and other countries of the world,. This will give the level of development in India in contrast to the rest of the worlds (Wide spectrum of under developed, developing and developed nations should be considered). For this WCD should provide necessary information to IIPA and MIDS.

6 Table 1.2 shows state wise, information of L&M dams in India. It is brought out that the distribution of the dams is uneven. Reasons for this uneven distribution should be discussed in the context of hydrology, availability of suitable site, varying levels of purposes, e.g., irrigation, hydropower, water supply, flood-mitigation.

7 Similar information on minor irrigation should be discussed. It should be clearly brought out why L&M dams were necessary in contrast to other options. If some of the options were left out, it was obvious that in order to enhance the level of development, and to feed population of the second largest country in the world, quickest options of production were necessary. Water harvesting schemes in the present form were not known 10 years ago. While there are a large number of tanks already built in south India, evaporation losses in these tanks are very high. It is well known that without a backup storage, (System tanks) supply of water from these tanks is not dependable. And the system tanks cannot work without a backup storage. One can estimate how many small tanks or small dams, (height less than 10 Mts.) would be required to connect these dams. Dependability studies on this aspect will clearly bring out the importance of these large and medium dams. A pretext that the data is not available is not acceptable, as it is well known that such data can be generated from CWC basic observation sites, at least for rough estimates.

8 Under table, 1.3 net sown area in India and Pakistan at partition is given. Current information on this aspect is not compared. This information is published every year by Ministry of Water Resources, CWC in Water related Statistics and by Agricultural statistics by Ministry of Agriculture. The table below may be useful in this regard:

Area Under Irrigation (Mha) in India (excluding Pakistan for Col.2):

	At the time of Independence	**At end of (1993-94)**	**Percentage increase in 46 years over 1947 base**
Net Sown Area - NSA (Mha)	116.8	142.1	21.67 %
Net Irrigated Area – NIA (Mha)	28.2	51.45	82.45 %
Percent of NIA to NSA (%)	24.1%	36.21%	

It may be seen that during last 46 years or so, there is a clear increase in net sown area by 22 %. And the net increase in irrigated area is tremendous i.e. 82.45%. It will be shown later that the tremendous jump had been possible due to development of major, medium and minor (SW+GW) going hand in hand. At no stage, minor sector had been neglected.

9 Table 1.4 (Reproduced as Annexure –I at end) shows development of irrigation through plans upto VIII plan. This table suggests that three sectors (major, medium and minor) had been developed hand in hand. While the information on created potential and its utilization's is presented, the information has not been compared in context of the ultimate potential for the country under two sectors (Major+medium and Minor (SW+GW)). Table given below is useful in this regard.

Irrigation Potential (Mha):

	L&M Ultimate (58.5)			Minor (SW+GW) Ultimate (81.4)			Total (L&M + MI) Ultimate(139.90)	
	Created C	Utilised U	% C of U	Created C	Utilised U	% C of U	Created	Utilised
End of VIII Plan 1997	32.70	28.2	86.23%	58.10	52.90	91.05	90.80	81.1
% of Ultimate	55.89%	48.20%		71.37%	64.98%		64.90%	58.00%

It may be seen that while 56% of the L&M potential has been created, corresponding level of development in Minor sector has been developed upto 71%. This means that more work is required to be done in the L&M side as compared to Minor (SW+GW). For the entire irrigation sector 65% of the country's potential has been created and only remaining is 35%. The gap between potential created and potential utilised is also not very large.

10 From the tables given in paras 7 and 8 above, it is evident average intensity of irrigation (all three sectors) had been of the order of 160% and above. (100*90.80/51.49= 176%). This clearly shows that the intensities of irrigation in case of large and medium reservoirs had been much higher. The contribution of the large dams in the area of food production is clearly evident.

11 It is reported that it will not be possible to present authentic details of irrigation systems backed by large dams. Such information on the basis of individual dams is not reported. However, such information for State as a unit is available. In this paper, the role-played by the large dams in context to the country as a whole is relevant. Clearly role played by L&M dams has been brought out in the para 9 above.

12 It is reported (see also table –1.4) that the gap between potential created and utilized is increasing plan by plan. This is not justified. Annexure – I at end (reproduces the information given in Table 1.4) shows gap of potential as a percent of potential created for L&M sector as well as Minor irrigation sector. It may be seen that % gap in L&M sector from first plan to fourth plan had been of the order of 7 to 10% 9not necessarily increasing. The same after fourth plan is more or less uniform at 14%. This increase in gap by 4% after 1994 is because rain-fed and canal irrigation commands were first brought under irrigation backed by stoppages. Less developed rain-fed and non-canal sites were added later. Besides, there is a shift in cropping pattern in Punjab, Haryana, UP. Here major producers of wheat have shifted to sugarcane and paddy. Similar trend is also observed in on minor irrigation site where a gap of 7 to 8 percent is continuing since 1980 onwards. Subsidy on energy required for GW development encouraged farmers to shift to Paddy. Procurement of food grains under PDS is also responsible to some extend for switching over from wheat to Paddy. Introduction of HYV of wheat and paddy also resulted in increased utilization of water which resulted into short supplies to the tail-ender. In Punjab, where warabandi system of rotational watersupply is introduced, a major shift towards GW development (sort of conjunctive use in an un-organized way) has developed. Besides keeping 3 to 4% fallow land is also necessary for HYV crops.

13 Investment details are then provided under Table 1.5. plan-wise expenditure under two (Major+Medium and Minor) sectors are reproduced. It may be seen that total expenditure under Minor irrigation sector is 55% of that of major and Medium. It may be noted that expenditure on Minor sector does not include cost of energy which is highly subsidized for agriculture (GW) sector.

Expenditure (I&CAD & FCD Sector):

At the end of VIII plan (1996-97)	At Actual Prices		At Constant prices	
	Rs Crore	% of Total	Rs Crore	% of Total
L&M	52602	57.21	132390	57.21
Small (Minor)	29168	31.72	73389	31.72
CAD (L&M – mainly)	5418	5.89	13386	5.75
Flood Control	4857	5.28	12222	5.28
Total	91943	100.00	231387	100.00

- This table suggests compounding factor over the years is not adopted and a single compounding factor is applied as an average over 50 years. The conclusions on benefits are thus not valid since it gives an erroneous picture.

It may be noted that total expenditure during 1951-1966 had been only 3177 crores which includes 1232 crores under Minor irrigation. And this was the period when sizeable Major schemes like Bhakra, Gandhisagar, Kota, Hirakhud, Nagajuna sagar, parts of DVC and many other projects were created.

Another point worth mentioning is that for arriving at constant prices, a constant factor has been adopted for all plans. It is clearly evident from the above table (data of the table 1.5 is reproduced here). And this data has been used everywhere in the report by other Authors for their draft on other chapters (from MIDS and IIPA). Clearly the cost data used is erroneous. The present cost of projects created in 50's and 60's is likely to be at least 50 times the actual cost. And these are projects that are responsible for major share of development. Constant prices are to be arrived at on year to year conversion factors based on inflation indices.

14 Total Hydropower potential of the country is 84000 MW out of which it is reported that the potential of small and micro schemes in the country is 10000 MW.

Hydropower Installed Capacity (MW) AT 60% LF:

As on 31/3/1997			
Developed	Under Developed	Yet to be developed	Total
12475 (15%)	5879(7%)	65690(78%)	84044

National Power Policy (1998) has dealt with the desirable Thermal- Hydro ratio and had concluded that it is desirable to achieve a ratio of 60:40.

Hydro-power is the ideal source for peaking This could be discussed in the context of total potential of the country including all sources, renewable, non renewable and non-conventional. The contribution of Non-conventional alone cannot satisfy demand.

15 A rough comparison of resources and corresponding potential is made in Annexure II with Norway, an industrialised nation and world leader in Hydropower. This Annexure suggests the present level of development in India. In contrast to the developed countries.

a) It may be noted that at the rate of 6 hours of pumping in 267 days (both Kharif and Rabi) using 5 kWh pumps, total energy requirements per hectare work out to 8010 units (267*6*5) and at the cost of Rs. 3/- per unit from sources other than hydropower, the cost per hectare works out to Rs. = 24000/-. As hydro energy is subsidized at 0.20 paise per unit, the same cost per hectare from hydro works out to Rs. 1600/- as generation cost of hydropower is of the order of Rs. 20/- paise per hectare. The difference in cost per hectare works out to Rs. 22400/- per year.

b) Looking at the table given below, it may be seen that live capacity created so far has been only 9% of the average annual flow. In contrast this ratio is well above 150%. It may be seen that comparative to the developed world, the country has a long way to go. However, our potential sites are too less. Resources developed are far too less. Any effort in this direction is only a drop in the ocean. The country has to develop all options.

Basin – Wise Scenario on Utilisation

Basins	Av Annual Flow (BCM)	Av Utilisable Flow (BCM)	Live Capacity of Schemes (BCM)	% of Live capacity
Large and medium Basins	1931.18	690.00	173.73	9.00%
Minor Basins	31.00		0.00	0.00
GW		432		
Total	**1961.18**	**1122 (57%)**	**173.73**	**8.85%**

Live Capacity (1996 – 97) (BCM)

Stage	Live Capacity	% of Total
Completed Projects	173.73	45.54%
Under Construction	75.42	19.77%
Under Consideration	132.32	34.69%
Total	381.47	100%

It may also be seen that the ultimate percentage at full level of development is at19% only, as compared to USA's level of 150%. And development of remaining irrigation and hydro potential is crucial for us in the next 40 years or so, until our population stabilizes. As of now, the path of development has.to be pursued by the country.

c) With out a comparison of L&M with Minor sector, the controversy of the options cannot be brought out in true perspective.

d) In contrast, present level of utilisation of SW and GW under Minor irrigation sector is (presented below) suggests that surface water potential is developed at 70% level. However GW is required to developed in future for which massive energy is required.

Present Level of Utilisation SW+GW:

Purpose	Present Utilisation (1997) BCM
Irrigation	501
Domestic	30
Industrial	20
Energy	204
Others	34
Total	605
Surface 70%Ground 30%	

Breakup of Minor Irrigation Schemes (1993 – 94)

	Number (Lakh)	Potential (Mha)
Surface water schemes	5. 80	3.800
Surface Lift Schemes	4.32	1.456
Total Surface water MI	10.12	5.256
Dug Well	81.00	11.900
Shallow Well	52.00	21.600
Deep well	1.85	1.800
Total GW Schemes	134.85	35.300
Total	144.97	40.556

e) Dams are catering to the needs of drinking water supply to many cities including mega cities. Urban population is growing very fast. It is anticipated that in about next 25 years, about 40% of the population will be living in cities.
About 10 years ago, the percentage of the live storage for drinking water supply (first priority as per National Water Policy) was about 5%. Already it is around 10% now. If this trend continues in next 25 years, about 30 to 40% of the live storage will have to be reserved for water supply.

f) The Large &Medium (L&M) dams should also be discussed from the operational aspects showing why dams are essential in Indian context.

- 90% of rainfall occurs in 100 hours of rainy days
- If there were no L&M (and also small) dams, Rabi beyond 10% and Kharif irrigation upto 10% was only possible – Rest was rainfed.

- With just 3.91 % of the storage we are able to meet the challenge of the country.
- Dependability of the flows increases through storage - so much so that potential of Khraif increases by many folds.
- And potential of Rabi and also of summer or pre-kharif matches Kharif. This was not possible in case of rainfed.
- Larger the storage & higher the dam, larger are the irrigation and hydropower benefits. Clearly such benefits are not possible with small dams.
- Even flood moderation is higher if flood cushion is higher.
- It is not understood how small dams are helpful in mitigation of floods when there is no flood cushion storage.
- Records show that all major flood s occur in September end or October beginning in the Indian Rivers. Clearly flood mitigation capacity of the L&M dams is much higher.
- Small dams are silted up very fast. These are to be dredged every year. We may have to include dredging cost of these dams in O&M.
- How many small dams have been designed in the World with flood control as one of the purpose? This can be critically seen by MIDS while projecting alternative options.
- How such moderation can be coordinated particularly in September end when most of the floods occurs in India and this is the time for Rabi Preparation.
- Development of large and small dams had been going hand in hand and this may be unavoidable if demand needs are kept in view.
- Choice of a project option in a basin depends on many factors, not necessarily Engineering alone.

g) Much of the criticism on large dams have been their effectiveness with respect to storage capacity, sediment inflows, flood moderation and conservation, environmental impacts, social impacts, their ability to meet the purposes for which these are designed. In this context, it would be appropriate that how dams in India were and are being designed .

h) With more and more Advancement of Technology in water resources sector, particularly dam design and hydrology, the. design flood, conservation storage, adequacy of the limited data used (particularly sediment data), estimation of optimal crop water requirements, dam safety, cost procedures, and environmental aspects are kept in view. It may be more relevant that these aspects are also dealt with in the chapter under dam adequately.

Paper 2 Laws, Institutions etc. – R. Ramaswamy Iyer

1. The paper deals with Constitutional provisions, Inter State Water Dispute Act, River Board Act, Various Irrigation Acts, Land Acquisition Act, Central Electricity Act, National Human Rights Commission Act, Tribal Self rules, Official Secrets Act. etc. besides Policy Frameworks. Some of the relevant Policy Documents referred to, are, National water policy State Water Polices (TN, Orissa), Various Guide lines issued by CWC, PIM, National Rehabilitation Policy, Policy on Hydro-Power. Planning System, Planning processes, Approval , Implementation, Institutions responsible are then touched upon.

2. In the context of basin planning, paper mentions as :

"National water Policy 1987 does talk about planning a hydrological unit (basin), this is not operationalised. National Commission on Integrated Water Resources Development plan (1999) (NCIWRD) has recommended Organizations of a Representative kind). This report is yet to be accepted."

It is reported that a truly integrated, holistic planning for a basin or a sub-basin would involve an inter-disciplinary planning for the basin or sub-basin marrying land-use and water-use, harmonizing diverse water uses on the demand side and integrating all development from local rainwater-harvesting and micro watershed development to mega projects (and surface water and groundwater) on supply side, while at the same time fully internalizing environmental, ecological, human and social concerns, and fully associating the people concerned (Stakeholders) at all stages. That kind of basin planning has not really been seriously attempted in India.

Paper may suggest directions on dealing with policy, administrative and technological aspects for integration of surface and ground water.

Policy Planning in India had been dynamic and had been incorporating changes from time to time. Provisions of NWP (1987) and recommendations of the NCIWRD are a step in this direction. Associating peoples involvement in R&R, WUA and PIM, right to information under national policy The paper concludes that:

Inter-Disciplinary Approach is not adopted in Project Planning by the States or Approval Criteria by CWC. Transformation of CWC on these lines is recommended by NCIWRD. *(This is a step towards integrated approach).*

- There is a need to internalize EIA in the planning process. Only this can lead to true basin planning. *(Already done – changes required need to be elaborated.)*
- Irrigation is dominant in various multipurpose schemes, other uses get low priority. This may lead to conflicts. Within the ambit of project, multiple options at various stages are to be examined.
- *Comment is towards Total Systems Approach which will be obtained with the move towards basin planning approach.*
- Alternatives to given dam project can also mean, local water harvesting/ watershed development, getting more capacities, adding capacity to the project, obviating need for supply side solutions, increased efficiency of water resource-use, resource conservation etc.

(It was demonstrated in the comments on the previous paper of Mr. R. Rangachari that there is a need to consider simultaneously all options.
The policy of coordinated development of all options including large and medium dams, minor irrigation sector (including ground water) is to be favoured.However, the effort had been in an isolated manner. Options were being developed independent of other options. The situation is likely to change with Basin approach model.

(Most of the concepts are not outside the framework of Basin planning advocated by National Water Policy-1987 and steady progress is to achieve these concepts).

Paper No.5-Environmental and Social Impacts of Large Dams: The Indian Experience (Summary Report) by Prof. Shekhar Singh et al of IIPA, New Delhi.

1. It is to be noted that the paper prepared by Shri. Sekhar Singh et al, of IIPA reflects only negative impacts leaving aside all positive impacts on large dams. Most of the relevant publications containing useful data and information on the topic published by MOWR, CWC, CEA, CBIP, IWRS, NIH, CWPRS and the Institution of Engineers (India) have been over-looked while preparing the draft paper . On the other hand, most of the publications referred to in the paper have either been written by non-professionals or anti-dam agencies which alone have been seemingly utilised.

2. Water Resources Day (WRD) functions are held throughout the country since 1987 for creating balanced public awareness and theme papers published for the water resources day are widely circulated. Most of the issues covered in the referred paper have been dealt within the WRD theme papers published by the Indian Water Resources Society and also in the proceedings of the Bi-annual National Water Conventions organised by National Water Development Agency, sponsored by Ministry of Water Resources . Such publications are available in various libraries.

3. It is relevant to note that the theme for the IV National Water Convention held at Thiruvananthapuram in June, 1993 was, 'Water and Environment'. Similarly, in the V and VI National Water Conventions held at Faridabad and Bhopal, respectively, the performance

overview of water resources projects and need for public awareness in water management were discussed and published in detail. Even such prominent publications have not been used in the study at IIPA, New Delhi.

i) Many case studies and related aspects of environmental and social impacts of water resources projects are available in some of the publications given as Annexure. This brings out a critical review of environmental impacts of Indian river valley projects. The authors may please refer all such relevant material while preparing the crucial paper on, "Environmental and Social Impacts of Large Dams", to make it more meaningful as World Commission on Dams is looking into the overall impacts and not the negative impacts exclusively, as has been reported.

4. It is a matter of concern that the Representatives of most important stake holders like, Industries, Municipalities farmers, , etc. were not invited in any of the two stake holders meetings organised at Chennai and New Delhi on 1st & 3rd March, 2000. (*There was no representative from the Ministries of Agriculture, Industry, Urban Development, Rural Development, Power, Environment and Forests, Health, etc. while discussing the response of the stakeholders on the crucial subject of large dams. Most of the participants in the two meetings belonged to the fields of journalism, anti-dam activists, non-professional NGOs, authors of the papers besides the few participants from the Ministry of Water Resources and select Academic Institutions.*)

5. Only the summary report of the paper has been received wherein only the negative environmental and social impacts of large dams have been blown up while their tremendous positive environmental and social impacts are totally omitted. Even in the tabular representation of the stated possible environmental impacts (Annexure 1.I, page 81) and possible social impacts (Annexure 1.II, page 82 & 83); not a single out of the manifold beneficial environmental and social impacts of large dams has been mentioned.

