

Tehri Hydro-Electric Project
Narmada Valley Project

Environmental Hotspots

**Tehri Hydro-Electric Project
Narmada Valley Project**

Compiled by :
Jagdish Bahadur



Vigyan Prasar

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TEHRI HYDRO-ELECTRIC PROJECT NARMADA VALLEY PROJECT

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List of Abbreviations

BCM	–	Billion Cubic Metre
CAT	–	Catchment Area Treatment
CCA	–	Culturable Command Area
CFCs	–	Chlorofluorocarbons
EIA	–	Environmental Impact Assessment
EPGA	–	Expected Peak Ground Acceleration
FRL	–	Full Reservoir Level
FSD	–	Flood Surface Depth
FSL	–	Flood Surface Level
GCA	–	Gross Command Area
GLOF	–	Glacier Lake Outburst Floods
GOUP	–	Government of Uttar Pradesh
GSI	–	Geological Survey of India
Gwh	–	Gigawatt hour
HLC	–	High Level Committee
IIM	–	Indian Institute of Management
IRR	–	Internal Rate of Return
ISRO	–	Indian Space Research Organisation
JCL	–	Jyoti Consultants Ltd.
LOI	–	Letter of Intent
M ham	–	Million Hectare metre
MAF	–	Million Acre feet
MCM	–	Million Cubic Metre
MCT	–	Main Central Thrust

MDDL	–	Minimum draw down level
MRL	–	Maximum Reservoir level
NBA	–	Narmada Bachao Andolan
NCA	–	Narmada Control Authority
NGOs	–	Non Government Organisations
NSP	–	Narmada Sagar Project
NTT	–	New Tehri Town
NTWL	–	Normal Tail Water Level
NWDA	–	Narmada Water Dispute Tribunal Award
NWDT	–	Narmada Water Dispute Tribunal
NWP	–	Narmada Planning Group
NRL	–	Normal Reservoir level
ORG	–	Operations Research Group
PAP	–	Project Affected Persons
PGA	–	Peak Ground Acceleration
RSAC	–	Remote Sensing Application Centre, Lucknow
SSNN	–	Sardar Sarovar Narmada Nigam
SSP	–	Sardar Sarovar Project
SWS	–	Sub-watersheds
THDC	–	Tehri Hydro Development Corporation
THP	–	Tehri Hydro-Electric Project
ZSI	–	Zoological Survey of India

Foreword

It would be a gross understatement to say that India is besieged with problems of environment. Most of our big, medium and small towns and cities are becoming more unlivable for humans with every passing day — notwithstanding a good bit of public interest litigation, an activist judiciary, the human rights commission, and the fact that a large part of our urban population in all major cities and bigger towns inhabits slums under inhuman, unsanitary and intolerable conditions.

Why, in the midst of all this, talk about “India’s top environmental hotspots?” You would indeed be right in wondering why! For, each problem is worse than the other in terms of severity and chances of it getting resolved or overcome without a whole lot of things happening and many an actor getting their act together!

That’s precisely why! Vigyan Prasara does not have solutions to those problems. (No one else does either!) Through these reports, we would like more and more people to become aware of each of these problems in a way which would allow them to take a more dispassionate and objective view of the real issues involved, of the contentions being made by the proponents as well as the opponents; of whether the hard data available are, or are not sufficient to back up or support contentions on either side of the divide, or to clinch any issues decisively in favour of one view or the other; and so on — and form their own **informed** opinions on such issues, as also be able to query proponents/opponents on specific points.

Accordingly, for each selected hotspot, we have attempted to present at one place all the relevant facts, data and information available; the contentious issues involved alongwith the stated positions (on each of these issues) of the proponents and opponents — and a bibliography listing references, sources of information and other materials available for more details and further reading.

We at Vigyan Prasar felt that while such contentious issues get a great deal of coverage in the mass media (print, radio & television), especially during public campaigns launched by the opponents, and common people become aware of these controversies, they hardly know anything about the key issues involved, or of their background and are unable to formulate their own stands for lack of ready access to the required information. Hence, these reports! We also intend bringing out language versions of these reports depending on the response they evoke and the feedback they generate.

While bringing out these reports we are conscious of the fact that there is a plethora of information available on most of the topics, but spread out at hundreds of places. In fact in some cases the enormity of diverse materials available comes in the way of getting at the desired information. Particularly those who are not following the events find themselves at a loss. These reports are not intended to oppose or to support any existing view points on a particular topic. Nor should one expect any fresh insights or inputs — other than seeing all the essential things at one place. While putting together the relevant material if something has been left out, in spite of our sincere and conscious efforts, it should not be construed as intentional. We would be happy to see someone pointing out such an omission and we would try correcting it immediately.

We would welcome critical comments and observations on these reports and love to receive inputs/suggestions on further topics we need to include under this series.

Narender K. Sehgal
Director
Vigyan Prasar

September 1998

VIGYAN PRASAR

An Introduction

Vigyan Prasar (VP) was set up by the Department of Science and Technology, Government of India, as an autonomous registered Society in 1989 for taking up large-scale science popularisation tasks. Its broad objectives may be summarised as follows:

To undertake, aid, promote, guide and coordinate efforts in popularisation of science and inculcation of scientific temper among the people and to increase the knowledge, awareness and interest about science and technology among all segments of the society.

To provide and promote effective linkages on a continuing basis among various scientific institutions, agencies, educational and academic bodies, laboratories, museums, industry, trade and other organisations for effective exchange and dissemination of S&T information.

To undertake development of materials—audio, visual, audio visual and printed—methods and modes of communication, so as to enable the masses to better understand, appreciate and comprehend abstract scientific principles and practices.

To organise research work, courses, workshops, seminars, symposia, training programmes, fairs, exhibitions, film-shows, popular discussions, street plays, quizzes, song-dance-dramas etc., in furtherance of the objectives of the Society.

After its establishment Vigyan Prasar remained dormant for a few years. Only in 1994 some activities could be taken up in right earnest. One among the first few programmes initiated by Vigyan Prasar was the 'Ready-to-Print' Science Page project. The idea was to prepare a well laid-out newspaper-size page with one or two features and several smaller items on scientific

and technological (S&T) developments taking place in India, appropriately supported with photographs, illustrations, graphics etc., and to supply it to newspapers to carry as it is. Initially, such pages in Hindi and English were planned for release once a month. Subsequently, a children's page, science pages in other major Indian languages and a feature packet service were also added. Today, these pages are being carried once or twice a month by more than 30 editions of some 20 newspapers spread all over the country. Infact, today Vigyan Prasara's are the largest circulated science pages in the country. The combined print order of all these newspapers exceeds 2.5 million copies. These pages have led to fresh demands for enhanced science coverage in other newspapers.

Vigyan Prasara's publications programme is gradually taking shape. A number of important series has been launched; some more are planned. The first major English publication brought out by Vigyan Prasara, viz., *"Memoirs of Ruchi Ram Sahni: Pioneer of Science Popularisation in Punjab,"* under its series on Pioneer Science Popularisers in Pre-Independence India has generated positive awareness among science communicators and enthused researchers about the need to unearth other such personalities in other parts of the country. Already names of a number of individuals who did pioneering work in the field of science popularisation in pre-independence India have come to light.

Popular science classics written by Great Masters in the past, which have inspired generations of students of science, are no longer seen in the hands of our younger generation. This is not because these books have gone out of context, but because they are no longer available. Vigyan Prasara under its Popular Science Classics series intends to reprint these books and bring them out in low-priced affordable editions so that more and more children can have them. Already two such classics (Michael Faraday's *Chemical History of a Candle* and C.V. Boys' *Soap Bubbles And the Forces Which Mould Them*) have been brought out and more are on the way.

Inspired by the focal theme for the National Science Day-1995, viz., 'Science for Health', Vigyan Prasara initiated a Health Series. Under it publications on all common diseases, along with possible management of their curative and preventive aspects would be brought out. The first three titles on *Sexually Transmitted Diseases, Asthma and Jaundice*, have already been released.

Under its series of Monographs on India's Scientific Heritage Vigyan Prasara intends to bring out publications on specific science and technology areas in which India's contributions have stood the test of time, as also have made an impact on modern-day science. The first monograph in the series *The Rustless Wonder : A Study of the Iron Pillar at Delhi* was released on 30 January 1997. The second volume 'Where Gods Come Alive : A Study of the South Indian Bronze Icons ' would be going to the press shortly.

The Total Solar Eclipse of October 24, 1995, provided Vigyan Prasara a rare opportunity to organise a country-wide awareness campaign, aimed at dispelling age-old myths and superstitious beliefs related to eclipses, and to develop among people an urge to learn about their known scientific aspects. Vigyan Prasara jointly with the National Council for Science and Technology Communication (NCSTC) organised a number of activities:

- i. Telescope-making workshops for students and teachers.
- ii. Development and production of books, a total solar eclipse chart and an activity kit for children.
- iii. Production of several video films and their telecast.

Vigyan Prasara conceptualised and implemented a novel idea for ensuring that people did come out and watch the total solar eclipse. It circulated a total solar eclipse pledge. People in thousands from all corners of the country sent in signed pledges. Many individuals and voluntary agencies got these pledges translated into regional languages on their own and distributed

the same in large numbers. All this led to a chain of activities throughout the country. The efforts made by VP, NCSTC and other agencies created a situation where millions of people came out and watched the spectacular event. This was a unique experience and made Vigyan Prasara's name a household word throughout the country.

Under its audio-visual programme, Vigyan Prasara developed a set of video films and several radio programmes on the occasion of the total solar eclipse of 24 October 1995. This event-based effort was enormously satisfying for the VP family and generated a very good response from the public at large.

Vigyan Prasara has recently begun building an Information System called VIPRIS — acronym for **V**igyan **P**rasara **I**nformation **S**ystem — to meet a long-standing demand from different quarters, particularly the science communicators, to establish a repository of background data and information on various aspects of S&T which would be accessible easily. The computerised system would be built on a modular basis, and aim to meet the information needs of science communicators of all kinds.

At this stage, under VIPRIS, we have a fortnightly clippings service, an electronic bulletin board service (BBS), two pages daily on Doordarshan's teletext service and weekly science news on the radio. Several other products and services including training, development and production of CD-ROMs, generation of data bases on different subject areas etc., are being planned.

The first phase of the database on "Environment & Safety Laws: Regulations & Guidance Documents" has been completed. VP launched its Home-Page on the Internet on 12 September, 1996. An online electronic popular science magazine 'ComCom', has been planned as part of the Home page. The other sections of the Homepage are, About Vigyan Prasara, Daily Weather Report, Sky map of the days/month links with other related

homepage, S&T vacancies in India, News from S&T laboratories, S&T databases etc. It has provision for Hindi HTML and support for Web browsers/users to download the Hindi Plug-in and install it in their system. It has also a discussion forum with support to display and keep visitors' view.

Vigyan Prasar has also produced audio-cassette sets of the 108-part radio serial 'Manav Ka Vikas' (jointly produced by the NCSTC and All India Radio) in 18 Indian languages.

A number of video programme has also been produced. Recent ones among them have been on "Herbal petrol" and "Comets"(in connection with the coming of the comet "Hale-Bopp"). Several other programme are possibly under production.

This is not all. Vigyan Prasar does many other things. But for now this should suffice.

Narender K. Sehgal
Director
Vigyan Prasar

PROLOGUE

The Tehri Hydro-electric Project is a major venture in the central Himalayan region. The river catchments in the area comprise highly rugged, multicyclic slopes resulting from glacial, fluvial and neotectonic processes. The area lies in a seismically active zone. Here glaciers are receding fast. Increasing biotic pressure, deforestation, mining, road construction and overgrazing in the forests are creating further instabilities in this geo-dynamically sensitive region. This has resulted in desertification. The harvesting and storing of water are of paramount significance for human wellbeing and the growth and development of our economy. The object of creating a 42 Km² water reservoir is to provide hydro-power (2400 mw) and irrigation to an additional 2.7 lac ha annually, besides intensifying the existing irrigation of 6.04 lac ha of land. The opponents, however, have been arguing for a large number of small dams in place of a big single dam.

The Tehri Project has become controversial due to several factors – inundation of large forest areas, submergence of cultivable land and the accompanying displacement of a large population (over one lakh persons), high rate of siltation of the reservoir, and the havoc caused by floods and landslides in this geodynamically active and heavily populated region.

The techno-economic clearance was granted to the project by the Government of India in the early eighties. But the construction has had to be stopped because of strident agitation by the opponents of the project. A lot of doubts have been raised on several counts. The lack of adequate scientific data prevents clinching of arguments on either side.

A confrontational approach has been adopted by both the authorities and the people likely to be affected by the creation of the water reservoir. Opposition to the project repeatedly flares up due to the lack of a knowledge-based approach on the one hand and the concern for environmental regeneration on the other.

Indeed, the river worshipped as "the holy mother Ganga" represents an apex of human experience through times immemorial based on the symbiosis between mankind and life support systems. The conservation and preservation of this unique heritage is therefore a national responsibility. There can be no denying the fact that economic and social development presuppose the existence of a harmonious and dynamic social culture which can absorb and benefit from economic and social inputs. Ganga in its upper mountainous reaches has been creating dams at different places and periods which break due to excessive water and soil inputs.

The Narmada Valley Project envisages the construction of some 30 major, 135 medium and 3000 minor irrigation and hydroelectric dams as per the Narmada Water Dispute Tribunal (NWDT) master development plan. The ambitious project aims to harness the largest westward flowing river Narmada and its 41 tributaries to regulate the seasonal water flows. Impounding the river will create India's (if not the world's) largest artificial water reservoir (area 91,340 ha.) and change the river characteristics from lotic (living in flowing water) to lentic (living in still water).