6. Even though on page 2, the authors have agreed that the dams have both positive and negative impacts, their statement, "*It is unlikely to find intended negative impacts, though positive impacts can be both intended and unintended*" makes it obvious that the paper is meant only to bias the reader.

7. On page 6 of the paper, while total reliance has been laid on the figures given by the NGOs especially regarding the displaced persons, submerged forests or the effective command; on the other hand, the government figures have been stated to be unreliable inferring that such departments interpret and present the data to promote their own interests best. It is quite clear that the anti-dam activists and NGOs, who have been reporting exaggerated figures of PAPs and submerged forests, have been supported in the paper while making no efforts for reconciling the figures due to varying definitions and time frames in the official documents.

8. The statement on page 6 of the summary report, "Wherever irreconcilable discrepancies emerged, the case study has tended to take the more conservative estimate in order to maintain the credibility of the data base", shows that negative environmental and social impacts have been added manifold on the basis of doubtful figures provided by the environmental activists and NGOs. Most of the figures relied in the study are not available in the summary report; nevertheless, distortion of some figures can be judged from the enclosed observations regarding the figures of silting of reservoirs.

9. The study clearly indicates that there was a paucity of data and the screening of dams by the authors cannot be claimed as a scientific sample. According to them, a letter was sent to 700 NGOs and concerned citizens, alongwith the outline of case studies. It is desired that the stated outline of the case study and the list of NGOs to whom request was sent is critically examined to know how many project authorities, professionals and water resources experts were involved in the process of this study. In the present form, the paper is clearly biased and reflects the viewpoints of only anti-dam environmental activists.

10. It is necessary that case studies of a few completed large dams should have been covered in the paper to capture experience and lessons learnt from large dams in India.

11. The achievement of water resources development of last 50 years in India have been totally neglected in the paper. The beneficial environmental and social impacts of the Bhakra Dam, Hirakud Dam, Ukai Dam, Nagarjuna Sagar Dam, Pong Dam, Ramganga Dam and several other major dams are available in the numerous publications cited above; which should have been covered in the paper. Most of these projects were planned and constructed before the adoption of the procedures of appraisal and monitoring of environmental and social impacts of river valley projects.

12. The tremendous environmental and social benefits of Vrindavan, Ukai & Ramganga Gardens, Periyar wildlife resorts, Kalindi Kunj, as by-products of large dams and improved environmental and social conditions in Rajasthan, Punjab, Haryana and western UP after the construction of large dams have been totally left out in the paper.

13. On the other hand, the three on-going projects namely, the Tehri, Indira Sagar and Sardar Sarovar Projects have been specifically looked in detail in the paper without associating their project authorities but laying much reliance on the activists struggling against these three projects. Considering the above and the comment which follows in succeding pages, the entire paper may have to be recast. Perhaps an independent Expert body with ample expertise in water resources and environment management can review the report of IIPA which may result in a balanced view on the subject aimed at by WCD.

Even though the entire paper highlights only the exaggerated and assumed negative environmental and social impacts, nevertheless, certain portions of the paper are commented in the enclosed observations

Environmental Impacts

Page 9 :

"The main impact that has been observed before construction has been the premature cutting of trees in areas that are to be submerged or otherwise deforested. Often the trees are felled much in advance of the actual submergence or need. Consequently, the area is denied the ecological functions of trees even before this becomes inevitable.
Though, occasionally, especially in the last few yeas, there has been a stipulation that trees are not to be cut below 2 to 4 m of FRL, there still appears to be no stipulation that the trees should not be cut prematurely. There have been complaints regarding various projects, including Tehri, Narmada Sagar and Sardar Sarovar that tree felling was done much before it was necessitated. This is a totally preventable adverse impact of dams."

Observation

The project authorities do not encourage cutting of trees prematurely for the reason that every tree cut has to be replaced by on an average, three to five trees as compensatory afforestation. However, people in the submergence area may resort to this, essentially because of thir tradional needs for firewood, which is possible to be overcome aith provision of alternate energy. In fact, hydropower and supply of gas for cooking are aimed at so that the felling of trees are avoided. Environmental education of general public may be of help in this direction. . It is possible to exercise full control on tree cutting by people at large 'even without the Project situation' is then feasible.

Page 10:

"Most recent projects stipulate that fuel wood or other types of fuel will be supplied to the workers. In recent years the MOEF, for almost all the projects that it has cleared has also stipulated this. Earlier projects, however, were silent on this issue. Even where such alternatives were planned for (for example in Kollimalai Project or Rajghat Project), no indication was found on whether these alternatives were actually provided. In at least one instance it was stated that head-loading occurred in spite of there being a provision for alternative fuel in the design of the project (Subernarekha). It was also recorded that labourers resorted to tree felling for firewood and to sustain their livelihood during the lean season when construction activity was at a standstill (CWC 1991)"

Observation

In all the new projects, contractors are being asked to ensure supply of alternate fuel for the domestic needs of work force. This is also being monitored by the Project Level/National Level EMCs constituted to oversee the implementation of environmental safeguards. During the last ten years of such monitoring exercise, no case of violation of this stipulation was ever reported. Supply of fuel-wood for labourers' use to be invariably a condition to be fulfilled by Project Authority. This condition is there even in projects like 'Sone Canal Modernisation Project' where only local labourers are to be employed for canal repairs.

However, Subernarekha case has been quoted in the referred paper out of context. On an allegation by Forest Officials, remedial measures were taken by project authorities at the instance of National Level Environmental Monitoring Committee. An isolated case need not cause so much concern and should not be generalised.

Page 10

"After the construction of the dam, where forests and other vegetation are submerged under the reservoir, the pressures on the remaining forests, mostly in the catchments, go up significantly. Also, the construction of roads and other infrastructure and the enhanced activities in the area put an additional strain on the catchment"

Observation

Roads and other infrastructure are essential for project construction and the submerged forest for such construction is accounted for in the compensatory afforestation. The lush green growth of trees has been experimented around the periphery of reservoirs of most of the major dams.

Page 10:

"The impacts of mining/quarrying for construction materials were not assessed as a prt of planning of any of the projects studied. In at least one recent project, Indira (Narmada) Sagar, the project authorities have been asked not to allow any mining of quarrying for excavating construction material for the dam, in the catchment."

Observation:

Assessment of such impacts is included in the appraisal of water resources projects. Restoration of construction sites is a common safeguard measure in all the river valley projects. Such aspects are usually taken care of during construction of projects.

Page 12

"In fact, a study by KG Tejwani, quoted by Verghese (Verghese ibid) suggests that if there was a pre-planned 25% reduction in sediment load it would allow the reduction in dam height, without reducing the benefits, thereby saving on construction and environment costs and avoiding some of the displacement".

Observation:

In the early stages practically no data on silt load was available and based on the scanty data available, assumptions based on thumb rules were made for the design purposes. In many cases, these assumptions have proved correct while in some reservoirs siltation rates were observed high (or even low). All the major projects which were designed with deliberate space allocation for sedimentation as per internationally accepted principles and standards are functioning well and meeting their objectives.

The data in table 2(a) has many discrepancies and in a number of reservoirs the assumed & observed siltation rate are erroneous. The correct siltation rates of some of the reservoirs are given below :

1. Nizamsagar

As per information available in CWC the assumed silting rate was 2.38 ha.m/100 sq.km./year against the reported assumed rate 0.29. The observed rate of silting is 3.78 ha.m/100 sq.km./year against the adopted rate 6.65 in the report. Observed rate as a percentage of assumed rate as per CWC is 158.82 against 2293.10.

2. Maithon

As per information available in CWC the assumed silting rate was 9.05 ha.m/100 sq.km./year against the adopted rate 1.62. The observed rate of silting is 10.75 ha.m/100 sq.km./year against the adopted rate 13.10. Observed rate as a percentage of assumed rate as per CWC is 118.78 against reported rate 808.64.

3. Panchet

As per information available in CWC the assumed silting rate was 6.67 ha.m/100 sq.km./year against the adopted rate 2.47. The observed rate of silting is 5.12 ha.m/100 sq.km./year against the adopted rate 10.00. Observed rate as a percentage of assumed rate as in CWC is 76.76 against the reported rate 404.86.

4. Shivajisagar(Koyana)

As per information available in CWC the observed rate of silting was 8.10 ha.m/100 sq.km./year against the adopted rate 15.24. The observed rate as a percentage of assumed rate as per CWC is 121.44 against the reported rate 228.19.

5. Beas Unit II

As per information available in CWC the assumed silting rate was 25.29 ha.m/100 sq.km./year against the assumed rate 4.29 . The observed rate of silting is 21.11 ha.m/100 sq.km./year against the reported rate 14.30 . Observed rate as a percentage of assumed rate is 83.43 against reported 333.33 .

The data for reservoir siltation for 46 reservoirs was published by CWC in a compandium on silting of reservoirs in India (Jan.1991). However at present the data of siltation of reservoirs in respect of 139 reservoirs is available in CWC which is being complied & likely to be published shortly.

The silt rate in some reservoirs where variations are large and wrong conclusions have been drawn, in the comparative statement

Comparative Statement of Sedimentation data of Selected Reservoirs

Sl No	Name of reservoir	year of impounding	Annual Assumed rate of silting (Ha. m./100Sq.km./Year)		Observed rate of silting (Ha.m./100Sq.km./Year		Observed rate as percentage of assumed rate	
			As per the Paper of IIPA (Draft)	As per data available in CWC	As per the Paper of IIPA (Draft)	As per capacity survey data available in CWC	As per the Paper of IIPA (Draft)	As per information available in CWC
1	Nizamsagar	1930	0.29	2.38	6.65	3.78(3 surveys)	2293.10	158.82
2	Maithon	1955	1.62	9.05	13.10	10.75(6 surveys)	808.64	118.78
3	Panchet	1956	2.47	6.67	10.00	5.12(6 surveys)	404.86	76.76
4.	Shivajisagar (Koyna)	1961	6.67	6.67	15.24	8.10(1 survey)	228.19	121.44
5.	Beas Unit-II	1974	4.29	25.29	14.30	21.11(14 survey)	333.33	83.47

Page 13

"As the justification for a dam is partly based on calculating the maximum amount of water available in the river, once a project is approved, there is often a ban on schemes which divert water from the river upstream of the dam. This results in upstream areas being denied the water they require, with adverse impacts both on the environment and on the well-being of people".

Observation
This is an incorrect statement. No such ban is put on upstream projects.In fact, projects are planned for use of water in various reaches of the river as per basin plans. There are several examples that where waters have been diverted in upstream projects later on after construction of downstream projects.

Page 14

"In fact, as CAT involves extensive afforestation, for which pits are dug, the actual flow of silt into the river increases rather than decreases while CAT work is ongoing. This means that more erosion takes place before CAT is completed (and allowed to stabilise for at least two years), the silting of the reservoir is even faster in the initial years than it would have been without CAT (NCA env)."
Observation:
It is correct that siltation rates in the initial years of project construction is increased due to construction works. In fact treatment of catchment areas is necessitated on account of various objectives and CAT should be undertaken as national priority project rather then tagging in the cost of river valley projects.

Page 14: Treatment of inadequate area:

"The distinction between "directly" and indirectly" draining catchments or watersheds remains an illogical one from the point of view of the impact of the catchment. After all, by definition a catchment is an area from which water and silt flow into the dam, either directly into the reservoir or therefore, no reason to neglect one and focus on the other. Besides, the "indirectly" draining catchment is invariably much larger than the "directly" draining one and, as such, has the greater impact".
Observation:
The Engineering philosophy on catchment gives due consideration to intercepted catchment and combined catchment when dealing with points along a river or stream on which dams are conceived. The run-off where a large catchment has interceptions due to upstream works is different from one where there is no intercetion. While for Up-stream sites ,the catchments are limited , progressively, the combined catchment becomes very very large e.g when the river system joins sea, the whole basin will be a vast geographical area. If such a criteria as advocated is used, then in case of Farakka barrage, the catchment of entire Ganga basin covering substantial part of the country would have to be to be treatedat Project cost!
The treatment of catchment areas are also taken up from general schemes like soil conservation, watershed etc. of other departments.
Hence, the policy change for treating indirect catchments at the cost of water resources project is unrealistic.

Page 14:

"When a free flowing river meets the relatively static reservoir, there is a build-up of back-pressure and a resultant back-water. This can damage of destroy the upstream ecology and damage property".

Observation:
Reservoir does not remain static. Some water is released for downstream uses. Even while filling up, FRL is attained at the end of monsoon season and in the meantime some capacity is left unfilled to absorb unanticipated floods. Since the water level is fluctuating over the year, damage to ecology is not pronounced.

Page 15:

"The results of these studies indicate that there are significant adverse impacts on the aquatic ecosystems and biodiversity at and around the site of the construction. ---- The blocking of a river and the formation of a lake significantly alters the ecological conditions of the river, adversely impacting on the species and ecosystem. There are changes in pressure, temperature, oxygen levels and even in the chemical and physical characteristics of the water".
Observation:
The kind of studies made for such comments should be briefed before offering such comments. The EIA study and environmental appraisal conducted as per broad guidelines provided by MOEF. CWC has also published 'Detailed Guidelines for Sustainable Water Resources Development(1992)'.

Page 16:

"In some case, through the introduction of adaptable species, the economic value of the over-all catch can be maintained or even improved. However, in other cases, this does not work. In both cases, the species mix of fish and their natural diversity is adversely affected".
Observation:
Quantifying loss of fish bio diversity may not be feasible. Costs of enhancing commercial fisheries after construction of dams may also be estimated. In most of the projects, pisciculture is developed and there is substantial income from fish production. New varieties of fish are produced in many reservoirs. In case of Ukai Dam in Gujarat, the benefits on account of increased fish production has substantially recovered the cost of Project..

Page 17:

"Data were available regarding forest submergence for 53 dams. On the basis of these, the average forest area submerged per dam works out to approximately 7000 ha. Therefore, in the 1877 dams to be built between 1980 and 2000 would be likely to submerge 13,13,900 ha (roughly 1.3 million ha) of forests."
Observation:
The average forest submergence has been found to be 2,400 ha. per project for 116 projects of which forest submergence details are readily available in CWC.
The stated figure of forest area submergence of 7000 ha. in each dam project is exaggerated . Further the average forest submergence for the 53 dams constructed in earlier plans may be high due to pristine nature of locations obtained around that period. Applying the same rate for the ongoing / future 1877 dams would be unrealistic and totally distorts the correct situation. Compensatory afforestation is a necessary condition in each of the river valley project.

Page 18:

"Apart from the forests, the reservoir and the dam also affect other eco-systems and various fauna and flora species. Unfortunately, till recently there was little effort to assess the impact on flora and fauna and on non forest ecosystems"
Observation:
This is again a general statement. Specific cases may be quoted where special attention is needed. It may not be possible to make such an assessment for all sizes of river valley projects.

Page 18:

"Also there has been a stress on 'valuable' species, which often means the more prominent or visible species. However some of the less visible species might actually be even more important to conserve. There is also a tendency to focus only on endangered species. Being concerned only about endangered species results in other species also becoming, over time, endangered. Besides, the endangered status is usually applied to species that are nationally or globally endangered. If a proper survey is not carried out it can never be determined which of them were locally endangered and therefore, requiring protection"

Observation:
By making a general statement this aspect cannot be taken care of. If any survey has been done for valuable species, the same can always be taken care of.

Page 20

"The impacts on rim stability can not be prevented but, in some cases can be minimized if proper measures are taken"
Observation:
The rim stability is checked wherever required.

Page 20

"For reservoirs in the tropical regions of the world, especially those that are below 1000 m elevation, there is a significant threat of vector breeding"
Observation:
Experience over the last 20 years shows that malaria has not assumed epidemic proportions in India , as was the case earlier. There had also not been any report of malaria as epidemic around any reservoir constructed in the country. This clearly shows that increase in reservoirs in the country has not contributed in any way for increase in vector breeding.

Page 21

"However, though the benefits of the anticipated increase in agricultural productivity are taken as a benefit of dams, the resultant costs of pesticides and fertilizers on the environment are very rarely computed or even studied"
Observation:
On one side it is said that the increase in food production is due to fertiliser and on otherside it is denounced. There should be conformity in the report.

Page 23: Para3

"Though-RIS cannot be prevented, the damage it causes can be minimised by strengthening all dam structures and also by strengthening other structures and buildings, old or new, in the region. This has a cost which should be assessed as a part of the project cost , but rarely is."
Observation:
Reservoirs induce seismicity is still a hypothesis yet to be validated beyond questioning. Some researchers are trying to establish that there could be a likelihood for this phenomenon, from observations available. Some other Researchers dispute this claim. Thus, it is still being researched.
Dams are designed to withstand seismic accelarations, determined as appropriate for tectonic activities from various seismogenic sources and these parameters are considerably larger in comparison to those applicable for ground-shaking due to RIS. Various Researchers on RIS have no difficulty to conclude that RIS cannot exceed the tectonic levels and a structure designed to withstand 'the worst case scenario of tectonic earthquake' is far more adequate to withstand RIS. It has been

argued that RIS causes induced activities and damages in areas surrounding reservoirs though the dam itself may not suffer any damage because of the design precautions. Granting the RIS though not accepting, the RIS quakes are smaller in magnitude and in a way causes a preparedness and readiness of the people in the region to face events of ground shaking of smaller levels. The awakening and necessary precautions in strengthening their structure besides preparedness to earthquake causes much less damages when the tectonic earthquake of a larger intensity occurs. The people are in 'a better preparedness' situation. The suggestions for bearing the cost of strengthening the buildings and dwelling units not designed to withstand earthquakes at Project Cost could be a point that deserves merit

Page 23 to 25

Observation:

The project wise data reproduced on page-25 contains, more or less same project names but figures vary widely in respect of water logged area. Therefore the veracity of figures of both the sources appears doubtful. Even as per this, the waterlogged area is about 2% of the net irrigated area in the country. This has already received attention and remedial measures are being taken. There is no reference of remedial measures being taken in the report.

The comments on waterlogged area given in respect of MIDS work by CWC with actual data will be useful to recast the portion of the chapter by IIPA.

Page 27 to32

Observations:

The construction of dams ensure regulated minimum flow in downstream which improves ecology & environment downstream.