The two main projects are the Sardar Sarovar Project (SSP) in Gujarat and the Narmada Sagar Project (NSP) in Madhya Pradesh (MP). SSP is a multipurpose irrigation and hydroelectric project which aims to provide annual irrigation to 17.92 lakh ha. in Gujarat and 0.73 lakh ha. in Rajasthan. It is expected to generate 1450 mw of power to be shared by Madhya Pradesh (MP), Maharashtra and Gujarat in the ratio of 57:27:16. The Narmada Sagar Project aims to provide annual irrigation to an area of 1.69 lakh ha. and generate 1000 mw of power in MP. Located about 300 kms upstream, it is designed to regulate the release of water for SSP. Full implementation of the master plan could take 50 to 100 years.

The monsoon is very erratic in the Narmada basin, varying by 20 to 25 percent a year. The normal annual rainfall decreases

from 1,700 mm in the east to 600 mm in the west. The river and the reservoir area which remain dry on highlands will be most benefited both upstream and downstream by the changed moisture regime as well as by the greater water availability round the year. However, the enhanced land irrigation may create problems of waterlogging and salinity in the area. Some of the best deciduous forests such as teak and bamboo in the Chandgarh and Punasa ranges in MP will be submerged. Intangibles such as the socio-economic value of the forests to the tribals and the loss of habitat and genetic potential etc. have not attracted the serious attention of the project authorities. Thus, there is little evidence of any systematic plan for recreating the biodiversity and richness of these forests.

The river Narmada is revered in the countryside as well as in the forests. It is deeply ingrained in the lives of the people threatened with displacements, whose number ranges from 1 to 10 lakhs. Due to the interstate character of the project and the largescale forest submergence and displacement of the people, there has been growing opposition to the project. Non-availability of reliable and comprehensive data on the social, economic, cultural and ecological aspects of the completed and ongoing projects raises further doubts in the minds of the affected people. The right to know and the right to participate meaningfully appear to have been denied to the project affected people (PAP) and the general public at a time when empowerment of the local people for the management of natural resources is well on its way to becoming a universally accepted right. Participative management has been upheld in many resolutions passed by the state and powerholders but not practised.

The development plan has to address the issues of ecological sustainability, problems arising out of human displacement, and provision of adequate compensation to the affected people. Monitoring of the implementation programme by independent agencies would only enhance the credibility of the project.

PART-1

***TEHRI HYDRO-ELECTRIC
PROJECT***

1. Origin and Background

The Geological Survey of India (GSI) considered Tehri a suitable site for constructing a high dam in 1949 provided subsurface investigations did not reveal anything adverse. Detailed investigations were carried out in 1963, and the site was found suitable after the visit in 1965 of the then Union Minister for Irrigation and Power, Dr. K.L. Rao. By 1967, several Indian and foreign experts had visited the dam site and recorded their opinions. Preliminary investigations by GSI had revealed a river bed fault at the dam site which strengthened the decision to opt for a concrete dam. Apprehensions were expressed with regard to the geologically vulnerable area around the dam site, the unstable hill slopes forming the reservoir rim areas, and the high seismicity of the region. It was decided to go in for a clay core rock-fill dam since such a structure would allow more flexibility. Another notable feature is that about one-third area of the catchment is covered with snow and glaciers (receding at an average rate of 12m per year for the last 50 years) and is prone to hazards such as avalanches, dam bursts and heavy siltation. It needs to be monitored for meltwater and silt load contributions. The topography of the catchment is highly rugged. The multicyclic slopes have emerged from glacial, fluvial and neotectonic processes. The catchment area has several high mountain peaks, above 7,000 m (asl) and is one of the richest as far as biodiversity is concerned.

While many believe that the project will usher in prosperity, there are some who believe that it will spell doom. Project authorities are convinced that the Tehri Hydro-Electric Project (THP) will be a boon for the region just as Bhakra was for Punjab. They point out that the delays on account of the opposition to the dam are adding to the cost of construction besides denying benefits to the local inhabitants and the country as a whole. Some diagrams and pictures have been included to facilitate the the reader's comprehension about the project area and the stages of developments (Figs.1 to 6).

2. Project Description

The Tehri Hydro-Electric Project is a multi-purpose irrigation and power generation project. It is designed to provide irrigation to an additional area of 2.7 lac ha annually and stabilise existing irrigation to 6.04 lac ha of land by providing intensified irrigation. The project envisages the construction of the following structures:

- A 260.5 m high earth and rock-fill dam at Tehri.
- Four diversion tunnels each with a diameter of 11m. Their total length is 6.3 km.
- Two underground powerhouses, each of 1,000 mw capacity on the left bank of River Bhagirathi.
 - 4 x 250 mw conventional power plant
 - 4 x 250 mw pumped storage plant
- Water conductor system for each powerhouse comprising two head race tunnels, each of 8.5m diameters; four penstocks, each of 5.75m diameter, two tail race tunnels, each of 9m diameter.
- Koteswar dam project comprising a 103.5m high concrete dam and surface power stations of 4x100 mw capacity located 22 km down stream of Tehri dam.
- Associated transmission system for evacuation of 2,400 mw of power generated at Tehri complex at the northern grid.

The Tehri Dam Project is a large river valley project, with gross water storage of 3.5 km³ in a lake of about 42 km² that has become controversial on account of various factors. These include loss of agricultural and forest lands, displacement of a large population, reduction in biodiversity of flora and fauna, sedimentation of the reservoir, and high seismicity of the area. The river discharge at the damsite generally varies from 30 to 3,000 cumecs, it being minimum

in the months of January/February and the maximum in August. The average annual run-off at the Tehri dam site is of the order of 8 km³.

3. Official Parameters/Data

3.1 The Salient Features of Tehri Dam Project

Tehri HPP (Stage-I)

1. Dam

Type	– Earth & Rockfill
Top Level	– 839.5m
Height	– 260.5m above deepest foundation level
Width at river bed	– 1125m
Width at top	– 20m flared to 25m at abutments
Length at top	– 575m

2. Diversion Tunnels (Horse Shoe Type)

On left bank	– 2 nos., 11m dia, 1774 & 1778m long
On right bank	– 2 nos., 11m dia, 1298 & 1429m long
Diversion flood discharge	– 8120 cumecs

3. Reservoir

Catchment Area	– 7511 sq.km.
M.R.L.	– 835m
N.R.L.	– 830m
Dead storage level	– 740m
Gross storage	– 3540 million m ³

Live storage – 2615 million m³

4. Spillways

- (A) Chute spillways – Gated
- Crest level – 815m
- Water way – 3 Bays @ 10.5m width
2 Piers – 4m wide in between
- Design discharge – 5480 cumecs
- Type & No. of gates – Tainter, 3 nos..
- (B) Right bank shaft spillways– Ungated, 2 nos.
- Crest level – 830.2m
- Dia of shaft – 12m
- Design discharge – 1950 cumecs each.
- (C) Left bank shaft spillways – Gated, 2 nos.
- Crest elevation – 815m
- Dia of shaft – 12m
- Design discharge – 1900 cumecs each.
- Type & no.of gates – Tainter, one for each shaft.

5. Intermediate Level Outlet

- Number and size of tunnel – One, 8.5m dia meter
- Discharge capacity at EL.830 m– 1,200 cumecs
- Crest level – 700 m

6. Powerhouse

- Type – Underground, two in number

Cavity size	- 134x22x50m (Stage-I)
	- 144x22x65m (Stage-II)
Design head	- 188m
Head race tunnels	- 4 nos. each of 8.5m diameters, total length: 4,441 m
Installed capacity	- 1,000 MW (4x250 MW) (Stage-I)
	- 1,000 MW (4x250 MW) (Stage-II)

3.2 Rehabilitation

Uprooting people from their hearth and homes is always a traumatic experience for the affected population. The rehabilitation package offered by THP has not been implemented thoroughly. The people who were relocated nearly a decade ago have not got a legal title to the land. The landless labourers, marginal farmers, sharecroppers, tenant-cultivators, artisans, cattle-grazers, fisherfolk, and the like who depend on the region's natural resources have not been compensated satisfactorily for the loss of their traditional livelihood. Some salient aspects of the rehabilitation package are:

- * 2 acres of developed agricultural land to each rural displaced family, or 0.50 acre land within the municipal limits of Dehradun city in lieu of acquired land, even if the latter is less than 2 acres.
- * 2 acres of land to landless agricultural labourers, free of cost.
- * Cash compensation for land: As per the Land Acquisition Act, 1884.
- * A minimum of Rs. 2 lakhs for those Project Affected Families (PAFs) who wish to opt for cash compensation, instead of allotment of land.

- * Ex-gratia payment
 - Irrigated land : Rs. 12,000 per acre
 - Class-I (unirrigated) : Rs. 6,000 per acre
 - Class-II (unirrigated) : Rs. 4,000 per acre
- * House compensation : 1.3 times of the depreciated cost of the house, plus ex-gratia payment equal to depreciation, subject to a maximum of Rs.50,000.
- * Rs. 4,000 for seed and fertiliser for the agricultural land allotted to each family.
- * Rs. 5,000 for shifting household effects.
- * In addition to a developed agricultural plot and subject to availability, a residential plot of 200 m² shall also be given on payment of cost.
- * At New Tehri town, plots of 60, 100, 150, 200 & 300 m² are being allotted at the following rates:

A. upto 150 m ²	Rs. 5 per m ²
B. 151 to 200 m ²	Rs. 50 per m ²
C. 201 to 250 m ²	Rs. 100 per m ²
D. 251 to 300 m ²	Rs. 150 per m ²
- * Rs. 1,500 for commercial goods upto one truckload (75 quintals), and Rs. 2,000 for more than one truckload.
- * Rs. 5,000 for each family for household effects.
- * Rs.3,000 payable for settlement at New Tehri town (NTT).
- * Rs. 4,000 Payable for settlement elsewhere.
- * Minimum of 60m² size plot to all families at NTT but next higher size if existing land of family is more than 60 m².

Status of rehabilitation is given in the accompanying table:

Rehabilitation Status

A. Rural Families

	Fully affected	Given Compensation Cash/plot allotment	%age Program
STAGE I			
(Affected by Coffer Dam)	2064	2034	98.5
STAGE II			
(Affected by Main Dam)	2845	435	15.29
	4909	2469	50.3

B. Urban Families

1. Plots

	Reqd.	Developed	Alloted
Public	2087	2087	2049
Govt. Offices/ Institutions/Banks	351	351	351
Total	2438	2438	2402

2. Flats

Public	774	629	304
Govt. Offices/ Institutions/Banks	2079	1854	1765
Total	2853	2483	2069

3. Shops

784	787	588
-----	-----	-----

Dr. Hanumantha Rao Committee has made fresh recommendations in October 1997 for following the rehabilitation norms. All sons and unmarried daughters of a family should receive compensation of between Rs.75,000 and Rs.1.5 lakh in lieu of land, and another Rs. 50,000 for house construction. Owners of shops which are not doing business should get a shop at cost price, and Rs. 40,000 for every additional shop. All house owners should receive at least Rs. 60,000.

3.3 Submergence of Villages

	First Stage	Second Stage	Total
* Fully affected villages	28	9	37
* Partly submerged villages	—	88	88
	28	97	125

The total land area affected by the project is around 13,000 ha (See Table 4.2 for details).

3.4 Land Use Statistics

The Garhwal region abounds in forests, meadows, marshes and swamps with their characteristic plant composition. The vertical distribution of flora consists of alpine conifers and subtropical vegetation. The flora shows great variation depending on climate, soil, slope, and altitude of the terrain. The vegetation includes a wide variety of broadleaved species along with numerous shrubs.

The accelerated pace of erosion in this geodynamically sensitive region, coupled with the growth of human and livestock populations, has brought about certain irreversible changes which are endangering the flora and fauna of the region. Over exploitation of forests for commercial purposes,

the undermining of slope stability by indiscriminate and ruthless excavations for mining and roads, and overgrazing in forests are largely responsible for the present state of affairs. The population density of the area is about four times higher than that of the adjoining plains, while the productivity of land is considerably lower. It is estimated that the per capita income is nearly half the subsistence consumption level, with the Tehri Garhwal district having the lowest per capita income in Uttar Pradesh. The pressure of grazing is 2.5 to 4.5 times higher than the supporting capacity of the forests, with the consequence that the forest cover has been reduced to less than 30 per cent of the surface area. Land use patterns indicate that almost 43 per cent of the land is unfit for agriculture. This barren and uncultivated waste land is riven with gullies. Only very thin, poor bushes and grasses grow on it. Landslides have become endemic, particularly in the belt of the main central thrust (MCT), and many faults threaten to tear apart the mountain ranges. The current rate of erosion of 1mm per year is about five times what it was in the past, producing sediments at the rate of 16.5 ha-m/100 km² per year. These sediments are filling the reservoir and choking up streams. Springs are drying up or becoming seasonal. With the increasing run-off from the forest slopes, the incidence of floods has greatly increased in the mountain streams and rivers. The evaporation of soil moisture on the degraded slopes of the Bhagarithi river watershed is as high as 160 per cent, leading to the progressive drying up of the ground surface. It is estimated that if the present rates of fuel and fodder consumption are maintained, the entire crop of fuel wood will be exhausted by 2031 AD and of fodder by AD 2041. The invasion by xerophytic plants of the naked slopes of the river valleys is evident in the entire Garhwal Himalaya range. Further, recent earthquakes have raised huge mounds of sediment, which may collapse at any moment. All these factors render the Garhwal Himalaya ecosystem vulnerable and can be described as harbingers of desertification.