Dam Break Analysis is being carried out for sensitive projects wherever considered necessary.

A Separate Dam Safety Organisation in the Designs & Research Wing of CWC looks after Dam Safety aspects of existing dams . This is an ongoing process and several States have also established their own Dam Safety Cells / Organisation to look after issues arising out of regular review exercise undertaken in a systematic manner. Based on studies, as appropriate, remedial measures are initiated if safety aspects are suspect, wherever necessary.

Annexure

i. Environmental Impact of Water Resources Development, published by M/s Tata McGraw Hill Publishing Co. Pvt. Ltd., June 1993, Reprinted in 1995.

ii. Hydropower and River Valley Development - Environment Management Case studies and Policy Issues, published by M/s Oxford & IBH Publishing Co. Pvt. Ltd., Dec. 1999.

iii. CBIP Publication No. P-248, Environmental Impact Assessment Studies (case studies) (1995).

iv. Proceedings of National Seminar on Environmental Management of Water Resources and Power Projects, 6-8 Sept. 1995, CBIP, Indore,

v. Symposium on 'Large Dams Vs Small Dams – Socio Environmental and Techno-Economic Assessment', CBIP, New Delhi, Dec.91,

vi. Proceedings of National Seminar on Environmental Management in Hydroelectric Projects', 11-12 Nov.99 held at India International Centre, Institute for Resource Management and Economic Development, New Delhi.

vii. Central Water Commission, 'Guidelines for Sustainable Water Resources Development and Management' New Delhi, 1992.

viii. Proceedings of National Seminar on Large Reservoirs – Environment Loss or Gain ?, 5-8 Feb.92, Indian Water Resources Society, Nagpur.

ix. River Valley Projects Development in India: A Critical Review of Environmental Impacts", R.S.Goel and. Kamta Prasad , Published in National Seminar on 'Environmental Management in Hydro-Electric Projects 11-12 November 1999.

Brief of the speech delivered by Shri Z. Hasan, Secretary to Government of India, Ministry of Water Resources

The speech was delivered at the Inagural Session of the Stakeholders meeting on "Large dams - the India Country study" sponsored by World Commission on Dams & held in IIPA on 3rd March, 2000 at New Delhi.

Introducing himself as an Engineer having contributed in various capacities in Central Water Commission for the planning & design of dams and reservoirs in the country, Shri Z. Hasan , Secretary, Ministry of Water Resources in Government of India pointed out that if CWC was blamed for pushing large dams in the country as mentioned in the draft report in the India Country Study for WCD, then he too was responsible in pushing the large dam's cause in the past!

Shri Z. Hasan focussed attention on the countries that are going to be affected from a report by World Commission on Dams. **(W.C.D)**. WCD has been constituted at this juncture when one obtains different scenarios with regard to Dams in respect of different countries, developed, developing as well as under-developed . As an example, some cases of developed countries were indicated, as detailed below:

In U.S.A., just the two dams, Hoover and Grand Canyon dams built over 50 to 60 years ago, were planned and constructed to store three times the average annual flow of Coloroda river. The initial filling itself took 3 to 4 years.

Recalling his visit to France in 1984. Shri Hasan indicated that France had exploited all its hydro power resources before turning to nuclear power as well as fossil as early as in eighties. In fact the order in which they tried to undertake power development in their country was hydro-power followed by fossil and nuclear power.

In respect of Egypt which is a developing country, the Great Aswan dam was built so as to store three times the average annual flows of Nile river.

In Europe, the precipitation is fairly uniform both temporaly as well as spatially. Most of their dams are meant essentially for hydro-power and they were completed long back.

Contrary to the above, in tropical countries the rainfall occurs in monsoon and for a limited period , that too for a few hours as storms. The intense rainfall in a few hours causes floods and water is lost into sea un-utilised. This a collasal wastage of a precious good. In India, the total live storage of all the dams is less than 10% average annual flow of the river.

It is thus very necessary that large storages are created in a country like ours. The water available during monsoon can then be utilised during non-monsoon or dry periods for various usages.

It is the developing countries as well as the under developed countries which will be affected gravely by any of the adverse recommendations of World Commission on Dams, as they have not yet constructed the required number of dams for storage purposes. These are essential and barest needs for the sustenance of the Society. It is particularly so in India, Nepal and Bhutan where a large number of available storage sites are yet to be exploited. And these are the countries that are going to be mostly affected, by the Report of WCD.

Starting with a meagre development at the time of independence, India had been making steady progress with regard to Water Resource Development in the past five decades. Out of 140 million ha of cultivated area that can be developed, we have so far developed irrigation in about 50 M. ha. Similarly, out of 84,000 MW power potential at 60% Load Factor, we have so far developed 22000 MW only. We require an installation of about 140,000 MW for this load factor and energy capability. Though remarkable, it is far behind compared to overall potential. It is just 15% of potential as all of us are aware , power requirements are going up and up and load shedding is a constant feature in all the States, proving increasing gap in demand and supply.

Referring to a report that he came across recently, he pointed out that our oil import bill has shot upto 13 billion US \$. This is equal to about Rs. 55,000 crores per annum! This is a big drain on the exchequer, when we see that we are wasting water into sea without exploiting it to the last drop for our welfare. Hydro-power is replenishable, non-polluting and environment-friendly. Our population has risen from 35 Crores at the time of independence to 100 Crores now! The population of mega-cities is exploding ! There is a definite and irreversible trend of Rural to Urban migration. Delhi had a population of about 10 lakhs in 50's and has more than one crore population, now. The biggest problem we face is as to how we can meet the growing requirements for the ever increasing population.

How are we meeting the requirements for mega-cities? The drinking water supplied for Delhi is met from Bhakhra reservoir to the tune of 200MGD(400 cusecs); another 100MGD(200 cusecs) comes from Ramganga dam in U.P. The requirements of Delhi is over 1200 cusecs and Yamuna could provide only 600 cusecs, while another 600 cusecs are coming from outside Yamuna basin i.e. from Satluj and Ganga. (Delhi's supply from ground water is hardly 10%). Groundwater resources may serve various rural requirements but not for urban water supply for megacities, beyond 5 to 10%. It would not have been possible to meet Delhi's requirements had Bhakra and Ramganga not been constructed. This is a typical problem faced by all mega-cities.

Why we need a dam?

The monsoon flows due to intense rainfalls in the few months in various parts of the country, concentrate for a few days causing floods and damages. In India we call live storages for water stored behind dams whereas in USA they call conservation storages for waters retained behind these structures. This is a more precise definition. Dams are needed to store or conserve water to even out the supply & demand.

Why large dams?

Let us consider an example of building a 1000 cubic Meter capacity by ponding. We can have ten 10 meter high dams to submerge on an average 100sq.m area but if we can store by building a 100 meter high dam, the submergence will be 10 sq.meter only. Large dams thus, cause considerably less submergence for storing water, besides yielding more power generation. And submergence is the main problem for which we all are concerned.

Power is produced because of the head of water apart from quantity of water. More the head, more the power. Thus, high dams and large storages behind them dams are required to meet our enormous and growing energy demands. We also need energy to our pump-sets for irrigation. In India , about 27% of electricity is used in agriculture. If we have to sustain self sufficiency in agricultural products and avoid imports or starvation due to drought, we have to continue building storages.

It is acknowledged that we must ensure better deal for project affected persons (PAPs), especially in submergence areas. We should ensure that least possible damage is caused to the affected people and environment at large. We are moving in this direction and would try to ensure that the PAPs are better off with the project construction.

In conclusion, Mr.Hasan urged the World Commission on Dams to consider all the aspects in a balanced manner while making their recommendations. This is specially so in respect of developing and underdeveloped countries where the resource harnessing is still in progress. We have to think more on how best to construct Dams keeping in view all environmental concerns rather than resorting to a 'No Dam approach'.

7.3. Review Comments

7.3.1. Comments from Reviewer Dr (Ms) Armaity S. Desai on the World Commission on Dams – India Country Study.

Introduction

The World Commission on Dams (WCD) has the mandate to learn from the experience of dams (large and medium) around the world. India is one of the countries included in the study. The assignment to conduct the review of the Indian experience and the lessons learnt therefrom was entrusted to the Madras Institute of Development Studies (MIDS), Chennai, and the Indian Institute of Public Administration (New Delhi). The papers generated, by these two public organisations, were distributed to various stakeholders and meetings were arranged for discussion at Chennai on March 1st and Delhi on March 3rd. There was better attendance from the Government of India at the meeting in New Delhi than in Chennai where their absence was keenly felt by the stakeholders.
The objectives of the India country study were to:

- Review the contribution of large dams to irrigation and food production, power, flood management and water supply.
- Review policy, legal and institutional framework for assessment of options in water and energy resources development and management.
- Review India's experience in assessment and mitigation of economic, social and environmental impacts and how current practices are informed by lessons from the past and emerging social and environmental concerns.
- Derive key lessons emerging from India's experience with planning and implementation of large dams to guide future water and energy development programmes.

The observations in this note are based on the papers circulated for these meetings, the discussion that took place at the meeting of the stakeholders and the Executive Summary of the papers which had been circulated.
The objectives of the India country study were the framework for the papers and the meetings of the stakeholders. The discussions and the submissions of the written comments showed considerable polarisation between the governmental and non-governmental stakeholders with both differing perspectives and interpretations. The need to open up such a dialogue became very evident and if WCD has succeeded in at least starting such a dialogue, a very useful purpose would have been served. In a large country like India, where planners and decision-makers appear to be remote and inaccessible, not only particularly to those affected by displacement but even to civil society generally, the commencement of such a dialogue was very essential. It would be pertinent if this dialogue could continue on the past experience of large dams and the lessons learnt, so that, these could feed into the future. There is especially a need for detailed longitudinal follow-up studies to be undertaken over a period of time to throw up the required data as we face many gaps in information.

The following review will cover the objectives, not sequentially, but through the prism of the framework of this note which will cover:

a) Basic assumptions underpinning this reviewer's framework in the note.
b) The expected approach to development derived from the above framework.
c) The specific areas of concern which have emerged with respect to choices
d) Areas of disagreement which emerged
e) Issues which must be addressed
f) Some current realities
g) Areas which need greater stress, but have not received adequate attention.

Basic Assumptions Underpinning the Reviewer's Framework in the Note

To approach a difficult task which is to learn from the country experience on the construction of dams, it is very necessary to have some framework within which one can determine the value of the experience. Hence, it is necessary to state the basic assumptions, that is, the values/rules/norms which one takes as accepted and which provide the screen through which the experience can be viewed emerging from the papers and the discussions. These are:

a) The protection of human rights
b) Equality and social justice to inform all social relationships and decisions based on our Constitutional mandate.

The protection and conservation of the environment.

The nature of development, the path to achieve the fulfilment of the promises to the people to reduce and eradicate poverty and to assure the basic minimum needs and services to the population of the country, within the context of sustainable development in a democratic society and a pluralistic social order.

The protection of human rights is embodied in several articles of the Constitution including the basic right to life and the principle of equality regardless of caste, class and gender as well as age. It assumes protection for the marginalised sections of society including the Scheduled Castes and Tribes. To operationalise the Directive Principles of State Policy in the Constitution, as also the specific articles in the Constitution laid down by our farseeing constitutional framers, the Government of India has set up the Human Rights Commission, the Women's Commission, and earlier on the Scheduled Castes and Tribes Commission and the Minorities Commission. Both human rights and environment is the issue of the nature of development which respects the rights of people and the protection of the environment to preserve it for future generations, with the principle of equity and social justice and, especially, distributive justice in the gains derived from development. Hence, the concern in development is who owns and who benefits in the process of the path of development which is selected, who determines what is in the "public interest" for whom, and how. The public instruments for decision making became significant and especially the role of civil society in developing institutions which mediate between the people and the government. A healthy democracy requires a vigilant civil society and a civil society can only emerge in a democratic social structure. In a pluralistic social structure as India, a vibrant democracy and a vigilant civil society take on added significance.

The Expected Approach to Development Derived From the Above Framework

The above framework enables us to determine the approach to development, and especially the choice of technological development, which we may seek as well as the role of people in development. Some of the following approaches, which were discussed, assume significance.

a) The choice of technology has to be user friendly.

b) It should be low cost delivery to impact on the largest number and, hence, it should be as less capital intensive as possible.
c) It should assure equity in terms of distribution of the gains of development.
d) It should have the affected persons and user participation built into each stage from planning to policy, design, decision making, implementation, monitoring and evaluation.
e) It should be locality specific taking into consideration the local needs, options available, cost-benefit, and viability, especially in terms of the social and environmental costs which are not only to be calculated in economic terms.

The Specific Concerns which Emerge Regarding Choices

The areas that emerge in our consideration of the choices we must make, in a development framework, which is informed by the above assumptions and approach to development, are:

a) The social and environmental concerns, that is, the effects of the choices we make and the best means of minimising possible negative impacts.
b) The choice of technological development and its likely impact on the above.
c) The economic and financial costs and their bearing on the carrying capacity of the country as also the users/beneficiaries.
d) The criteria and guidelines and especially the laws and governance to ensure that the decisions taken are implemented and, in some cases, even became justiciable such as those related to the rights of those likely to be affected by development dimensions or the environment.
e) The process of participation by which development decisions are taken, must involve people from planning, to selection of location, design, final decision on the plan of action, implementation, monitoring and evaluation. It presupposes that the process is bottom up, that it involves those who are likely to be affected by the decision in a way which impacts on their current life situation, how they as well as others will be benefited and how informed consent will emerge through a process which has transparency and allows for public dialogue and debate.

Some Basic Facts

a) From 1971-1990 2256 dams were built out of 4291 dams in India. Regional disparities exist with 73 per cent of the dams situated in Western India – Maharashtra, Madhya Pradesh and Gujarat.
b) Of these 4291 dams, 96 per cent are primarily for irrigation and only 4.2 per cent have hydropower as one of its objectives.
c) By the eighth plan period which ended in 1997, 38 per cent of the total irrigation potential created was major and medium irrigation projects while 63 per cent was for minor irrigation projects.
d) On the other hand, major and medium projects accounted for 57 per cent of the total investment. This means that these projects were capital intensive and the cost per acre was high as only 38 per cent were covered, whereas, with lesser investment, 63 per cent of the irrigated area was covered by minor irrigation.
e) Hydropower is only 25 per cent of the total power of 89,000 MW till March 1998, and has gone down for 50 per cent in 1963.
f) The southern states account of 45 per cent of the installed hydropower capacity and 25 per cent of the irrigated area. On the other hand, the northern states have only 29 per cent of installed hydropower but half the irrigated area. The North Eastern states have the least with 10 per cent of hydropower and 6.5 per cent of the irrigated area, whereas, they have the potential for creating (generating??) hydropower and even selling it to the neighbouring states.
g) Ninety per cent of the country's drinking water supply still comes from ground water sources even though many urban areas are fed through reservoirs.
h) Cost of large dam projects is high but the returns remain low with subsidies ranging around 24 per cent.

Areas of Disagreement

So far, the attempt has been to lay down the parameters of the development paradigm which emerged from the papers and the discussion which took place at the meetings. These parameters could enable us to resolve some of the areas of disagreement which were inevitable when stakeholders representing different entities meet to dialogue on issues which are of burning concern to them. These are brought out below:

The pro-dam concerns voiced were that dams are inevitable because of their large storage capability linked to the need to serve urbanising India and the size of India's population with its requirement of food resources. Since rainfall in India is for only 100 hours in a year, there is a need to store it for distribution spatially and over time. On the other hand, it was pointed out that, while serving the urban users, those whose water was being diverted suffered from want of water and electricity. They remained deprived and even displaced. Using population growth as an argument did not respond to the fact that increasing food production is meaningless if development policies lead to increasing poverty and lowering of purchasing power. For the displaced, there is both a loss of purchasing power and the traditional means of production. Hence, they become marginalised. Moreover, there is a greater propensity to increase the production of cash crops like sugarcane which results in decrease of food crops and over-utilisation of water. Further, the availability of water through large dams has its negative repercussions on the displaced and other marginalised groups, especially when the use of labour is replaced by mechanisation.

A second area of contention was the actual increase in production. While the increase was attributed, generally, to the introduction of the high yielding variety (HYV) of seeds and fertilisers, it was claimed that these were successful precisely where irrigation was introduced. Those for large dams claimed that the increase had been 30 per cent, which included raising more than one crop a year, and those who believed that the increase was marginal of 10 per cent and did not justify the costs.

The issues of waterlogging, salinity and flood control were also controversial with those against large dams pointing out these problems. The Ministry has taken cognisance of the problems of waterlogging and salinity/alkalinity it has initiated projects wherever States have come forward for assistance. The estimated area is 3.30 million hectares for salinity/alkalinity. It has published a Manual on Waterlogged and Salt Affected Areas in Irrigation ?? the waterlogged areas as 2.46 million hectares. However, those in Government, who felt dams had their place in the scheme of water resources, stated that dams were needed for flood control. This was challenged, as during heavy rains dams became full and in panic reaction water is discharged. It has not been found possible to keep less water in the dams before the rains since the vagaries of the monsoons leave uncertainty.

Hence, in a heavy downpour they become overfull and an unusual discharge becomes necessary. As a result, the reservoirs cannot take sudden clandbursts resulting in floods. The amount of waterlogging and salinity in the soil, resulting from irrigation, and the increases in sedimentation in the dams and canals, came in for conflicting views, with pro-dam persons denying it as a major problem and others pointing out instances of such problems. Careful data collection is needed in order to study the impact. In that connection, transparency in data with the Government is required. Lack of longitudinal and careful monitoring of projects has been a great disadvantage in the evaluation of performance. Such longitudinal performance data are very essential if information is to be utilised for future planning.

The experience of dams in one country may not be useful in another. Thus, countries like USA, Norway, and Sweden, had low population densities which made large dams possible with the least displacement. This is not the position in developing countries. It can be argued that developed countries have completed most of their dam requirements and, therefore, any ban on large dams would have negative implications for developing countries which are yet to fully develop their needed capacities. On the other hand, it can be argued that, if we are to develop location specific projects, then developing countries with large populations, where impact on displacement is of considerable proportions, and use of technology which is capital intensive on which the rate of returns has been extremely low, large dams may not become the right choice of technology. This is an issue requiring very careful consideration.

The procedures, so far followed by the Ministry of Water Resources in processing large dams, also came in for considerable debate and disagreement. The officials believed that all the procedures were faithfully followed and no decisions were taken till all clearances were obtained including those relating to the resettlement and rehabilitation of the displaced as also the impact on environment. They felt that, departmentally, options were considered and the laid down procedures followed including cost-benefit analysis. Others pointed out the lacunae at various levels as follows:

a) Lack of consultation, let alone concurrence, through public hearings at site and in the affected area, including upstream, down-stream and in the command area.
b) Lack of transparency in calculating costs and not fully taking into consideration costs related to R and R since detailed and full survey were never undertaken of the dam affected and including the proposed canal networks prior to the final sanctions. This was true also of environment clearance also.
c) There was no involvement of the concerned public in the choice of site, canals and total design.
d) The options were considered internally only and, therefore, when the final proposal was put up it was the only one related to the proposed dam. The pros and cons, the cost-benefit, etc. of more than one choice did not form a part of the proposal before it went to the sanctioning authorities. The problem lay in the administrative arrangements as the Ministry of Water Resources was only concerned with dams and other types of structures were scattered in the various Ministries.
e) There was no integrated planning of large dams with other structures to fully reap the benefits.
f) The appraisal before approval was sought, did not take into consideration the issues of fuel, fodder and bio-mass and, hence, lacked rigour.
g) The cost of operations and management (O and M) were not adequately included. Hence, the outlay on it was far less than required.
h) The cost-benefit analysis was not adequate and there was some question as to whether one should consider the economic costs/benefits or account for the outlay and the gains in financial terms.
i) It was seriously posited that the number of persons to be displaced and the human costs should outweigh any other cost/benefit analysis. Viability of a dam should be solely determined by this factor. The issue of "trade off" between economics and human and environmental costs were debated with the NGOs believing that not all costs were quantifiable in economic terms and we need to draw the line with respect to social costs, both human and environmental.
j) Monitoring is weak and the reports are not available to the concerned persons in civil society including the displaced. Compliance of the guidelines is the main focus of the monitoring.
k) All requirements must be met before submergence takes place. Clearance for submergence should await a final evaluation by an independent body.
l) Only the actual area required needs to be appropriated. Instances were cited when the area appropriated is large and, therefore, the surplus area is converted into houses with large kitchen gardens/farm houses while the displaced are deprived of their land. Tourism, including motels and hotels, are developed on rich agricultural land.

The cost to the country of not having dams was posed. However, it was pointed out that, while Maharashtra had the largest number of dams, yet 70,000 villages had no drinking water. Hence, dams alone may not be the answer to the vast needs of this country. Moreover, an experiment near Pune showed that even an urban area could receive 30 per cent of its water through proper measures of water harvesting and dams alone may not be the response to urban needs.

There was also disagreement on the issue of seismicity. Those concerned with dam construction argued that it was taken into consideration in the design of the dam to prevent any mishap but this was also contested.

On the issue of floods, it was felt that while floods may have decreased where there were some better controlled measures in specific dams, the problem of drainage has increased. Moreover, some dams have remained incomplete and, therefore, their flood control impact is not felt.

There was much less focus on hydro projects since they are mostly part of dams to be used for multiple purposes. Their value as renewable and cheap energy source and early start-up were emphasized. The concern was that both the displaced, and those who remained in the area, did not share in the final product – electricity. Not only their lives remained unchanged, but they were also deprived of the river as their major asset for food and water besides their villages being submerged and their lives dramatically changed by relocation. The persons remaining in the area were equally deprived.

While the private sector was entering in hydro projects, though not in irrigation, the problems of underutilisation remained due to problems of management while, on the other hand, distribution remained poor both in its operations and management so that the cost of the projects could not be recovered.

Issues Which Must Be Addressed

The following issues came forth very forcefully at the meetings and require to be addressed.

There is a need to develop a very comprehensive master plan which includes the reasons for deciding on a dam as a first choice and why other alternatives were rejected; the selection of the site and why other sites were rejected; the detailed plan and design of the dam and its network; the detailed plan of relocation and rehabilitation including the exact numbers affected by the dam and its network; the alternate land available, its exact location, size and quality as well as its present ownership; the detailed environmental impact and plan for compensatory afforestation, its location, type of land, species to be planted, saving of animals and other fauna and flora, loss of fuel, fodder and its compensation especially for those left behind.

The participation of the affected persons is another issue beginning from site location to the final decision to build a dam and especially to make a requirement to obtain the full consent from the gram sabha, and not merely consultation. It should be done in the presence of those who can ensure fairness in the proceedings without undue pressure from the stakeholders including the officials or persons who are likely to benefit in any way from the dam. Mechanisms for the same need to be developed. Participation has been the most neglected area and the people's movement against displacement has assumed a considerable proportions because the people have been used as the objects of development instead of as the subjects of development. They have lost confidence in the state. They must also be involved in finalising the R and R package and approving the relocation sites which must be acquired before the final plan is approved.

Flowing from the above considerations, the full costs of development need to be arrived at prior to decision making such as costs related to the dam, the canal system, upstream and downstream requirements, command area treatment, etc. No new project should be started till a previous project is completed. The amount given to irrigation is the highest in the transfer of resources from the Centre to the States. There should be a lid on the amount which would be available in a plan period and any prior spill-over must be accommodated within this allocation, so that there is no additional burden as a result of the spill-over. Without an independent assessment of the completion of a dam, and the consequences it has had on people and the environment, and the progress of rehabilitation, no new dam projects should be permitted. Even if there are long delays, these are likely as gestation period of mega projects is that much greater.

Legal framework, policy and governance should be justifiably binding and mechanisms to take legal recourse when there is non-compliance.

Both the Official Secrets Act and the Land Acquisition Act need to be amended. If the building of a dam is considered to be a public purpose, it must have transparency in its plan, design and costs. Moreover, land acquisition is being seen as anti-poor and pro-landlord. Most land appropriations are of those who are at the bottom of the ladder such as the dalits and more so the tribals. The "burden of proof" in all hearings, legal or public, should be on the party who wishes to alter the existing situation and not on the citizens.

For greater openness and transparency, it is essential to utilise experts, and organisations with expertise, to undertake assignments on specific aspects of the plan, whether it is decisions on alternatives, location of site, persons likely to be affected including demographic details, the economy pursued, social integration, cultural aspects, their lifestyle and their potential (or lack of it) for reintegration in a new location as also the nature of desirable location. Furthermore, independent agencies should also be called in to assess environmental impact in its totality including effects on flora, fauna and water resources as well as air and soil. Waterlogging and salinity, effects of the dam, should also be studied.

The method of cost-benefit analysis needs to be reconsidered as the benefits take into consideration the gains but not the losses, especially related to the people and their life style as also the environment, historical monuments and other infrastructure. Techno-economic inability cannot be the only factor in the final assessment.

Once an area is identified for submergence basic services and investments are frozen. As the gap between site location and actual resettlement can span a few years, this action causes much hardship to the people. If this is a way of forcing people out of the area, it could constitute a violation of people's right to such services.

The compensatory afforestation record is not very encouraging. More plantations are environmentally unfriendly and recreating a natural first habitat takes centuries, not even decades. Hence, concern is expressed in this area.

The quality of impounded water needs frequent testing.

The efficiency for irrigated water is 38 to 40 per cent compared to 60 per cent for ground water schemes. This issue needs considerable attention as even 10 per cent increase in efficiency would ?? 14 million hectares of irrigated land.

Like all other government schemes, complain prevails in the schemes for water supply and the larger the scheme the greater the corruption. How government would propose to address this issue needs to be seen.

Some Current Realities

While the resettlement and rehabilitation packages have improved over the past, in fact, the practice has remained more of resettlement than actual rehabilitation. The policy of "not worse off than before" is a minimalist statement. There is not adequate literature on those displaced and their condition over a period of time. The few studies done at the Tata Institute of Social Sciences (TISS) on some experiences of past displacement due to "development" (such as mines, ports, hydro-projects, etc.) have shown that the displaced remain marginalised. There is an increase in inequality and their social and cultural fabric is destroyed. There is a serious gap between policy and practice. In cases such as the Koyna dam, the dislocated, to a large extent, have disappeared. Their present position cannot even be ascertained.

It takes considerable time for the displaced to recover in a new economy. There is a substantial period, of minimally three years, when they need support for their daily expenditure or else the amount on compensation is consumed leaving very little for investment on regenerating their economy such as in the improvement of the soil, bunding, planting trees, and sinking well.

Not only is there a loss of cultural moorings, but tribals enter into a monetised economy with which they are not familiar. For the first time, most of them become indebted, because their skills are not related to the new environment. Loss of common lands, other assets, the products of the river and forests, are never compensated. Loss of grazing grounds results in difficulties to maintain domestic animals and, consequently, a vital loss of livelihood. River and forest produce provided food which is denied to them as they cannot make up this loss in their food basket through their earnings. Hence, it has effects on their health status.

Moreover, there is displacement of labour in command areas, as machines replace persons, thus further denying employment opportunities to the displaced as well as displacing the assetless in the existing economy of the area.

The active life of dams is regarded as 50 to 60 years because of siltation. Hence, their cost-effectiveness over various phases needs to be determined.

There are now shifts in the mouth of the river Ganges and the glaciers are also melting. Vast plantations of the conifers have led to acidity in the soil having environmental repercussions. These will have serious impact on water resources in the future.

There is no gainsaying that hydro-power is cheaper and its start-up quicker, besides being a renewal source of energy. It has contributed to ground water irrigated agriculture and has, therefore, made a contribution to food security but, where poorly managed, it has led to depletion of ground water resources as no attention has been given to its replenishment. The problem is one of the inter-relationship between the project, the people and the environment as already pointed out earlier.

To harness the hydro potential, which is both replenishable and more eco-friendly, there is a need to make an assessment of the cost benefits of large, medium and small hydro projects as options under specified conditions.

The operation and management of projects has remained poor. Where people have little control, distribution of water and upkeep of the network has remained poor. Less has been spent also on operation and management as, at the time of obtaining approval, these costs are sought to be kept low. This is an area which is a reality and remains to be remedied if performance has to be improved.

Areas Which Need Greater Stress But Have Not Received Adequate Attention

Neither in the papers, nor in the discussions with the stakeholders, the following received adequate attention and, therefore, are being brought up here for serious consideration.

An area of great concern, which is not being stressed adequately, is related to ethical issues, the foremost being informed consent. With the 73rd and 74th amendments, grassroots democracy has been given its legitimate space. Therefore, public hearings must become mandatory at the gram sabha and higher levels, as also with the concerned members of the civil society at large.

There needs to be greater documentation on alternate water resources and options. When considering the experience of dams, more lessons would have been learnt if a comparative approach had been taken. Possibly, existing documentation on alternate methodologies is not adequate and papers need to be commissioned in this area to develop an adequate knowledge base which makes options possible, based on documented information.

With defective land records in the country, compensation poses a major problem. Unless land records are fully updated, and there is no corruption in the process, the adequacy of compensation to a household cannot be determined fully. Most families do not update their records as lands pass from generation to generation. Moreover, lands encroached decades ago, and which are the only means of livelihood, also remain disputable for compensation. This is particularly so where juhm cultivation is practised.

Issues related to the health of the displaced have been paid little attention except for malaria due to water storages. However, issues such as deterioration in health status due to deprivation of traditional means of livelihood needs considerable attention and the differential impact related to gender and age. In fact, gender, age and the socio-economic factors need to be disaggregated for study. There is a need to study the differential impact of displacement on such areas as health, economic, social and cultural factors with respect to women, children, the aged and those with few or no assets. The generational gap, as children grow up in a different cultural environment, imbibing values different from those of their parents, need to be studied for the impact these have on the family and the community. Hence, impacts need to be studied in a disaggregated manner on women, men, children, tribals, dalits, large, middle and small land holders, the landless, the artisans, the casual workers, urbanising India and rural India.

Integration in the host community is a major problem, especially when they belong to the dominant group and those displaced are dalits or tribals. Sharing their economy in itself creates tensions but cultural factors further exacerbate these tensions.

Women's status is particularly depressed especially when they move from a predominantly tribal society to a more "sanskritised" host society. Besides cultural factors there is a loss of skills which they utilised in a forest economy which supplemented agriculture. They become reduced to casual labour in a host economy.

While shifting the whole community, intact, is a favoured relocation policy, in fact, it has not taken place generally. The result is that not only their culture is lost, but also their support systems, in life crises and life cycle, are lost.

Forests are a nation's wealth. Both, construction of dams are relocation have led to the loss of forest cover which is the nation's wealth. Even, normally, the country is losing its forest cover at an alarming rate. The drowning of forests or clear filling are adding to the problem.

There is a great need to evaluate the curricula of engineers with respect to irrigation, and flood control. Their courses cannot be confined only to engineering and these must become interdisciplinary so that they are better prepared in knowledge and attitudes with respect to issues related to environment and displacement, the issues of human rights and ethics. Besides, the curriculum needs to be holistic with respect to water management so that the inputs are not only on large dams and irrigation networks but also in traditional and modern practices with respect to water harvesting at local levels. When the dams impact on people and the environment so substantially, to what extent should it be an engineer dominated or engineer led activity? There has to be a more holistic view of the action to be taken in which engineering is only one specialised aspect.

There is also a great need to develop in-service refresher courses for engineers, so that, the newer inputs in such curricula can be given to them. It is perceived that WALMIS are barely functioning to the expected level and these are even non-functional in some cases. Sustainability in the use of natural resources, human rights and ethics need to be stressed in such refresher courses. Institutions with the relevant expertise need to be identified.

While there is a great deal in favour of small local efforts to harvest water, there are three areas that need attention:

a) There are various experiences in local water harvesting and the best means of equity in the sharing of the water between land holding and non-land-holding families. NGOs have been working in these areas and their practices need to be documented. Having societies of only land-holding water users, makes only the propertied the owners of a resource which belongs to the community as a whole and, in which, all should have an equal share.
b) How and by whom several micro watersheds initiatives, at local level, can be integrated into a larger viable watershed, or even a river basin development needs consideration. People's participation in self-help efforts is generally local. Neither they nor small NGOs have the resources to develop a larger area and may need considerable networking to make it possible.
c) Costs must be evenly borne. In some cases, reaching water to those in more remote areas will be much higher cost but they also happen to be poorer. Hence, the proportion of costs should be evenly worked out

Whenever people's participation is provided, in fact, women are not seen as stakeholders and particularly when the water is for domestic use (drinking water, etc.). Design of the system, planning the distribution system, water timings and operation and management of the system can be in their hands. Hence, it is very essential that they receive the necessary skills especially in the area of maintenance. There should be no gender bias in this area.

An area that needs more adequate attention is the whole concept of resettlement and rehabilitation. There may be a need for a moratorium on large dams till a humanistic policy can be evolved and is acceptable to the displaced. In fact, till all those displaced in India, running into millions, by projects other than dams, besides those dislocated by dams, receive their fair share, the funds available should not be further stretched and spread thin. The issue of land for land is a major one for those whose skills over generations are built around it. Those without land as an asset, but skills as assets, may or may not be able to continue their vocation unless the community is relocated totally as their skills represent local consumption needs such as carpenters and blacksmiths. Then there are those for whom employment is not an option due to lack of education and no other skills to recommend. To what extent can those, who give up the area lived in by their forefathers for the "greater good" of others, share in its gains by obtaining a share of the land of the owners in the command area, or by means of profit sharing especially on projects which yield profits? To what extent can the whole area benefit, that is, those who are left behind such as through the electricity generated and availability of piped water, even if it has to be pumped to them? These are major issues which need consideration aside from the vital issues of social and cultural disruptions that relocation entails. In fact, relocation is being addressed but rehabilitation is a far cry.

There is now an increasing questioning of the development model itself which leads to large scale displacement for which rehabilitation is an impossible tasks. For persons who have suffered the consequences, a relocation, it has been torture, and some have been relocated even more than once. There has never been full compensation. For example, from large teakwood houses, they are either given small plots with very little compensation for reconstruction, or, only a small module is built. This is only to serve as an example of how they are short-changed. This is carried out in other areas such as in the size and quality of the land holdings they own and the land offered to them in the area of relocation. Even if it is said that they have access to services we know that these are, generally, very poor such as education and health. They are more losers than gainers, being depressed to a status much lower than they have enjoyed, from being the masters of their environment to becoming the serfs of others. Costing non-monitised economies is not our strength and, therefore, the policies under-rate the required compensation and rehabilitation where some of the older skills are no longer useable. Even when fishing is introduced in the water storages, the rights are given by auction, so that, only middle-men take advantage instead of forming cooperatives of displaced persons. Hence, the very concept of development is being questioned by the vocal NGO community, and how far the means are as important as the ends to be achieved.

The place of NGOs, as part of a vigilant civil society, is not recognised. In fact, it is they who mediate between an uninformed group of the persons likely to be displaced and the powers that be. In a democratic society, the role of such civil institutions is important as it safeguards democracy and assures to the marginalised the right to information, and access to the powers that be for hearing their point of view. Hence, NGOs should be seen as partners in development, not only when they "cooperate" or get "coopted" by the government, but also when they help communities to voice their concerns. A major change in perception is needed as it is social movements, and not governments, which are the promoters of change. Due to a lack of this recognition, issues become polarised and there is no means to approach a solution which is satisfactory to the community. People's movement should be seen as a sign of a vibrant democracy and not as a symbol of the retradation of progress. The patriarchal syndrome at present is that the "government knows best" just as "father knows best"! This entire attitudinal change in Government is a pre-requisite to development.

It is no one's brief that we do not want to eliminate poverty or develop self-reliance, but we need to explore, with an open mind, the best means to achieve it, and the factors which weight or do not weigh in favour of mega capital intensive projects or their alternatives, keeping in mind that population will not only outpace development which is capital intensive but also, thereby, increase poverty.

At present, there is little coordination between Ministries on the whole issue of water management. While dams belong to the Ministry of Water Resources, medium and minor resources are scattered in other Ministries. Therefore, an integrated plan between large, medium and small, traditional and modern practices is not practiced. For instance, as suggested by Suhas Paranjpe and K.J. Joy, a larger dam can be integrated with a series of smaller water storages where rain-water conservation could serve the purpose during the monsoons in the smaller storages, and only when these are depleted, the water from the larger dam could be utilised. In that case, the larger dam need not be large and it need not dislocate many persons. While this is only given as an example, there is a great need to take a more holistic view of developing water resources than the fractured method utilised thus far. This will serve the purpose for developing more enabling policies for dams. A great deal of reconsideration is necessary at the level of the government as stand-alone projects are not noted to be viable and cannot optimise performance.