The total catchment area upstream of the Tehri Dam is 6921.25 km², which forms the watershed of the rivers Bhagirathi and Bhilangana. In the former, the gully densities range from 4 to 7 per km², and in the latter from 3 to 5 per km² covering 8 to 10 per cent of the waste catchment.

Tehri Dam is under construction approximately a kilometre down stream of the confluence of Bhagirathi (originating from Gangotri glacier) and Bhilangana (originating from Kathling glacier) near Tehri town. There are 16 subwatersheds (SWS) in the area, comprising 149 micro-watersheds (12 subwatersheds in the Bhagirathi valley containing 110 micro-watersheds ; and 4 subwatersheds in the Bhilangana Valley containing 39 micro-watersheds. Of the 16 SWS, three namely Gomukh, Jalandhri, Jadganga and Managad are snowbound or glacial in nature (Figure 3). The land use classification of the Tehri Dam catchment along with the area needing treatment is given below:

Table - 3.4.1
Landuse Classification in Tehri Catchment Area & Area needing Treatment

Category	Total Catchment (16 sub'watersheds)	Area Needing Treatment in Total Catchment (16 sub'watersheds)	Catchment Directly Draining in Reservoir (9 sub'watersheds)	Area Needing Treatment of Directly Draining of Reservoir (9 sub'watersheds)	(Area in Hactare.)
1. Severe erosion	3,340 (05%)	3,340 }	1,334	1,334 }	
		} 21,335 Ha.			} 10,177Ha.
2. Moderate erosion	17,995 (2.7%)	17,995 }	8,843	8,843 }	
3. Slight erosion	22,675 (3.4%)	22,675	13,464	13,464	
4. Cropland	21,045 (3.1%)	-	16,609	-	
5. Fallow Land	16,861 (2.5%)	16,861	12,043	12,043	
6. Open Scrub	18,581 (2.8%)	18,581	15,382	15,382	
Sub Total 1 to 6 - (I) =	1,00,497	79,452	67,675	51,066	

Table - (cont.)

Category	Total Catchment (16 sub'watersheds)	(Area in Hactare.)		
		Area Needing Treatment in Total Catchment (16 sub'watersheds)	Catchment Directly Draining in Reservoir (9 sub'watersheds)	Area Needing Treatment of Directly Draining of Reservoir (9 sub'watersheds)
7. Good Forest (II)	2,22,141 (33.1%)		1,16,120	
8. Snow Covered (III)	3,46,849@ (51.9%)		5,070	
Total (I + II+ III)	6,69,487	79,452	1,21,190	51,066
Deodar	13,626	Permanent Snow : 1,92,445	Deodar	-
Chirpine	1,33,654	Alpine Blank : 1,17,761	Chirpine	87,987
Oak	74,325	Rocky : 36,643	Oak	28,133
kail	536		Kail	-
Sub Total of (II)	2,22,141	Sub Total of (III) 3,46,849	Sub Total of (II)	1,16,120

**** Notes**

1. Afforestation and soil conservation measures on the degraded forest land and barren civil soyam land were started in 1983-84 in 13 sub-watersheds. In 1987, the Uttar Pradesh Land Survey Directorate and the Forest Department surveyed the area and estimated the land use and erosion intensity for the whole catchment. Based on their estimates, the Tehri Dam Catchment Project was formulated in January 1988.
2. The progress of of catchment area treatment (CAT) is reported as follows:
 - a. Prior to the implementation/execution of the 1994 CAT Plan, the treatment in the Tehri Dam Catchment was being done in the critically degraded areas of the entire catchment of 13 sub-watersheds. Treatment of an area of 22,746 ha was completed under the earlier plan, from 1983-84 to 1993-94.
 - b. From 1994-95 onwards, under the CAT Plan, the treatment of an area of 6,600 ha, in nine identified sub-watersheds directly draining in to the reservoir, has been completed upto November 1996.
 - c. The cumulative treatment of 29,346 ha. has been completed. Treatment of the balance catchment area of 6,900 ha has been planned for completion by 1999-2000, before the impoundment of the reservoir as per the data shown in the Table:

Table - 3.4.2

**Sub-watershedwise Plantations raised in Tehri Dam
Catchment Area**

Name of subwatershed	Area Planted (in Ha.) upto March, 1997
Loharinag	55.00
Kanoldiya	585.31
Indravati/Dhanari	1127.36
Jalkurgad	1795.67
Khurmolagad	4595.90
Syamalgaad	3423.19
Nagungad	4928.22
Kaldigad	362.23
Ghonti	3342.29
Badangaon	3095.79
Bhilangna	2828.65
Balganga	3180.28
Pilanggad	30.00
Total	29,352.09

Thus, plantation in 29350 ha has been completed, with the plantation of 360 lakh saplings . Against the submergence of 2,582 ha of forest land with 48,000 trees, compensatory afforestation of 2,582 ha of the land in the Jhansi and Lalitpur districts of Uttar Pradesh has already been completed, with 90 lakh trees being planted. Soil conservation measures such as buildings a large number of check dams have been undertaken for different streams of the micro-watersheds to check silt erosion.

4. Key Environmental Issues

Key environmental problems issues in the project are :

- Inundation of forest areas.
- Submergence of cultivable areas along with the displacement of a large population.
- Reservoir-induced earthquakes in the sensitive area.
- High rate of siltation.
- Havoc caused by floods and landslides in a geodynamically active region.

4.1 Inundation of Forest Areas

The Tehri reservoir will submerge 2,583 ha of the forest area (272 ha of reserve forest and 2,311 ha of civil soyam). The area is sparsely dotted with trees, with an average density of about 19 trees per hectare.

The project has carried out compensatory afforestation in an area of 4,540 ha in the districts of Jhansi and Lalitpur. Thus, it appears that a forest with a density of about 2,000 trees/ha has been provided to compensate for the submergence of forests with a density of 19 trees/ha, besides afforestation in the catchment area.