New systems for resolving inter-area or inter-state conflict need to be created. These should involve stakeholders but not necessarily the political structure of governance to avoid politicisation of water. Enabling legislation is required.

It is questionable whether resources are available for capital intensive projects in irrigation. The model of development needs a full examination if water is to be made available especially the majority in rural India. The reason for India's urbanisation at a fast rate is not simply the lure for cities paved with gold. Most migrants live in cities in the most deplorable living conditions and lose their homes from time to time due to removal of slums, some of them several times. What brings them to the cities are push factors. Hence, the need to develop alternative technologies for water resources, to serve villages and small towns, have become imperative. These have to be participatory with stakeholders, low cost and labour intensive integrating indigenous knowledge and technology with the modern. Especially irrigation, it is not privatisation but community ownership which will hold the greatest potential. It is only as our villages and smaller towns are made more livable, they will stop such migration which has become, itself, unsustainable.

Post factor assessment is almost absent including cost escalation, benefit shortfalls, low utilisation and increasing state subsidies. Besides monitoring done by the Central Water Commission and its Regional Officers, it is very essential to set up periodic monitoring by specialised institutions on technical, economic, policy, and legal aspects, social and environmental aspects of each dam. No reports should be treated as secret documents.

The draft of the proposed national policy for resettlement and rehabilitation should be widely circulated to NGOs, academic/research institutions and stakeholders, as also put on the internet. It should be debated widely, and suggestions incorporated, before it is adopted.

Government of India's comments dated March 10, 2000 on WCD's India country study Draft dated March 1, 2000

The GOI comments are quite ad hoc, off hand, many times plain untruths and contradictory. Many times what is stated is quite incoherent (many samples are available on page 34, 45 for example). In many cases, what is stated in response does not answer the point being responded to. In other cases, the answer makes unsubstantiated (and mostly unsubstantiable) statements. Some of the Annexure (for example Annexure III mentioned on page 23 top) in the text are not found in the document. For many of the figures given, no reference or basis is given. Such figures would have no credibility. In case of some other figures even years are not given. Some very inappropriate figures are given (for example, single year siltation rates). Some indicative examples of problems with this response are presented below, though it must be added that the list is not exhaustive. The comments show that such a response cannot be taken very seriously

CWC should be asked to provide some of the figures mentioned. For example the time series data of siltation rates (observed and actual with proper references for 139 reservoirs mentioned on page 42), forest submergence data (with references, for 116 projects as mentioned on page 44) and hydrology data of rivers.

Some of the comments given on pages 8-17 are quite objectionable as without providing any justification the comments direct that certain statements in the WCD report should be removed or added.

To say that rainfall in India falls in a period of 100 hours is at best misleading statement.

It is recommended that macro analysis like that of Shri A D Mohile should be used. But macro analysis that is not based on micro information and analysis has no value. Mohile's analysis, as presented in GOI response, does not emanate from micro analysis

Local water harvesting, reuse of water, adoption of two pipe systems, etc, is mentioned relevant for domestic water issues (page 3) but none of it is being practised. On the contrary, when it comes to making recommendations, the paper seems to say that there is no alternative but large dams for urban water supply (page 49). Very unsubstantiated and unbelievable statements (page 33) are made about 10% of water storage in India is being used for urban water supply. And that this figure will go upto 30-40% in next 25 years. Unless full analysis is provided, such figures only discredit the CWC.

About contribution of dams to food production, two contradictory claims are made. On page 14 it is said that the contribution is over 90% while elsewhere it is said that the contribution is 30%. Neither is a result of any coherent analysis.

Low (operating) cost of hydropower generation (page 14) is stated as indicator of their sustainability!! The cost mentioned does not include most of the crucial costs of the project.

Need for storages are equated with storage behind large dams (page 48 and elsewhere). The storage potential as soil moisture, in biomass, in local systems and in groundwater aquifers is not

mentioned at all. Some 30 BCM of storage due to minor systems is mentioned on page 5, but it is not clear if this is based on any survey or analysis. Since it is well known that there has been no comprehensive survey of existing or potential storage from local systems for any hydrologic unit like a basin or sub basin, such figures are quite meaningless.
At many places (e.g. page 32), the paper tries to show that the electricity used in agriculture sector is being provided from hydropower generation. Such a statement not only has no relation with reality, it is a technically wrong statement. In any case, the major stated benefit of hydropower, namely that it can provide peaking energy, is something that is not applicable to agricultural use of power. Agricultural use of power is generally considered non-peaking demand.

Projections for storage availability in year 2050 (page 4-5) assumes that siltation will take up about 10 BCM by 2050. However, it is well known that siltation has already taken up more storage space than that.

The paper has little to say by way of social justice, equity or even basic resettlement of people affected large dams and related works. On the contrary, the recommendations of the paper go in opposite direction when it is recommended (page 6) that quick availability of land and reduction of risk is required to encourage private investment in hydropower project. It is also indicated on page 6 that legal and procedural changes also would be initiated to facilitate construction of large dams through speedier R&R procedures. CWC needs to be told what is happening on ground in case of the first large privatised hydropower project in the form of Maheshwar project in Madhya Pradesh.

The response clearly indicates on page 11 that there is no role for people above the tertiary level of systems. However, on page 19 it contradicts itself when its states, quite untruthfully that "Participatory management even at initial stage is also welcomed and beneficiaries are consulted while planning of projects".

In some places, very pious sounding statements are made, but without any indication as to how the stated objective can or will be achieved by the government. Thus regarding reduction in flows in rivers it is stated on page 4: "We would have to ensure that this reduction occurs mostly during monsoon and low flows in fact are improved". On page 6 it is stated that "It is essential that water policies are evolved in such a way as to reduce the decision making capacities of the users in regard to the key decisions of water management and even water planning". On page 7 it is stated that there may have to be a performance analysis in regard to water. Elsewhere it is stated that basin-wise planning and water resources development will be done in future.

The paper continues to make unscientific statements that the water going to sea is wastage (page 7) and that wherever sites are available, dams must be built because such sites are rare (page 7, 10, 19)

The statement about flood control (page 9, point 9) is quite misleading and wrong. It is stated that floods have been controlled and attenuated wherever dams have been built and floods continue to recur in river basins where dams have not been built. In case of Damodar, Mahanadi and Tapi, in spite of the dams (and in some cases higher floods after the dams) floods continue. Cause for floods in undammed rivers are elsewhere and not in absence of dams.

CADA is mentioned on page 9 (point 8) as a measure to bridge the gap between created and utilised potential. But it is not stated (as GOI's Ninth Five year Plan states) that CADA has been quite a failure twenty six years after its inception.

The response to (para 1.5.2 - 1.5.3) the contention that CWC has been pushing through large dams without waiting for all mandatory clearance mentioned on page 19 does not answer the issue at all.

The TAC cost figures mentioned in Annexure I and referred to on page 19 are not useful unless the relevant documents put to TAC are appended to show that the costs being mentioned are comparable. Moreover, in the annex, arithmetic average of per ha cost for different projects are taken to show that the average costs are low. Firstly, arithmetic average is not valid in this case and weighted average will have to be taken. Secondly, it is also not clear if the costs are for the same base year.

It is stated on page 20 that monitoring of major projects have been taken up since 1974. But if the reports of such monitoring activities are not made public, it will be of little use or impact.

Annexure II mentioned on page 21 is not found in the document. The point about the created storage not being filled up is not answered by the CWC response. The general basin-wise picture sought to be presented for a specific decade does not answer the issue of overall performance of specific reservoirs.

It is claimed by CWC on page 22 (third line from top) that present yield from rainfed area is only about 0.7 ton/ha as against 1 ton/ ha reported in the WCD study. This claim is not substantiated and contradicts other data available. The unfounded claim has been made only to show that contribution from dams has been higher than what it actually is.

The claim made on page 28 (para 7) that large dams were the quickest available option and that water harvesting schemes were not known is totally incorrect. The Grow More Food Campaign document (Planning Commission, Govt. of India) of as early as 1948 (and many other documents) mentioned that traditional water harvesting systems were one of the quickest and best options for India's agricultural development.

The contention in the same paragraph that the system tanks cannot work without a backup storage is also not true and is unsubstantiated.

The attempt made to show in point 9 on page 29-30 that more work is done in minor sector is not correct as the figures of ultimate irrigation potential from minor systems is not based on any comprehensive survey, but based on some ad hoc figures. The response itself accepts later on that comprehensive river basin level planning has not been done for a single basin in India.

The point sought to be made in point 10 on page 30 that irrigation intensities in access of 160% has been achieved is not correct as it is based on incorrect data and calculation. First of all, the intensities of irrigation in case of groundwater based systems are much higher. Secondly, to arrive at irrigation intensities achieved from Major and Medium projects, segregated areas based on irrigation source will have to be used.

Some rather incoherent statements are made in point 12 on page 30. For example, it is stated that "Procurement of foodgrains under PDS is also responsible to some extent for switching over from wheat to Paddy". But main cropping season of wheat is Rabi and main cropping season of Paddy is kharif. How these can interchange is difficult to understand.

It is clear from the flip flop with figures indulged by CWC (India's premier and only organisation that can be expected to have proper figures) response in point 11 on page 30 that CWC does not have basic figures about irrigation provided and food production enhanced due to large dams in India.

It is stated by CWC response on page 31 that the cost data about constant prices is erroneous. It would be noteworthy that the cost data for which this comment is passed is from Govt. of India's Ninth Five Year Plan.

A strange statement is made on page 34 that "if there were no Large, Medium (and also small) dams, Rabi beyond 10% and Kharif irrigation upto 10% was only possible - rest was rainfed". This statement does not make much sense as such unless it is specified what time period it is talking about. Secondly, this statement will not help support for large dams as it clubs contribution of large and small dams. Most importantly, the statement ignores the reality that over half of all irrigated areas are irrigated by groundwater sources.

It is stated on page 34 that small dams cannot control floods. But how many large dams have been constructed and successfully operated for Flood control in India?

About siltation rates mentioned on page 34, it may be pointed out that siltation rates do not change with size of dams. If siltation rates are high, the large dams will also get silted up over time. There has not been any successful instance of large dam being dredged to clear the accumulated silt. In fact, once silted up, large dams will be a much greater liability. It is at least possible to desilt smaller dams, as has been achieved by communities in the past

On page 39, it is observed that people in submergence area are responsible for deforestation in submergence area of reservoirs. A more factually wrong and anti people statement would be difficult to find. It is also stated here that "hydropower is aimed at so that felling of trees are avoided". This again is something difficult to understand. It is not known if hydropower has replaced fuel wood as cooking medium in India.

CWC response claims on page 44 that average forest submergence for 116 projects is found to be 2400 ha. This means that these 116 projects have submerged 278900 ha of forests. This cannot refute the figures given in IIPA report, where data is given for 53 projects with average submergence of 7000 ha per project. This comes to 371000 ha, about 33% higher than the figure provided by CWC for 116 projects. Both data can be used to arrive at a more accurate picture and CWC should be requested to provide the data mentioned.

A statement is made in CWC response on page 45 that "There had also not been any report of malaria as epidemic around any reservoir constructed in India". This is quite a shocking statement. To give just one instance, under construction Sardar Sarovar Project has already seen such an event, as recorded by the World Bank (Morse report, 1992).

The statement on page 45 is a symbol of how mindless this response from CWC is. It says: "On one side it is said that the increase in food production is due to fertiliser and on other side it is denounced. There should be conformity in the report". While it is true that fertiliser use has lead to increase in food production, to point out that this has also lead to environmental impacts including pollution is certainly not contradiction?

The first two bullet points mentioned on page 46 are something that will need a lot of substantiation as facts point to contrary. It is claimed here that dams ensure minimum flow in downstream areas and that dam break analysis is being done for sensitive projects. It is well known that dams lead to stoppage of natural flows and in many cases all flows in the downstream areas. Moreover the govt. has been quite reluctant to do disaster management plans for dams, leave aside the question of making them public, which is necessary condition for success of such plans.

- Regarding Delhi Water Supply scene, as per information just provided by National Capital Region Planning Board:
  Out of Delhi Jal Board supply of 591 MGD to Delhi, 81 MGD comes from groundwater sources. This amounts to 13.7% of DJB supplies.
  In addition, a large quantity of groundwater is used by private sources. As per a study done by INTACH in 1998, this amount (DJB has no figure on this, but it has not refuted this figure published in 1998) is about 270 MGD. If we add this to 81 MGD of groundwater in DJB supplies, we see that Delhi gets 41% of its water supplies from groundwater and not 5-10% as mentioned by Shri Hassan on CWC response page 49.
  Shri Hassan here does not mention that leakage and other losses from DJB supplies amount to at least 30%.
  That Delhi citizens on average already get over 250 lpcd supply when rest of the country gets much less. Even as a large portion of water in Delhi gets used in watering lawns and in washing cars everyday. Moreover, this average figure is quite misleading and vast majority of people gets much lower quantity of water.
  That Delhi citizens do not pay the minimum operating costs of the water supplied to them. If proper water price is fixed, the water use will come down substantially.
  That plans are available with Delhi govt. for use of at least 138 MGD of rainwater that now flows away ununilised. Practically no action has been taken by the Delhi govt. for implementing these plans.

How justified is it to talk about dams for Delhi's needs in such circumstances?

Himanshu Thakkar

March 24, 2000

7.3.2 Review Comments by Mr. P.K. Deb

India Case Study:

Review of the Draft Final Report
Pradeep K. Deb, Jaipur, India (Consultant)

Review submitted as part of Contract No. 99/II/7 between the World Commission on Dams and the Consultant

BACKGROUND

The World Commission on Dams (WCD) has commissioned a case study of India's experience with large dams. The objective of the study is to assemble data to assess and illustrate views on the performance and development effectiveness of the dams in the context of the river basin. Among other aspects, the case study seeks to assess and illustrate key decision-making processes for the dam at each stage in the planning and project cycle, including how the key decision tradeoffs were handled, and draw out lessons learned.

The case studies facilitated by the WCD represent an important multi-stakeholder contribution to the broader WCD knowledge base. They will serve to inform the Commission Members in their deliberations on the Global Review of the Development Effectiveness of Dams.

The implementation phase of the ICS includes parallel steps of data collection and verification, structured interviews, enquiries, and invitation of submissions from interested parties to form a knowledge base. The study team is to provide an initial analysis of the information assembled, and identify the convergent and divergent views that have emerged.

Institutions responsible for the study were:

Institute of Public Auditors (IPAI), Delhi, India
Part A: Cross Check Survey of selected dams

Madras Institute of Development Studies (MIDS), Chennai, India
Part B: Section I and Section II

Indian Institute of Public Administration (IIPA), Delhi
Part B: Section II

A five-member team drawn from these three institutions wrote the main report. Members of the team represent following specialisation:

Dr. Nirmal Sengupta, Development Economist
(Professor and Currently Director of MIDS; Water Resources Development specialist, and author of several books on dams, alternatives, etc)

Prof. Shekhar Singh: Environmental and Social Aspects Specialist
(Professor; Former Member, Indian Planning Commission; Serving member of Government of India's Narmada Working Group on Environment (for Sardar Sarovar Project)

Mr. Ramaswamy R. Iyer: Water Resources Planner and Administrator
(Former Secretary, Ministry of Water Resources, Government of India; Member, Indo-Bangladesh Joint Rivers Commission; Member, National Commission on Integrated Water Resources Development Plan)

Mr. R. Rangachari: Dam Engineer
(Former Member of the India's Central Water Commission and Additional Secretary to the Government of India; a former Chairman of the Brahmaputra Board and of the Ganga Flood Control Commission; and a former Member (for over 15 years) of the Indo-Bangladesh Joint Rivers Commission).

- **Mr. Pranab Banerji,** Economic Analyst
  Professor and currently with the Indian Institute of Public Administration, New Delhi)

The Draft Final Report of the India Case Study (hereinafter referred to as the ICS/DFR) was submitted to the WCD in May 2000. The consultant received it on 19[th] June 2000. He is required to carry out the following tasks:

[a]. To review main report and reports of individual components, namely:

i). Economic and financial analysis

ii). Social and environmental aspects

iii). Framework for options assessment and decision making

Form an understanding of the issues emerging from the stakeholder meetings and review the manner final report dealt with the comments.

Based on the analysis and evidence presented in individual chapters and from his own analysis, to indicate to the WCD:

iv). The key lessons that can be drawn on India's experience in Planning, Construction, operation, monitoring and decommissioning of large dams

v). The key lessons on the future role of dam and non-dam options to food production, food security, water and energy needs in the growing understanding on social and environmental implications;

vi). Any other strategic guidance/strategic agenda/policy focus that the consultant may want the WCD to consider in the context of India's food production, food security, water and energy needs

The consultant had the good fortune to attend the stakeholders meeting at Delhi. He has also been provided a copy of the background papers for the two stakeholders meetings at Chennai and Delhi and the comments of the Government of India on the draft report discussed by the stakeholders. This review is a result of the consultant's appreciation of the proceedings of the stakeholders meeting and the draft final report of the team that prepared the ICS/

Structure of the Review

Although the ICS/DFR is divided into certain coherent sections, the consultant feels that the entire gamut of issues could be more logically presented. Accordingly, this review is divided into six sections, each dealing with a specific aspect of dams in India. The various sections are:

Chapter III	Historical Perspective
Chapter IV	Legal Framework
Chapter V	Social & Environmental Issues
Chapter VI	Technical Issues, Options
Chapter VII	Project Formulation & Analysis
Chapter VIII	Institutions, Operations & Management
Chapter IX	Key Lessons

Each Section gives an overview of the conclusions reached and the analysis contained in the draft final report of the India Case Study. This is followed by an analysis from the reviewer and a summary of major conclusions.

It must be emphasised that none of the sections are watertight and there are issues that cut across a number of sections. Wherever possible, the cross linkage between sections has been indicated in the body of the document.

The review draws mainly on the extensive material gathered by the authors of the India Country Study and the views of the Government of India/Central Water Commission. It therefore does not give a separate bibliography or extensive annexures. It refers to documents or references given in the India Country Study, wherever necessary.

It must be emphasised that while the review draws extensively on the past studies and documents, the views presented and the conclusions drawn are those of the consultant and may not represent the views of either his employers or the World Commission on Dams

1 Historical Perspective

This section deals with the contribution of existing large dams to the economic & social fabric of India. It also comments on the efficiency with which these advantages have been achieved.

1.1 Conclusions Reached in the Draft Final Report

The ICS/DFR makes the following statements while summarising:[1]:

> Large dams have made important contributions to the development of irrigated agriculture and improved productivity and the production of food. They have contributed to hydro-power and enhanced water supply;
>
> However, they have also had significant adverse impact, including social and environmental impact. Specifically they have displaced a large number of people and submerged large areas of forest and other lands;
>
> Some of the adverse impact of large dams are of such a nature that they can be neither prevented nor mitigated;
>
> Most of the adverse impact and some of the incidental benefits from large dams have not been recognised and assessed in the past.

Sengupta makes the following additional points[2]:

> The strategy that was chosen for irrigation development was based primarily on canal and tubewells irrigation. This has been at the cost of traditional irrigation systems such as tanks and other sources of irrigation.
>
> There has been large-scale displacement and misery. While in general, Public Sector policies towards displacement have been better that those of the private sector, they were and are found wanting.
>
> Although irrigated agriculture contributed to 60% of enhanced foodgrain production, this is not solely due to dams based irrigation strategy. Major projects have contributed 21.6% of the total foodgrain production. Even in this, there are many claimants to the credit for the achievement of self-sufficiency in foodgrain production such agronomic practices, use of better seed, fertiliser use, price support etc. Sengupta estimates that not more than 10% of foodgrain productivity increase is due to large dams.
>
> Since independence, India has added about 22,000 MW of hydropower generation capacity. Hydropower now contributes around 25% of the total generation in the country, but this share is going down;
>
> The evidence available does show that large dams have been effective as a measure of flood control, but the extent of impact is not clear;
>
> Exact information of use of dams for navigation is not available; and
>
> While public water supply is not often a stated objective of large dams, increasingly, surface water storage is being used for meeting the drinking water needs of many towns and cities.

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1 ICS/DFR Executive Summary para (v)

2 ICS/DFR: Chapter 2

- Other benefits such as pisciculture, afforestation of catchments etc. are often not included in the declared objectives of dams.

Sengupta goes on to paint a future scenario.[3] He makes the following points:

The Planning Commission proposes to use 90% of the total estimated utilisable surface & ground water resources by 2025 AD both for irrigation as well as generation of electricity. This pre-supposes the potential surface water resource development given in Table 1 alongside.[4] Sengupta points out that the estimates of available, utilisable and utilised water resources as well as the ultimate irrigation potential are not sacrosanct. Reservoirs often do not fill to their designed capacity year after year, the economically utilisable water resources is at best a guesswork and in any case the figure depends on the technology used and the quality of management of water resources.

ble 2: Irrigation & Hydro Potential

Type of Project	Irrigation Potential (BCM)	Hydro-electricity Potential (MW at 60% PLF)
Completed or under Construction	249.15	18,758
Projects Under Consideration	132.30	2,834
Possible Future Projects	-	62,452
TOTAL	381.45	84,044.00

Additional techniques will influence the water utilisation. One technique is inter-basin transfers. Another is the utilisation of water "locally retained" through watershed management techniques.

Management of water resources can drastically alter the estimates of utilisable water resources and ultimate irrigation potential. Technically feasible water resource projects may well not be economically viable.

1.2 Analysis

The consultant generally agrees with the conclusions drawn in the draft final report of the India Country Study [ICS/DFR]. It is however, felt that some important issues have not been fully addressed while preparing the report.

1.2.1 Contribution of large dams towards food security:

It is somewhat misleading to determine the contribution of stored water towards irrigated agriculture in percentage terms. The various factors that are instrumental towards improved productivity are not mutually exclusive and to say that irrigation has a 10% role or a 30% role may not be logically sustainable. Use of high yielding varieties of seed, fertiliser, agronomy etc. are all mutually dependent and absence of any one of these inputs could result in reduction in yields. Water may well be the most critical input.

It is not a matter of chance that 67% of the increasing food production and the major productivity increases in Indian agriculture has come in irrigated areas. So far, the productivity increases in rain-fed agriculture are neither as dramatic nor as assured as in irrigated agriculture. It may be incorrect to devalue the immense contribution of irrigation towards sustainable food production in the country as a whole.

It is true that only around 33% of irrigated agriculture is in the command area of storage reservoirs. In the rest, the major source of irrigation is ground water. Over the years, as the emphasis on groundwater has increased manifold, it is perhaps proving to be a far bigger threat to ecology than irrigated agriculture from dams, large or small.

3 ICS/DFR: Chapter 2.5

4 Summarised from Table 2.7 of the ICS/DFR

The inescapable conclusion from a more in-depth study of Indian agriculture indicates that dams, large and small, have indeed been a critical factor that has enabled sustained food production and therefore assisted in providing overall food security to the country.

The need for improving productivity in dry land agriculture is unquestioned. Indeed, technological and managerial inputs in dry land agriculture would not only bring about higher productivity but would also go a long way towards equity in distribution of productive resources. It is also true, that in a future scenario, as new canal irrigation projects become increasingly expensive and unviable, major increases in for productivity will have to come from dry land agriculture. Nevertheless, it must be said that, in the past, dams have played a significant role in stabilising Indian agriculture.

1.2.2 Social Impact

The consultant agrees with the draft final report insofar as the social and ecological impact of large and medium dams are concerned. A more exhaustive analysis of the economic and social impact of dams must await Chapter V, but it is worthwhile to look at the historical evolution of the rights of the displaced.

In fact, the State has consistently tried to deny payment of a fair compensation to the displaced. It has been more the Supreme Court of India, which has upheld the right to be compensated for compulsory acquisition of property by the State. The court has repeatedly held that while it is the right of the State to acquire land for public purpose, it has to pay compensation and the compensation cannot be illusory. Unfortunately, the State has not shown an equal concern for the rights of the individual.

In the early years, it was held that large projects would lead to development and prosperity. It was presumed that if, for the good of many, a few had to suffer, it was all for a good cause[5]. It has taken decades before this attitude has started to change. It is now acknowledged that the displaced has a right to a fair compensation and that his way of life, his social environment and his cultural heritage has to be respected and preserved to the extent possible.

Therefore, since large dams necessarily cause large displacement, the finding that big dams have been the source for misery for very large numbers is a valid argument. The only redeeming feature is that the State, in India, has started realising the inequity that it has caused in the past, and consequently has been more open towards improvement of compensation packages. Whether the compensation packages are still adequate or otherwise is a matter of perception, but the heartening factor is that the State no longer talks of development at the cost of the displaced. Legally, and otherwise, the State now accepts that the displaced must be taken care of.

1.2.3 Drinking Water

It is necessary to point out a major social benefit of dams that seems to have escaped attention while compiling the ICS/DFR. Increasingly, water stored in dams is being used to meet drinking water requirements of large sections of the population. In Rajasthan, the Bisalpur dam has been constructed primarily for supplying drinking water to Jaipur town and Ajmer and Tonk districts. ~10% of the water available from the Bhakra-Beas project is reserved for drinking water needs and will provide water to around 15 million people by 2007. It also meets part of the drinking water needs of the national capital of Delhi. The Narmada project has been repeatedly justified because it will meet the

5 R. Ramaswamy Iyer puts this view across very cogently at page 37 (Chapter 3.2] of the ICS/DFR where he speaks of the arguments that the beneficiaries of Irrigation Projects proffer as a class.

drinking water needs of thousands of villages in Gujarat and Rajasthan. Large dams already provide much of the drinking water requirements of Chennai and quite a few urban centres in India.

A counter argument has been that watershed management and recharge of aquifers can adequately meet the drinking water as well as much of the irrigation needs of large sections of the population. This argument is not sustainable. Such local water harvesting structures have been successful in only isolated cases and universal application is doubtful. It also pre-supposes the existence of a vibrant community activity and an altruistic local leadership. Across the country, such community based activity have either not succeeded on a long term or has been sustained by a strong local leadership component supported by external groups such as NGOs. It is yet to emerge as a universally replicable model.

It seems likely that in the near future (20 years?), surface water storages will increasingly sustain human and animal populations by becoming the primary source of drinking water. The difficulty faced by the State in enforcing discipline in management of Ground Water is likely to accentuate this trend.

1.2.4 Other benefits and damages arising out of big dams

Other issues raised in the ICS/DFR will be dealt in the following Chapters[6].

[6] The issue of additional benefits from dams will be referred to while discussing the economic and social analysis of big dams in Chapter VII. The role of dams in flood control, generation of hydropower etc. will be discussed in Chapter VI (Technical Options). The possibilities of other options are also discussed therein and in Chapter V.

2. Legal Framework

The legal framework in which dams are built and operated in India has been described in the section on the Legal and Institutional Framework[7] and the lucid exposition by R. Ramaswamy Iyer[8]. Although Iyer has discussed both legal and institutional issues in Section 3 of the ICS/DFR, we shall restrict ourselves to the legal framework in this section. The institutional framework will be discussed in Chapter VIII.
In the agreed conclusions[9], the ICS/DFR broadly concurs with the conclusion reached by Iyer. To briefly summarise, the following points have been emphasised both in the Executive Summary as well as in Section 3.2:

> There is an implicit assumption that surface water resources need to be managed by the government on behalf of the people. That people may have concerns and interests of their own and that there could be conflicts between the aims of government and the local people is not recognised.
>
> There is also no policy or legal framework which encourages local participation in irrigation management. PIM is still a long way off in most parts of the country. The village level local institutions such as Village Panchayats etc. may start playing a bigger role in future but at present, their role is severely limited.
>
> The Land Acquisition Act is the principal instrument of displacement in water resource projects. While an individual has the right to question the quantum of compensation, he can rarely challenge 'Public Purpose' as defined by government. Very few State Governments have any kind of policy that deals with rehabilitation of Project Affected Persons. The R&R policy at the national level is still to be finalised. The absence of institutional arrangements for consultation and grievance redress often generates serious dissatisfaction and, in some cases, confrontation.
>
> Until recently, and public hearing of environmental issues were not a statutory requirement. It has still not become an established procedure.
>
> The Official Secrets Act creates a veil of secrecy behind which government action loses its transparency. As information is denied, it also reduces any form of participation by people.

Iyer further points out that national level institutions and the legal framework under which they operate has not been adequate enough to ensure compliance of decisions taken much less influence decisions. Most of the powers of the Government of India emanates from its financial assistance to the State Plans. Since most of this is not project linked, it severely limits the options with the Government of India.

> The constitutional position is different in the case of hydroelectric power. Electricity is in the concurrent list and both the Centre and the States can exercise executive power on the subject.

Finally, Iyer points out that the persistent efforts of the judiciary to expand the human rights jurisdiction of courts and extend the scope of judicial review of executive action has helped in re-shaping much of the laws related to resettlement and rehabilitation of project affected persons.

2.1 Analysis

2.1.1 Where the ICS/DFR is right

The ICS/DFR correctly identifies a number of shortcomings in the existing legislative and policy framework for the water resources sector. The need for an effective National Water Plan and State Water Plans is undoubted. As the ICS/DFR points out the existing Plans are more in the nature of pious wish lists that have had little impact. There are two reasons for this:

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7 Page vii to ix of the Executive Summary

8 Section 3 of the ICS/DFR

9 Executive Summary, I CS/DFR

In some cases, the NWP and the SWP have carefully chosen wording which paper over differences, but the compromises do not lead to effective action at the field level.

The NWP and the SWP have not been supplemented by legislation, Plans, Programmes etc. and have remained more on paper.

Many important legislation/Policies have been held up either by the cumbersome process of evolving a consensus between the Centre and States or because of lack of initiative on part of the Centre. A glaring omission is the National R&R policy, which could have been the model for the States to follow. There has been no policy worth the name for ground water management or even participatory management although these issues have been agitated in almost every forum of note.
Most of the conclusions drawn in the ICS/DFR and by Iyer are valid criticisms of the legislative & policy framework in the Water Sector.

2.1.2 What the ICS/DFR misses out

Having said this, it must be pointed out that the ICS/DFR appears to have looked at only the areas where there is a government to people interaction. It fails to take a critical look at the enabling legislation that permits creation of water projects.
The entire discussion appears to be focused towards providing equity to the project affected persons. The ICS/DFR has not given much thought to the effectiveness of existing laws in dealing with the issues related to water. This review is an inadequate forum to give a detailed note on the laws that govern construction, operation and maintenance of dams or the laws that regulate use of water resources in the States, but it is necessary to highlight this very important part of the overall scenario in which dams are built. We can broadly define three groups of legislation which cover these areas:

Legislation governing inter-state water resource sharing and management;

Legislation governing management of water resources in the State;

Legislation enabling people's participation in water resource management.

The following sections give an overview of the impact of such legislation and tries to indicate the areas where legal initiative may be necessary.

2.1.2.1 Centre-State relations in the water resources sector:

The ICS/DFR has not attempted to analyse the impact of legislation and the policy framework that governs the water resources sector in India. It is generally felt that conflict in interests of different States has held up both exploitation of the available water resources as well as proper management of existing dams and Canal systems. A cumbersome process of evolving a consensus on each issue has led to postponement of important policy initiatives or legislation. Typically, issues such as the sharing of water of the Cauvery river basin, the Ganga waters, the Yamuna river basin etc. have not been decided in time. This has held up development of water resources that could have been otherwise used in the downstream areas of these basins or even for inter-basin transfers. Typical examples of projects held up are the Renuka and Kishau dams in the upper Yamuna basin.
Political compulsions too, have prevented the Centre from taking decisive action even when law permits such action. The headworks of the Bhakra system are not controlled by the Bhakra Beas Management Board even though there is an interstate agreement as well as legislative sanction.
Often, the absence of proper laws as well as the absence of an institutional framework has prevented adjudication in inter-state disputes. There is also a lack of enforcement of decisions in many cases. River basin management is projected as a possible future scenario[10]. If this framework is not evolved, river basin management projects may well be stillborn.

2.1.2.2 State Water Legislation

[10] See Executive Summary, item 14 on page viii, Section 3.5, Basin Planning page 42, 46, Section 5.14

The report pays very little attention to the Water & Drainage Acts that have been enacted in various States. Since grass roots management of water resources is totally at the State Level, the laws, rules and policies at this level are critical in any discussion on optimal use of water resources.

At present, all irrigation projects are the property of the State and the farmer is given his irrigation water by a benevolent State. He pays a small tax for this privilege but is at the mercy of the state machinery, which decides how much water he will be allowed and at what time. The state machinery is expected to be fair but often fails the test. It has powers to penalise those who do not abide by the rules but these powers are seldom used.

Currently, Farmer participation is usually at the apex level. A water distribution committee at the project level decides the quantity and timing of water release. The committee has Public Representatives some nominated farmers and officials from the Irrigation and Agriculture Departments. This committee meets before each irrigation season

The State is responsible for the upkeep of the irrigation infrastructure and the farmer is not even considered fit for such decisions. Only 3 States[11] have enacted legislation allowing the end-user to manage irrigation.

The current practices cause endemic problems in irrigation management. The major drawbacks of the current systems are:

There is inequity in distribution of water. The head reaches usually corner a major share of the water while the tail reaches may get little irrigation although both pay the same irrigation charges. A combination of political, caste and class pressures can lead to a dominant group or community cornering precious water. Sometimes, poor design and implementation of projects have also led to inequitable distribution.

In many command areas, the efficiency of use of water is very poor. The farmer tends to use far more water than needed by his crops. Often, this has caused water logging and salinity problems. This problem is a direct consequence of overuse of water.

Overuse of water is a direct consequence of very low irrigation charges. In most parts of the State the cost of irrigation waters is so low as to encourage waste. If all the water were to be used more judiciously, a far larger area could be irrigated than is possible at present.

The present system of levying a low Irrigation charge does not raise sufficient resources for maintenance of the canal networks. Maintenance costs are now borne by the State Government. The financial constraints mean that Irrigation systems are poorly maintained.

No State has legislation for the management of groundwater. Current legislation allows a landowner full rights over water under his land. There is very little control exercised in the absence of a legal framework.

Very few States have a State water Policy. Fewer still have a comprehensive database of their water resources. Even where State Water Policies exist, they have not been followed up with action plans, programmes and guidelines. Only a small part of this failure is due to a resource crunch. In most States, Irrigation has enjoyed a large share of the investible funds.

2.1.2.3 Participation in Irrigation Management

While the ICS/DFR mentions participation of the project affected persons in the planning and operation of Irrigation Projects, it fails to point out that the enabling provisions for this must be in the State level legislation as all irrigation projects are planned, executed and managed at the State level.

No State has enabled participation or public hearing in the pre-project or project planning stage.

This is only a very brief overview of the legal environment for irrigation at the State level. This is an area of critical importance and will need considerably greater attention than has been given so far.

11 Andhra Pradesh, Tamil Nadu & Orissa. A few States like Haryana, Rajasthan & UP are contemplating enactment of such legislation. All these initiatives have been backed by loans from the World Bank.

3. Environmental & Social Issues

If there was one issue that dominated the stakeholder's meetings at Chennai and Delhi, it was the issue of environmental degradation caused by large dams and the need for ensuring social equity. Fittingly therefore, Shekhar Singh, *et. al.* have devoted nearly 100 pages in bringing out the environment and social impact of large dams in India. It would be impossible to comprehensively review the mass of data and observations presented in Sections 16-21 of the ICS/DFR. We shall therefore, limit our discussions to primarily three areas, which have been considered critical. These are:

- Environmental Impact Assessments [EIA] of River Valley projects;
- The issue of Rehabilitation and Resettlement of Project Affected Persons;
- The issue of Social Equity in projects

Singh brings out succinctly the situation that emerges from the review of past efforts to study environmental impacts of projects[12]:

- Most of the possible environmental impact of dams were not assessed adequately in the past and even today, though things have improved, much still needs to be done;
- Even in retrospect, there has been no effort to assess the actual impacts that dams have had on the environment, for most of the parameters;
- The adverse impacts of dams on the environment, judging from international experience and the view case studies available in India, are significant and mostly irreversible;
- The preventive and mitigating measures that could have been taken to safeguard the environment have mostly not been taken; and
- Certainly, the financial, economic and social costs and benefits of the environmental impacts of dams have not been computed while assessing the economic viability of most projects, including recent ones.