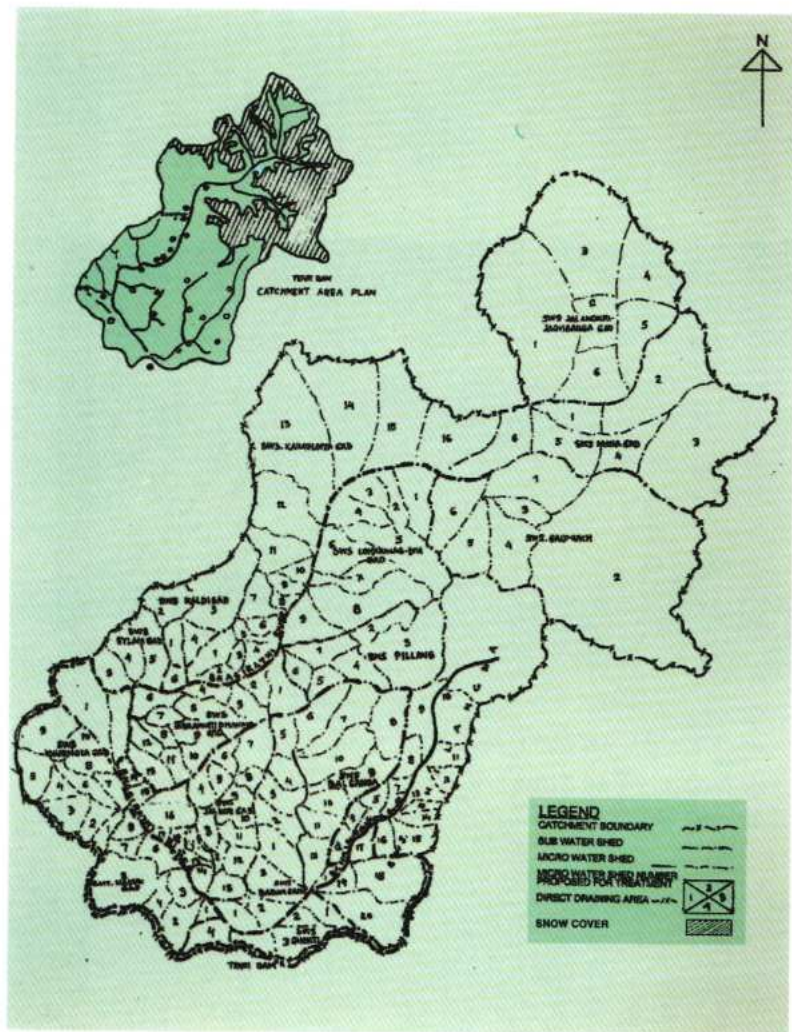
Table - 4.2
Submergence of Cultivable Areas

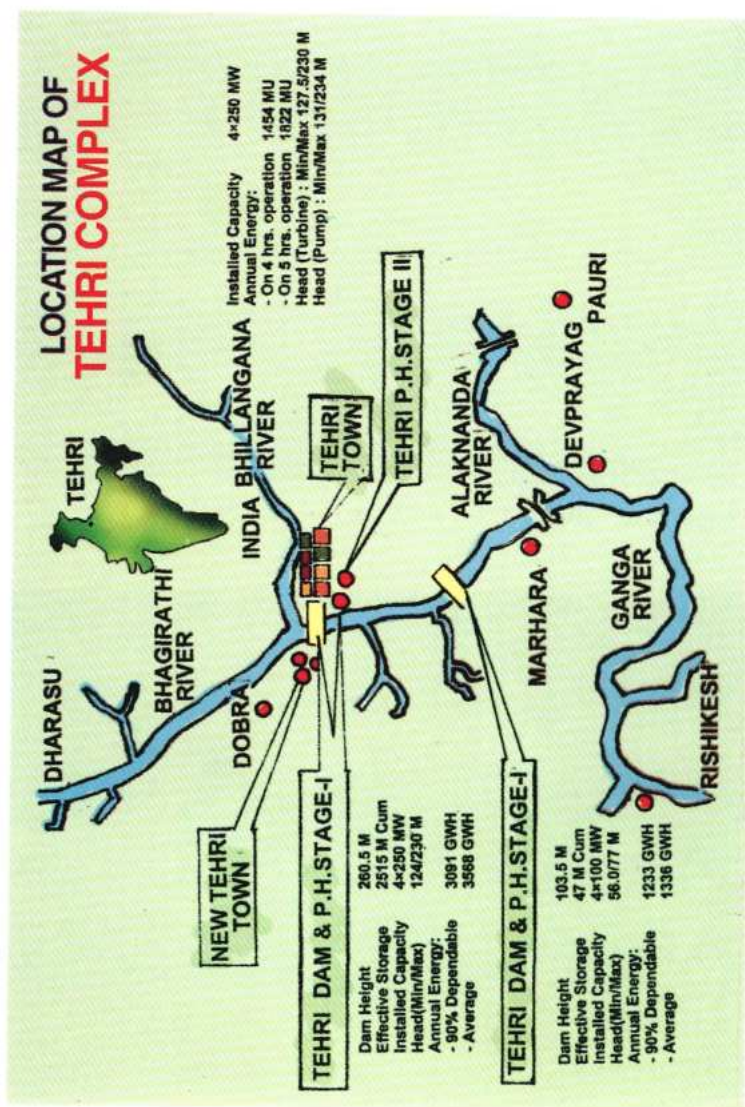
Affected villages category	Total Geographical Area (ha.)	Irrigated land (ha.)	Unirrigated land (ha.)	Forest land (ha.)	Cultivable waste (ha.)	Land not available for cultivable (ha.)
1. N.T.T.	490.49	7.68	290.99	-	7.29	184.53
2. Phase-I	1340.88	99.94	475.11	-	430.19	281.70
3. Phase-II	613.18					
4. Partially affected villages	10548.29	725.71	3799.94	137.21	4819.49	1044.52
Total	12,992.84	904.34	4,752.13	150.57	5,490.47	1,619.97
% of Total area		6.9	36.6	1.2	42.2	12.5

*Irrigation and Cultivation available Land in affected villages (1981 Census)



1. Gaumukh – The Snout of Gangotri Glacier – The Source of River Bhagirathi





3. Location Map of Tehri Complex

4. Construction Sites of Tehri Project



a) Raising of Cofferdam upto 661m



b) Power House Construction Work at Tehri Dam Project Site

5. Agriculture Development in Rehabilitated Project Area



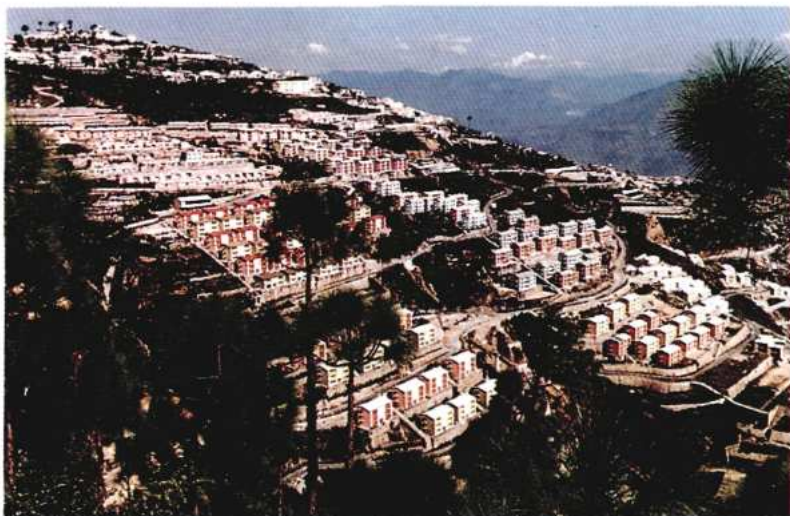
6. Development of Rural Infrastructure

a) Panchayat Ghar



b) Rehabilitated Project Affected Families

7. Development of Urban Infrastructure



a) Panoramic view of New Tehri Town (NTT)



b) New Residential Area in NTT



c) Shopping Complex at NTT

A recent socio-economic study of the families affected by the construction of the project has reached the following conclusions:

- * The value of the assets of the oustees has increased after they got rehabilitated.
- * Income from agriculture has gone up after rehabilitation. No one is engaged as agricultural labour since rehabilitation.
- * The annual income of a household after rehabilitation has risen by 34.67 per cent.
- * The new settlements created by THP are provided with pucca buildings, furnishing, electricity and schools as against inadequate educational facilities provided earlier.
- * Very good medical facilities have been provided in the new settlements, which were not available to rural households in the hilly area.
- * Drinking water facilities and LPG connections have been provided in the new resettlements, as against the traditional collection of water from springs and of wood from the forest in the hills prior to rehabilitation.
- * The new houses are modern and bigger than what were used by the oustees in the hills.
- * Agricultural land allotted to the oustees is in consolidated holdings as against fragmented holdings earlier.

In general, the quality of life of the rehabilitated families is far superior to what they experienced before rehabilitation.

4.3 Earthquakes – Reservoir-Induced Seismicity

The doubts regarding seismicity are crucial due to the lack of a scientific database and ambiguity about the methodology, preception and opinion of various experts. The main boundary fault and the main thrust fault make these regions seismically very active. The boundary fault

zone shows multiple fissures and the splitting, crushing and granulating of rocks. The shear zone rocks have low bearing strength and may locally provide passage to infiltrating water.

On the basis of the records ranging over the last 100 years or so, the highest earthquake recorded in the area was of the magnitude of 6.2 on the Richter scale at a distance of 35-40 km from the dam site. In view of the high seismicity of the regions detailed studies have been conducted. These include site specific assessment, testing of materials for dynamic properties, and a detailed dynamic analysis of the structure. Several highlevel expert committees have examined the seismic safety of the dam since 1979. The salient observations with regard to design are :

- * Magnitude of the strongest expected earthquake is +8.0 on the Richter scale.
- * Expected peak ground acceleration (EPGA) of 0.25g, frequency content of ~4 to 8 cycles per second, and duration of ~30 seconds.
- * Settlement of the section worked out for the EPGA is 0.52 m.

Experts from the erstwhile USSR after two years of investigations concluded :

With the information available, the estimates of the Tehri dam area seismicity is optimum and conservative taking into account that the Tehri Project structures will be loaded within a single tectonic block, and peak ground acceleration at the middle part of the canyon will not exceed 0.5g seismological and seismo-tectonic conditions of the area are suitable for high dam construction.

A Soviet geophysicist, has expressed that there is no danger to the Tehri Dam from earthquakes even with an intensity of 9 on the Richter scale.

Following the October 1991 Uttarkashi earthquake, the

design of the dam was test checked and found safe for an actual-accelerogram-of-Gazli- earthquake, with a PGA of 1.36 g vertical and 0.72 g horizontal, both acting simultaneously. Based on the observations of other dams in the Himalayas, there seems to be no possibility of any reservoir-induced seismicity in the region. For micro-seismic studies, a radio-telemetered array of seismic stations around the project area is planned besides other observatories.

In their defence against seismicity, the Project engineers maintain that the various design features ensure the integrity of the dam. These include:

1. To prevent the ill-effects of earthquake acceleration at the top of the dam, a wide crest of 20m width has been provided even though it is not needed otherwise. This width is further increased to 25m at its contact with abutments.
2. A very liberal free board of 9.5 m above full reservoir level has been provided to take care of any settlements, slumping due to earthquake, and wave action.
3. A fine sand layer has been provided on the upstream face which in the unlikely event of cracking of the core will get washed into the cracks and seal them .
4. Dam shell material is being compacted to high density to ensure little settlement and that consequently no pore pressure is built up during earthquakes.
5. A very conservatively designed downstream filter has been provided which can prevent the migration of fine particles of the core in the event of cracking.
6. The dam slope provided is relatively flatter compared to many dams constructed in high seismicity areas.

Internationally reputed engineering seismologist, Prof. Jaikrishna, remarked : "Since conservation has entered at almost every step of the decision-making, the overall safety

of the dam is high enough to eliminate any risk from earthquakes in the future."

The presence of soft rocks, the absence of fractures, and the homogeneity of rocks do not favour accumulation of stresses and hence preclude the occurrence of reservoir-induced seismic activity.

4.4 High Rate of Siltation

Factors contributing to a high silt load are receding glaciers, extreme degradation in the catchment, increasing biotic pressure, occurrence of landslides, frequent cloud bursts, road constructions, reckless mining and deforestation.

During the monsoon, the Bhagirathi carries large quantities of sediments. The Ganga Basin Water Resources Organisation of the Central Water Commission has been observing the suspended silt load in river Bhagirathi since 1972 at Tehri Steel Girder Bridge, about 1km upstream of the dam site. The average silt load from the data of 1973 to 1987 worked out to 14.86 ha m/100 km² per year which includes the excessively high silt load of 1978. For sediment distribution studies and estimating the life of a reservoir, a sediment rate of 14.5 ha m/100 km² per year, has been adopted. With this silt rate, it is found that the silted bed level of 715 m will be reached in about 160 years. It is natural to assume that the silt rate will reduce after the creation of the lake and the commencement of soil conservation and watershed management activities for which elaborate action plans have been formulated.

4.5 Havoc Caused by Floods and Landslides

Cloudbursts, snow avalanches, landslides, and glacier lake outburst floods (GLOFs) are known to occur at different intensities and frequencies in the high catchment area. These natural hazards need monitoring to reduce the damages inflicted by them. Vulnerable areas should be earmarked for detailed observations so that ameliorative measures can

be evolved, based on location-specific situations.

The creation of large reservoir might induce rock failure. And if there is a dislocation near the dam, the 260m thick sheet of water at an elevation of ~550m (asl) could turn into a veritable agent of widespread destruction and devastation. There are more than 25 landslides areas which cause a high degree of sediment movement and need special attention.

5. Economic Aspects

The growth of human and livestock populations have brought certain irreversible changes, endangering the life support system for flora & fauna. Over exploitation of forests for commercial purposes, destruction of slope stability, indiscriminate and ruthless excavations for mining and roads and overgrazing in forests are responsible for desertification of the area. Economically Tehri Garhwal is one of the poorest districts.