The Executive Summary draws the following lessons from the detailed analysis of Social & Environmental impacts of large dams:

- The process of planning for and assessing large dams must include a realistic look at the various alternatives that are available to deliver the types of benefits large dam is are expected to deliver. Each of these alternatives must be assessed in terms of their social and environmental impact and the alternative consequently chosen must not only be viable but also optimal. The process must be participative and transparent.
- Where a large dam emerges as the best viable alternative, this must be after the costs of preventing, reducing and mitigating the adverse social and environmental impact have been included in the benefit-cost analysis. The residual adverse impact must be considered while conducting the final assessment.
- There must be a strong institutional structure to ensure the proper implementation of the social and environmental safeguards, with the support of adequate legal backing.
- The monitoring of compliance with prescribed safeguards and conditions should involve independent agencies and should be opened to the scrutiny of affected and concerned people.

12 Page 257 of the ICS/DFR. See also section 18.2 Of th. ICS/DFR for the impact on environment.

- There must be a constant effort to learn from the experience by assessing, periodically, completed projects and judging the impact they have h and that having and how these compare with what was anticipated.

3.1 Analysis

Strangely enough, although the debate on social equity and environmental impact dominated the proceedings of the stakeholder's meetings, there was in fact, a degree of consensus on the need to address these issues far more closely and effectively. The differences lay more in the emphasis.

3.1.1 Environmental Impact

During the Course of the Stakeholders' meetings, there was a general agreement that:

Environmental Impact Assessments should be carried out by independent professional agencies. Just as projects are required to reach financial closure before any substantial investment is made, so also projects should be required to reach "Environmental Closure" before any construction is taken up.

Minimum standards must be laid down for adverse environmental impact. Similarly, detailed guidelines for conducting environment impact assessments must be published so that such assessments are done objectively and can be examined with a degree of objectivity.

Public hearing as well as transparency in both assessing the environmental impact as well as in publishing the results of the assessment should be institutionalised.

Options to each project must also be studied and environmental costs of each option assessed. Environmental costs must be considered while determining the benefit-cost parameters of any project.

3.1.2 Social Impact

3.1.2.1 Project Affected Persons: Resettlement & Rehabilitation

Singh has defined the basic principles of an R&R policy that are necessary to minimise adverse social impacts due to displacement[13]. There is very little to add to what has been already stated by him. We only differ with his observation that displacement should not *ever* be compulsory and that if people are unwilling to shift, the fault lies with the rehabilitation package[14]. The statement is too sweeping. There have been innumerable instances where, irrespective of the perceived benefits, a person wants to stay on due to emotional attachment to the land and since his family has been cultivating the land for generations. His reluctance is not always due to a belief that he will not receive the promised benefits.

3.1.1.2.1 The Land Acquisition Act

[13] Section 20, ICS/DFR

[14] Item xi & xii on page 260 of the ICS/DFR. Some have argued that informed consent of the PAP must be obtained. This may be an extreme view and could confer veto powers on the project affected and may not be in the interests of economic well being of the nation as a whole. On the other hand, the project authorities must also be held accountable for the reasons they proffer.

The Land Acquisition Act is the key piece of legislation under which the State can take over any piece of land. As of now, the satisfaction of the State that land is being acquired for a 'public purpose' is sufficient. This needs to change. A 'Public Purpose' must have the following ingredients:

The reasons behind declaring a project a 'public purpose' must be publicly declared and must be justiciable.

The project authorities must look at possible alternate scenarios, taking into account the displacement and rehabilitation costs. This should also be part of the overall socio-economic analysis of the project[15]

Any project must consciously try to minimise displacement.

While 'private' lands and structures can be compensated under the Land Acquisition Act, common properties are treated as belonging to the Government. Thus, village pasture lands, village forests, common lands, temples, social infrastructure etc. that have traditionally supported the community, both economically and socially, are held to be State owned and not compensated. The acquisition process also does not look at the loss of livelihood, temporary or permanent. It does not take into account the ways in which the people are dependent on both land and the community.

3.2.1.2.1 The R&R Package

We have discussed the need for a strong policy and legal backing of R&R packages for PAP in Chapter III[16] & Chapter IV[17]. We emphasise that the existence of an R&R policy is not sufficient. There has to be four additional ingredients to back up the policy so that its benefits actually reach the PAP:

It must be recognised that the benefits promised in a R&R package is a *legal* right of the PAP and that he can demand enforcement of his right;

Any R&R package must be preceded by a base-line socio-economic survey to determine not only who arte the PAP, but also their sources of income and social status. This should be done by an independent agency.

There must be an institutional structure for implementation of any R&R package; and

There must be periodic post-rehabilitation surveys to evaluate whether the R&R package has achieved the desired results.

3.1.2.2 ***Equity***

The Executive Summary does not highlight the question of equity. This is an issue that is dealt by Shekhar Singh and his group in their discussion on the impacts of large dams[18]. Singh makes the following points:

Dams cause inequity since the upstream losers are usually more vulnerable but have to bear a greater burden;

Inequity also increases downstream as the rich gain more than the poor;

15 More on this in Chapter VII

16 While bringing out the Historical Perspective, we have emphasised that the State has traditionally acted as the exploiter and displacement in large dams have caused untold misery.

17 In para 26, we have suggested the need for a strong National R&R Policy, backed up by State Policy.

18 Section 20.2 page 262 of the ICS/DFR

- Human beings gain at the cost of other species.

It is difficult to find fault with the statement that dam adds to inequity since the displaced are usually comparatively poor. Experience has shown that since dams are built mainly in hill tracts, the persons displaced are often tribals and other persons who are economically less well off. These people have to make do with less productive/marginal lands. On the other hand, the command area of dams is usually in the plains where the maximum benefit can be garnered. Comparatively affluent persons reside in these areas. Dams thus, have a tendency benefit the more privileged.

> This is where the R&R package can make a major difference. If the displaced are settled in the command area, particularly in the upper reaches, they too stand to gain from the dam and the inequity will reduce.

Singh argues that even in the downstream command area equity decreases since the rich gain more than the poor do. This argument is less convincing. It has been nobody's case that large dams are an instrument for bringing about greater socialism. Construction of a large dam does not automatically entail redistribution of lands downstream. Naturally, anybody with a larger holding (*ipso facto a richer individual*) will gain more than another person with a smaller land holding. It may also be true that the more affluent can invest in irrigated agriculture and would be in the benefits more quickly.

> On the other hand, all categories of people gain from irrigated agriculture. Since everybody gains, dams cannot be held to be responsible for greater inequity. The argument that farmers at the tail gained less than farmers at the head reaches may be true but it can be remedied better management and design. In any case, those at the tail also stand to gain.

The third argument prospered by Singh is unfortunately quite true. Any large dam requires large area to be submerged. Since dams are constructed in hilly terrain, the submergence usually causes loss of habitat for flora and fauna. This is where the Environment Impact Assessment and the action plan for environmental management can assist in reducing the impact.

4. Options & Technical Issues

Perhaps the second most contentious issue is the search for the optimal solution. There is universal consensus that both irrigation and drinking water are necessary for human survival. It is also accepted that energy requirements of a developing nation must be met. At the same time, there is now little doubt that large dams do cause environmental degradation and displacement problems.
Unfortunately, the debate usually degenerates into a large dam vs. small dam or a large dam vs. everything else kind of scenario. The ICS/DFR does try to present alternatives but ultimately falls prey to the same mindset. Before we analyse the options we should briefly review what the ICS/DFR proposes[19]. The proposals can be summed up as given below:

4.1.1.1.1 Power Sector

[b]. Increases in capacity utilisation as well as reductions in T&D losses can reduce the need to create new generating capacity. Similar reduction in capacity is also possible through rationalisation of tariff structures, use of energy efficient equipment will also reduce demand. Pumped storage facilities can meet the present peak demand shortfalls;

[c]. Technological options include small hydropower, wind & solar energy, biomass gasification etc. Technological breakthrough in other areas can also reduce the need to generate more power.

4 2 1.1.1 Irrigation Sector

[d]. Significant addition to the irrigated area can be made without large new investments in the projects by better utilization of the irrigation potential already created, reclamation of water logged and saline-alkaline lands and increases in efficiency of water use.

[e]. Productivity of irrigated agriculture in India is significantly lower than in other countries. Productivity increases can add substantially to agriculture production without the need for large new projects. Productivity of rain fed agriculture than also be significantly stepped up;

[f]. Participatory Irrigation Management and end user involvement in water management can also result in significant increases in water use efficiency and agricultural productivity. Community managed systems with small local storages can reduce the dependence of farmers on government;

[g]. Wide varieties of water appropriation techniques including *in situ* harvesting, surface and sub-surface storage, Soil conservation etc. can be used in conjunction with other options including large dams. Rain water harvesting and watershed development need to be extensively adopted in conjunction with Canal or groundwater irritation;

[h]. Traditional irrigation systems can be rejuvenate it and some principles can be applied in more than Canal systems leading to improve performance;

[i]. They should be greater emphasis on re-charge of groundwater;

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19 The proposals in the ICS/DFR are contained in the section on options in the executive summary and Section 4-7 of the report. It is also to be found scattered throughout the report, particularly in the sections on environment and in the discussions on river basin management.

[j]. Although good options to large dams in flood control measures are not available, a good /disaster mitigation policy needs to be adopted for this purpose. Networks of tanks and watershed development activities may be able to moderate flood flow to some extent.

Sengupta in his detailed note[20] comes out more strongly against large dams. He instead, strongly advocates a system, such as the one prevalent in the Tambaparni Irrigation system, in which local storages, controlled by local institutions, actually manage irrigation and the larger water harvesting structures are controlled by Government. In the power sector, he strongly urges alternative sources of power, and suggests that the cost of generation and capital costs may be comparable to hydro-electricity.

4.2 Analysis

Unfortunately, every discussion on options seems to degenerate into a pro-dam/anti-dam controversy. A better paradigm would be to look at the most efficient and equitable use of water, but this is lost in the heat of the debate.

In its analysis of options, the ICS/DFR does not seem to have considered a model in which emphasizes an inter-sectoral water planning and management. The emphasis on local management notwithstanding, the treatment of Participation in Irrigation Management is somewhat sketchy.

4.2.1 Energy Sector

Let us first look at the Energy Sector. The need to rationalize tariff and to reduce T&D losses is undoubted. It is a low cost option to new generation and must be taken up across the country. It is as true for hydropower as for other conventional sources such as thermal or nuclear power. However to suggest that installation of new capacity, particularly hydro-electricity can be reduced if such measures are successful may be debatable. The energy needs of India are so vast that even a 20% increase in power availability would not meet the current shortfall in energy needs. Since the growth in energy needs is likely to accelerate both in the urban and rural sectors, future needs can only be met through creation of additional capacity.

Secondly, since hydro-electricity is perhaps the "cleanest" and the most renewable of conventional sources of energy, improvements in transmission and distribution should replace other conventional energy sources and not hydropower.

The ICS/DFR shows an understandable enthusiasm for renewable alternate sources of energy stuff however, the report itself concedes that in the last five years renewable energy sources has attained a capacity of just 1365 MW. It also quotes a study which indicates that 90% of the village population meet domestic energy needs primarily from non-commercial sources and says that this makes a mockery of the of cited argument that India needs massive development of power sector.[21]

> The reality is somewhat different. Energy consumption in rural India is one of the lowest even amongst developing nations. On the other hand, this is growing at a rapid pace and the growth has come primarily in commercial energy. The study itself points out that the large increase in irrigated areas has come primarily from use of pump sets. Few pump sets run on non-conventional energy. In most states, energy demand is likely to grow at the pace faster than it has done in the recent past.

The other renewable sources quoted by the ICS/DFR simply do not have proven capacities for generating stable power or the technologies are simply not mature enough. It is interesting to note that the major increase in capacity installed (1365 MW) is due to wind power. This is not yet considered as a reliable source of power in any part of the world.

There is some doubt about the capital costs for renewable sources of energy. The figures given in the study appeared to be far lower than actual. Information gathered by this reviewer indicates that cost

[20] Sections 4-7, ICS/DFR

[21] Sekar (1999) quoted at page 69

per installed MW for non-conventional sources is between 60% to 200% more than conventional sources of power.
Notwithstanding the possibility that renewable sources of energy may some day replace conventional sources of energy, the current scenario, across the world, does not permit us to presume that they can become the mainstay of energy supply in a country such as India.

4.2.2 Water Sector

There is little doubt that efficiency of water using irrigation projects across the country leaves much to be desired. There is huge wastage of irrigation waters and some estimates indicate that if the existing water resources were to be properly harnessed the area under irrigation could be increased considerably (more than doubled).

4.2.2.1 Water Charges

Unfortunately, the report fails to look at the critical reason for inefficiency in use of water. Water rates in India are so low as to make irrigation water available almost at no cost to the farmer. Various studies indicate that in canal-irrigated areas, less than 1% of the cost of farming is due to water charges. In addition, across the country water charges are crop/area based and not volumetric. Such an approach does not reflect the scarcity value of water and has some extremely unfortunate consequences:

[k]. The low cost of water does not encourage the farmer to save water;

[l]. A crop/area based water charge actually discourages saving of water. A farmer who saves water and irrigates a larger area has to pay a higher price for water as the charges are based on the crop area and type of crop.

It has been very difficult to convince the politician in India that a higher water charge is actually in the interests of the farmer. Yet, this is perhaps the best way of bringing about equity in irrigation projects. Water rates can be rationalized so that the farmer pays a smaller charge for an initial quantity of water which is need based and has to pay a much higher charge if he uses more water than is considered necessary (a cascading rate structure). If this were done the farmers at head reaches would use much less water, as wastage of water would be an expensive proposition. The water thus saved could be used in the tail or even to increase the total command. It has been estimated that a 30% improvement in water use efficiency in the Indira Gandhi Canal Project in Rajasthan could lead to an additional command of more than four lakh hectares.

Strangely enough, a volumetric charge, which encourages efficiency of water use, could have two other major benefits:

[a]. It could reduce water charges since the same water can be used to cover much larger area and therefore the cost of irrigation would decrease;

[m]. It could reduce the need for storage, as lesser water would be required to cover the same area.

The actual benefit would probably be a combination of these two factors.

This reviewer is of the view that the most significant reform in the water sector and one that needs to be immediately implemented, is a change over from the current systems of water charges to a volumetric system that encourages water saving. This will need proper metering and monitoring systems but the cost is negligible compared to the benefits that can accrue.

4.2.2.2 Conjunctive use of water

Another area that needs greater examination is the possibility of conjunctive of use of ground and surface water. In irrigation projects, a large fraction of the canal water seeps underground. This, and excessive use of water, are identified as the primary causes for salinity-alkalinity and waterlogging. It is possible to reduce both these problems if say, only 70% of the water requirements of the farmer are met through flow irrigation and he meets the balance through installation of shallow tube wells. This combination of ground and surface water use can also increase the total water use efficiency, thereby allowing increase in the total command area.

> Conjunctive use of water is not a new concept. It has been tried, and proven, across the country. The only difference is that it has not been consciously made a part of the design of any irrigation project.

It must be borne in mind that neither rationalization of water rates nor conjunctive use of water by reducing water availability will be easy to implement. There is likely to be opposition from a farming lobby used to easy and almost free access to water. Nevertheless, this is imperative if any significant improvement in the use of stored water is to be achieved.

4.2.2.3 Participatory Irrigation Management

Participation of end users in irritation management is expected to increase productivity and create a more efficient water use regime. As water becomes a tradable commodity and therefore valuable resource, it is expected that local water users associations will use water to maximize the returns. PIM is also expected to reinforce the concept that water has a scarcity value.

Peoples' participation in irrigation management does not occur as a matter of course. It requires detailed micro-and macro level planning. In order to introduce PIM, action will be needed on a variety of fronts which include:

Improving the policy framework;

Strengthening the legislative and regulatory framework;

Establishing government and non-government institutions:

Introducing economic incentives;

Technological improvements; and

Improving modelling, data, performance and environmental monitoring; improving public information.

Even after all the planning introduction of PIM is fraught with a number of dangers. Some of the issues that will need careful consideration are:

Long Term Sustainability

> The long-term sustainability of WUAs is important. Apart from ensuring economic viability, the WUA must be able to play a useful and continued role which makes the farmer interested in sustaining and nourishing it.

Caste & Class Groups

> Caste & Class groups can play a divisive role. Dominant castes traditionally have also held a greater share of the economic benefits, sometimes at the cost of the weaker caste groups. A WUA, which seeks to create egalitarian division of an important economic asset, is likely to cause conflict. As and when elections are held, it is caste affiliations may dominate and executive ability may not be a criterion.

· The Rural Elite & its Role

Another class of people who can have a negative impact on the functioning of the Water User Associations is the 'Rural Elite'. The possible role of the traditionally dominant, who enjoy a major share of the economic resources, has already been discussed. There could be several conflicting economic grouping within a WUA and their interests may clash with the role of the WUA.

The Political Leadership

The role of the political elite will be crucial. It is possible that in many cases the WUA will become a rival centre influence since are expected to make collective decisions in many cases and may also get a legally enforceable right to adjudicate on certain kinds of disputes. Often, this could lead to immense influence at the village level, thus creating conflict with the traditional leadership. It will be necessary to take the political classes into confidence while setting out on a drive to create WUAs.

Existing Rural Institutions

There is also some misgiving on whether creation of specialized bodies, such as WUAs, is at all necessary. The 73[rd] and 74[th] amendment of the Constitution of India have given recognition to the Village Panchayat as the key statutory body at village level. The creation of WUAs may lead to a multiplicity of institutions jockeying for influence at the village level.

Interestingly the village level co-operatives and other such bodies may also be affected. As the Water Users Associations grow, they are expected to take on many additional functions such as providing for inputs, marketing of produce etc. This could bring them in competition with the co-operatives and other bodies sponsored by Government itself.

While Participation in Irrigation Management is extremely desirable, it will not be easy to introduce or sustain. A great deal of planning and foresight will be necessary before these institutions can become viable.

4.2.2.4 Higher Productivity

The ICS/DFR makes the point that the need to create greater storage can be balanced partly by improving productivity in Indian agriculture. The current productivity is low and can be dramatically improved. In rain fed areas too, improved productivity could help in improving the food security and thus reduce the need to create fresh storage.

The argument has considerable merit but not from an angle of reducing the need for water storage. Given the growing population, higher production and productivity will be needed in future as well. The productivity increases will come not just through irrigation but through farm management as well. The two are complementary and not necessarily an alternative to each other. Similarly, productivity increases in rain-fed areas is also necessary. Apart from helping meet the food needs this will also help in improving equity.

Higher productivity cannot be an alternative to water storage by itself.

4.2.2.5 River basin management

The reviewer agrees that that watershed based management, *in-situ* water harvesting, sub-surface storage etc. should be used in conjunction with other options such as large dams. Watershed management is not only required in the catchments of dams but also in command areas. However, the report does not highlight the need for planned development very well.

Large dams obviously cannot be ruled out as an option in hydro-electricity as the alternatives are not well developed. Similarly, large dams are not necessarily an unviable option for Irrigation

Management. What needs to be emphasised that the storage must be decided, not on engineering designs, but on the overall appreciation of social and environmental costs.

Even after a dam is found to be a viable option, it must be a part of the overall river basin and the total resources of the basin has to be planned keeping inter-sectoral water allocation in view. Such an integrated plan would take into account the ground water regime and the development of catchments. It would encompass both quantity and quality aspects of water.

In a river basin management plan, the emphasis must be on 'demand management' and not on increasing supplies. Demand management must include productivity issues as well. In the process, public awareness and participation will also have to be integrated into the plan.

If dams large or small are to be harnessed, it must be as part of a river basin or sub-basin plan and be an integral part of the total plan. It cannot be planned in isolation. In addition, it must be in harmony with the national & State Water Policies as well.

4.2.2.6 Flood Control

The reviewer is in general agreement with the views expressed in the ICS/DFR except to point out that in the Bhakra-Beas system, the reservoir is usually not filled to capacity in order to cater to possible flooding. Also there is little record to show that panic release of water from these reservoirs has caused flooding either in Punjab or Rajasthan Project Formulation & Analysis

Dams in India are said to be financial disasters. This has been brought out very clearly in the ICS/DFR by Pranab Banerji[22].His findings and that of the team can be summed up as follows:

4.3 Appraisal Procedures & Criteria

Banerji points out that the entire appraisal is based on some rudimentary quasi-economic criteria. The usual procedure is to evaluate the benefits as well as the costs at market prices and determine a ratio (the B-C ratio). This ratio is then used to evaluate the project. Any project with a B-C ratio greater than 1.5 is held to be viable. For drought prone areas, this ratio is taken to be 1.0. This criterion leads to the following anomalies:

The costs and benefits adopted for project formulation are often rule of thumb. There have been instances when costs have been underestimated and benefits exaggerated in order to get a project approved. The following differences are commonly seen:

i). Cropping patterns adopted for appraisal often are not related to the actual crops grown in the post project period;

ii). The area actually irrigated is usually less than projected;

iii). Environmental costs have been underestimated;

iv). Cost escalation and design changes make the appraisal meaningless.

The criteria adopted minimises the importance of securing adequate return from investment on Irrigation projects. A more rigorous economic criterion was proposed by the Nitin Desai Committee in 1983 but this was never implemented.

There has been no emphasis on cost coverage. While the Vaidyanathan Committee in 1992 did provide indicative costs of projects and these findings are incorporated in costs, the actual recoveries are much lower. The unfortunate fallout is that projects are financially not viable from the outset. Moreover, across the country, O&M costs are not fully provided in the budgets leading to decline in the quality of assets.

Capital costs are not recovered at all. Both the non-recovery of capital costs and operational costs imply an indirect subsidy to the farmer.

22 Sections 8-15, Executive Summary

- Distributional aspects are not taken into consideration at all

Analysis

The reviewer agrees with most of the observations of the ICS/DFR and would like to add the following comments additionally:

The environment management as well as resettlement & rehabilitation costs must be added to the capital costs. The costs should be computed based on the level of activity that has been suggested in the ICS/DFR and not on any arbitrary figure.

At the end of its life, a dam has to be decommissioned. De-commissioning costs must also be included in project costs;

There must be objective criteria for determining costs and benefits. A project should be realistically assessed in so far as costs and benefits are concerned;

A project must be assessed on its true costs. Even if the Government provides capital subsidies and O&M subsidies, the cost of capital should be built into the project cost.

Discounted cash flows and shadow pricing should be used to determine social costs and benefits. The report of the Nitin Desai Committee should even now be implemented.

Appraisal techniques as well as actual appraisal of projects should be made public and comments invited.

Appraisal should not be based on a single design or project concept. Alternate project concepts should also be examined in detail and benefit-cost criteria evolved.

A system of post-completion evaluation should be introduced.

5. Institutions, Operations & Management

5.1 Institutional Framework

The issues raised by R. Ramaswamy Iyer[23] are more in the nature of a factual statement and do not need elaboration. The agency for preparation of a large dam project is usually the Irrigation Department of a State or a Central Government Agency (i.e. National Hydro Power Corporation). After approval of the State Government, the Project goes to GOI for clearance. At GOI level, it is examined by a Technical Advisory Committee, a multi-disciplinary body. It is assisted by the Central Water Commission. Energy projects, are also examined by the Central Electric Authority.
The Ministry of Environment & Forest independently grants Environmental Clearance. Two separate clearances are needed. One under the Forest Act (by the Forest Advisory Committee) and the other under the Environment Protection Act (by the Environment Appraisal Committee).
Once it is cleared by these committees, the project goes to the Planning Commission for inclusion in the National Plan. The Planning Commission examines the project keeping in view the sectoral planning policies, investment priorities and funds availability.
Fragmentation and compartmentalisation of responsibilities at the administrative level militate against holistic integrated planning. Even within the area of water resources different components such as major/medium projects; minor irrigation; CAD; groundwater; watershed development; water management etc. are dealt by different agencies/ divisions/ departments. There is very little coordination much less integration.
The processes of appraisal and decision-making are not rigorous enough. There are no institutional arrangements for consultation and grievance redressal. The process of displacement resettlement and rehabilitation is usually left to the implementing agency.
There is no effective mechanism for ensuring compliance with conditions under which are project is approved or for responding appropriately in the event of non-compliance.
The implementing agencies can be any of the following:

A specialised organisation set up for the purpose (e.g. The Narmada Valley Authority, The NHPC etc.)

The State Government Department (Usually Irrigation Department).

5.2 Operational Issues

There is no separate section on operations and management of large dams in India. Insights are available in the various sections. There is some data available on project implementation, particularly with respect to capital costs[24]. There is much less information available on operational efficiencies and the impact of institutional framework on such efficiency. However, various official committees have looked at the discrepancies between actually and the resumption is in project reports.

5.3 Analysis

5.3.1 Institutional Reform

The analysis on institutional framework and operational issues is somewhat deficient, primarily because the ICS/DFR does not give a clear vision about implementation and management of large dam projects. It calls for a holistic view for planning and implementation but does not take this proposition to a logical conclusion by suggesting a proper institutional mechanism to implement this vision.

23 Section 3.4 & 3.5 of the ICS/DFR

24 Pranab Banerji in section 8.3 gives a good analysis

If a river-basin management approach, which takes a holistic view of water resources and inter-sectoral demands, is to be adopted, the following broad institutional structure will probably be necessary:

5.1.3.1.1 Central Level

We have already discussed the need to set up a standing dispute resolution body for inter-state water disputes. It is necessary to ensure that any of the States or the Centre can approach this body. It is also necessary to ensure that the decisions of this body are final and honoured by all concerned. It may be necessary to provide constitutional protection to this dispute resolution body[25].

River Board Authorities may set up in order to administer inter-state river projects. Such Boards will need to have sufficient authority to enforce its decisions, but given the federal nature of the Indian State, must work through the States. A starting model could be the Bhakra-Beas Management Board, but the authority and the functional freedom of the Boards must be enhanced to make them effective.

There is a need to strengthen and re-structure the apex bodies such as the TAC, the CWC and the Advisory Committees under the MoEF to allow the following:

v). Integrated and holistic planning and not compartmentalisation in decision making as is the case at present;

vi). Greater transparency in the appraisal and approval process including a system of institutionalised public hearings;

vii). A procedure and institutional arrangements for grievance redressal; and

viii). A monitoring and evaluation arrangement for post-project evaluation.

5.2.3.1.1 State Level Institutions

The first need is to set up a State Level Planning Board for the water resource sector. This body must finalise the State Water Plans, which must be in harmony with the National Water Plan. There should also be an executive body to translate the State Water Plans into action Plans and monitor their implementation;

Apart from water use, the States must give far more attention to irrigated agriculture and work towards the twin aims of improving efficiency of water use and improving productivity. Institutional arrangements to support the Water User Associations will need to be set up.

Existing State Level Institutions such as Irrigation Departments will need to be restructured to become 'enabling departments' from regulatory bodies. Regulatory framework will need to be changed and dispute resolution mechanism for local and other disputes set up.

5.3.3.1.1 Local Level Institutions

If PIM is to be ensured in Irrigation Management, the States will have to introduce legislation enabling and empowering Water User Associations (or other local bodies) for he task of micro-level irrigation management. Such institutions will have to be must be encouraged and prodded towards sustainability from the very beginning;

Assets created in the past should be transferred to community management wherever needed.

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[25] Please also see Section 33 in Chapter II

5.3.2 Operations & Management

5.3.2.1 Energy

Generation can be increased and T&D Losses reduced through technological upgradation. To improve efficiency, the user charges should be raised and made volumetric. A cascading rate of electricity should be considered.
Subsidised electricity should be replaced with a system that emphasises service delivery. The farmer in India is now conscious that he needs stable continuous power more than cheap electricity.

5.3.2.2 Water Resources

5.1.3.2.2 Ground Water
Ground water should be preserved for drinking water needs to the extent possible. Ground water use must be restricted through legislation as well as fiscal measures. The State could consider a levy on ground water usage that discourages excessive use of ground water and emphasises water saving.
Small water harvesting structures, sub-soil and surface barriers to ensure recharge, watershed development and other measures to augment ground water availability must be undertaken on a war footing.

5.2.3.2.2 Irrigation
In the Irrigation sector, there is an immediate need to improve water use efficiency. The Country needs to switch from a crop/area based water charge to a volumetric charge. Metering systems need to be introduced.
Maintenance of existing irrigation systems is very poor. Most states have not provided for adequate maintenance and have instead concentrated on new works. The focus needs to shift to improving irrigation efficiency. This will bring more area under cultivation than new projects and at a lesser cost. Rigorous post-project evaluation of irrigation projects should be introduced.

5.3.2.3 General Policy Reforms

States should publish their Rehabilitation & Resettlement Policy for Project Affected Persons. They could consider establishment of an independent directorate for implementation of this policy. Post-project evaluation of the state of the displaced through an independent agency should be introduced.
Key Lessons
The views expressed in this chapter are primarily that of the reviewer. They have been deeply influenced by the draft final report of the India Country Study and tempered by the reviewer's own experience, observations and studies. The reviewer submits this chapter as a synthesis of the multiple views that are available in the ICS/DFR itself and those that emerged in the stakeholders' meetings.

5.4 The Future Scenario

5.4.1 Hydropower

India will continue to depend on large dams for electricity generation at least until other technologies prove cost effective and stable.
Nevertheless, there is considerable scope for improvement of generation with more efficient turbines and other technological improvements. There is also a dire need to improve transmission and distribution losses which are extremely high.

5.4.2 Irrigation

India will continue to rely on irrigated agriculture as the main engine of agricultural growth. The growth in rain fed agriculture is still too small to make a major impact on the overall growth of this sector. Historically, Indian agriculture has grown at a compound rate of 3%. This has been primarily from the irrigated sector.

In addition, increased demands from other sectors, particularly drinking water, will have to be met from surface water sources. Groundwater is already over exploited and conservation, rather than expansion has to become the norm in this sub sector.

Drinking water needs will increasingly be met from surface water sources as ground water exploitation continues unabated. This will result in higher storage needs and reduction in commands areas.

There are two main options for achieving continued or higher growth. One is capacities/area expansion and the other is through productivity enhancement:

> Area expansion is encountering increasing constraints. India has already developed take considerable fraction of the service irrigation potential. Groundwater is over exploited. Environmental constraints as well as the capital cost of projects has been increasing rapidly and a proper social economic benefit analysis would make many new projects unviable. Fiscal constraint is also likely to play its part. Irrigation's shares in the overall Plan has been decreasing and is now only 7%. It is unlikely to rise.
>
> Future increases in irrigated area could come more from better water management than from new projects. There is considerable wastage of water and the water distribution in existing projects can be much better. Together this could result in large increases in area under irrigation and the quality of irrigation provided.
>
> Productivity enhancement has greater potential. The yield gap between research farms and actual farmers' fields is considerable. So is the gap between the productivity of Indian farms and that of other countries. Better farm management and inputs, supported by marketing structures can bring about much higher growth than has been thus achieved.

5.5 Policy, Legislative & Institutional Reforms

5.5.1 Policy Reform

The National Water Policy, 1987 provides a broadly favourable environment but needs updating. It has not been translated into effective action and more needs to be done in this direction.

Development and management of water is primarily a 'State Subject' it minimal action has been taken at State levels. Each State needs to prepare a State Water Policy responsive to its own needs but in overall compliance with the National Water Policy.

> The policy framework should include provisions for user participation in management, users rights on water available and the ultimate development of active water markets.

The National Water Policy and the State Water Policies will have to be supplemented by legislation, action plans, institutional restructuring and administrative action. In the past, they have more or less remained on paper.

The National Policy for Rehabilitation & Resettlement of Project Affected Persons must be finalised and published. States should publish their own R&R policies which will be in line with the National Policy. R&R should be based on the principles that the displaced should also benefit from the project and that, post rehabilitation, their economic and social status should not be less than that enjoyed by them in the pre-project stage.

Environmental Clearance must become more rigorous. If needed this can be given legislative teeth. Alternative models based on the principle of least damage and least displacement should be a part of project feasibility studies.

> Minimum standards must be laid down for adverse environmental impact. Similarly, detailed guidelines for conducting environment impact assessments must be published so that such assessments are done objectively and can be examined with a degree of objectivity.

However, it has to be ensured that the decisions are taken in a reasonable time frame and perceived differences should not become a tool to hold up projects indefinitely.

5.5.2 Legislative Framework

The Land Acquisition Act should be modified to ensure that the 'public purpose' as defined by the State becomes justiciable or at least the state must be bound to publish the reasons why a project is in public interest.
The Official Secret's Act must also be modified to enable free flow of information and informed public debate.
An inter-state dispute resolution body to arbitrate on water and hydropower issues must be set up. It must be given adequate legal recognition and powers and the decisions of this body should be final.
The River Boards Act must be amended and strengthened to enable the Centre to set up River Basin Development Authorities. These Authorities will work within the federal constitution limits.
Both Government of India and the State Governments must enact legislation to regulate pumping and use of Groundwater.
The States will need to drastically amend their Irrigation and drainage Acts to allow user participation in Irrigation Management. Legislation may also be needed to permit setting up of WUAs and giving them wide powers of management and revenue collection.

5.5.3 Project Feasibility and Appraisal

It is meaningless to convert every discussion on dams into a pro-dam and anti-dam controversy. The emphasis should instead be on integrated water resource planning which promotes demand management rather than maximising storage.

> Large dams should be part of a total River Basin Management Plan. River basin management should include inter-sectoral water allocation, integrated development of surface and sub-surface water, watershed management, ground water recharge etc. as an integral package.

Dams should be taken up only after an exhaustive analysis of alternatives and should be the best viable alternative rather than the preferred solution. While taking up a project involving construction of a large dam the following should be kept in mind:

> Environmental Impact Assessments should be carried out by independent professional agencies. Just as projects are required to reach financial closure before any substantial investment is made, so also projects should be required to reach "Environmental Closure" before any construction is taken up.
>
> Public hearing as well as transparency in both assessing the environmental impact as well as in publishing the results of the assessment should be institutionalised.
>
> Options to each project must also be studied and environmental costs of each option assessed. Environmental costs must be considered while determining the benefit-cost parameters of any project.

Resettlement & Rehabilitation Plans must be drawn up in full public gaze before a project is appraised. The need for a project must be established and the fact that alternatives have been considered must be apparent.

An R&R package should be based on the principle that the standard of life of a PAP shall be at least equal to the one he enjoyed before displacement. Wherever possible a PAP must be a beneficiary of the project. He should be provided land in the command area of a project or be the first to get electricity or both.

A baseline survey should precede an R&R package. The implementation of R&R should be made independent of project authorities. Post implementation studies to assess the impact of an R&R package should be carried out as a matter of course.

The overall project should also emphasize social equity and distributive justice.
Project cost should include environmental management costs and complete rehabilitation costs. In addition, the appraisal techniques should be improved to carry out a more detailed social cost benefit analysis, as recommended by the Nitin Desai Committee.

5.5.4 Operational Issues

Electricity Tariffs should be raised and made volumetric. A cascading rate can be considered where an individual pays more for higher consumption.

T&D Losses can be reduced substantially. Generation can be improved using better technology at costs than that for creation of new capacities.

Irrigation Projects should emphasise conjunctive use of ground and surface water for command areas of large dams. This, combined with lower water use can have a major impact on waterlogging and salinity-alkalinity problems in command areas of large dams. The water saved could be used to increase command areas and/or reduce storage needs.
Water use efficiency is very poor in India and needs to be improved drastically. Water rates must immediately be raised. It should also become volumetric and like electricity tariff, ensure that wastage is expensive. The water saved could be used to improve equity in water distribution and increase the command area.
The maintenance of assets in the Irrigation Sector has been very poor. More funds need to be allocated to meet maintenance costs immediately. A project should meet its O&M costs and at least a part of the capital costs through water charges.
PIM should be introduced at grassroots irrigation management as early as possible. The WUAs can be encouraged to fix their own tariff so that they are viable. At the same time, the difficulties envisaged in the functioning of WUAs must be kept in mind while enacting enabling legislation.

5.5.5 Institutional Reform

The institutional arrangements for appraisal of projects will need to be strengthened in order to emphasize holistic planning and appraisal.
Inter-state disputes in water & energy sectors must be expeditiously settled through an arbitration mechanism which needs to be set up.
River Board Authorities need to be set up for interstate river basins. These will work under the overall federal structure of the Indian State.
A State Level Planning and Monitoring Agency for the water resources sector needs to be set up in most States and where they exist they need to be strengthened.
A State level agency for R&R projects is desirable.
Local level institutions for PIM and for dispute resolution need to be set up.