The economic evaluation of natural resources, especially forest biota, land, soil and water resources have direct and indirect benefits to the society. There are several inherent deficiencies in various methodologies for evaluation of benefit-cost ratio. The basic norm adopted by Planning Commission is 1.5:1 and this makes project authorities to indulge in various manipulations to satisfy the above requirement. Even there are tendencies to enhance benefit-cost-ratio to get early clearance. In case of Tehri, Paranjpaye (1988) showed the deviation as shown in Table:

Table - 5

Item	Project Authorities	Pranjpaye Evaluation
Cost of Power	35 paise/Unit	73 P/Unit
Benefits to enhanced agricultural production (Rs. in Lakh)	1577	6467
B.C. Ratio for agriculture	3.49:1	1.28:1
B.C. Ratio for the whole project	Not calculated	0.56:1
Forest Area Cost	1600 ha.	4705 ha.
No. of displaced persons	46,000	85,000
Useful life of the dam	100 yrs.	62 yrs.

Paranjpaye pointed out that the project authorities have made two conceptual errors. First, they have not taken the dynamic with-and-without irrigation approach and second, the loss in output due to land acquired for rehabilitation was not considered. The revised benefit-cost ratio comes to 1.28 as against 3.49 projected by the authorities for the irrigation component alone. This is contradicted by the project authorities as the irrigation benefits have been reduced from 6.67 to 2.7 lakh ha in the revised evaluation. The fact is that the existing Ganga Canal developed in the last century is based on the concept of protective irrigation wherein small quantity of water is spread over large areas while the new project will provide intensive irrigation for high yielding crop varieties. The debate on economic benefits can continue but what is needed is establishment of a comprehensive database so that monitoring of benefits and losses is made from time to time for timely corrective measures.

6. Project Status

Major infrastructure works (e.g. project colonies, roads, storage areas, water supply construction, power supply arrangements) completed are shown in the Tables:

Table - 6.1
Development of Rural Infrastructure

SNo.	Item	Extent.
1.	Irrigation & drinking water facilities	
	i) Tube wells	17 Nos.
	ii) Irrigation guls for T.W.S. & canal	184.8 Kms.
	iii) Canal scheme	
	iv) Lift canal scheme	1 No.
2.	Electrification	54.8 Kms.
3.	Road & drains	88.9 Kms.
4.	Schools	
	i) Primary schools	8 Nos.
	ii) Junior high schools	2 Nos.
	iii) High schools	2 Nos.
5.	Panchayat ghars	10 Nos.
6.	Temples	9 Nos.
7.	Primary Health Centres	5 Nos.
8.	Seed Stores	2 Nos.
9.	Veterinary Hospitals	3 Nos.
10.	Post Offices	3 Nos.
11.	Shopping Facilities	3 Nos.
12.	Community Halls	2 Nos.
13.	Dormitories	7 Nos.
14.	Bus Stands	2 Nos.
15.	Kanji House	2 Nos.

Table - 6.2

Urban Infrastructure around New Tehri Township

S.No.	Item	Quantity
1.	Land area	539 acres
2.	Roads	25 Km of road network much wider roads with inter-connected foot paths/stair cases
3.	Sewerage system	Well planned sewerage system
4.	Street lighting	Well planned on all roads & under ground transmission to reduce breakdowns
5.	Religious building	Well planned modern spacious temples, Geeta Bhawan, Arya Samaj Mandir, Gurudwara, Mosques & Idgah being built
6.	Public Utility Buildings	
	a. Bus stand	Well planned Bus terminal with Yatri Niwas, spacious 12 countries for tickets & Shopping Complex.
	b. Stadium/clock Tower	Stadium with Clock Tower
	c. Multipurpose hall	Multipurpose spacious Hall, for Indoor games, Wedding functions, meetings etc.
	d. Hospital	75 Bedded hospital with all modern facilities.
7.	College	University Complex in 26 Acre, 300 boys 100 girls Hostel residential facility 112 room 28,333 sq.m covered area
8.	Hostel facility	Hostel facilities for 860 students
•	Foundation of Main Dam over the entire stretch of 1.1 Km. completed, Dam raised upto 15 m above the river bed.	

- 4 head race tunnels (8.5m dia each) completed
- All approach adits for access to underground works of power house completed.
- Cofferdam raised up to a height of EL 661m
- Civil works of power house complex is at advanced stage.
- Civil works of main dam has commenced.
- Essential excavation work for spillways started.
- Contract for electro-mechanical equipment of power house is under finalisation with consortium of Russian/Ukrainian manufactures/ABB, Germany.
- Government of India has appointed two expert committees, one on safety of dam and the other on rehabilitation and environment in Sept., 1996 and these committees have yet to submit their reports after thorough investigations.

Table - 6.2.1

Outlay and Expenditure - Tehri Dam and HPP (Stage-1)**Estimated Cost (Price Level March, 1993)**

	(Rs. in crores)		
	Irrigation Sector	Power Sector	Total
GOUP Share*	563.00	600.17	1163.17
GOI Share	-	1800.49	1800.49
Total	563.00	2400.66	2963.66
Actual Expenditure upto June, 1997			
GOI Share	-	847.57	847.57
GOUP Share	197.28	350.30	547.58
Total	197.28	839.63	1395.15

* Against its required contribution of 547.58 crores, GOUP has contributed Rs. 267.48 crores and the rest expended by GOI.

7. Key Contentious Issues

Safety of the dam is the most contentious issue. Some of the major points raised against the safety aspects are :

- i) Site chosen for Tehri dam is repeatedly being questioned, as the dam site is located in zone IV of the seismic zoning map of India which corresponds to an intensity rating of VIII on the M.M. scale.
- ii) Instead of such a high dam power benefits be obtained by utilising run-of-the river flows. Why only one dam and why not two or three dams of lower heights in cascade?
- iii) Some scientists have commented on the design parameters as the project lies in a high seismic area. It is feared that the dam is under-designed against seismic forces and that its revision would result in a major cost escalation.
- iv) A fear has also been expressed in many quarters that filling of the Tehri Reservoir would lead to induced seismicity in the areas, leading to a major earthquake like Koyna Earthquake of 1966.
- v) The life of Tehri dam depends upon the silt rate. It is speculated that high rate of siltation has been underestimated and the silt could fill up the reservoir much sooner than anticipated, subjecting the area to greater danger of flood havocs.
- vi) Another fear is on account of the large forest inundation, causing ecological imbalances and leading to accelerated soil erosion which would pose great threats of worse floods, and land slides and would also lead to shortening the life of the reservoir. Snow and glacier reservoirs in the upper river catchments are very active agents of both water and sediment yields. It is observed that the snout of the Gangotri glacier is receding faster presently

as compared to a few decades earlier. The project authorities should make a glacier monitoring programme for these natural water-reservoirs to better understand the behaviour of these regulators of water and sediment discharge.

- vii) The systematic data on natural resources of the region is scanty for undertaking such a major project. Much more emphasis should have been laid on collection of data from the river catchments of the project.

Some of the contentions issues raised by opponents on rehabilitation and environment and their replies by the project authorities are given as follows :

1. There is no Rehabilitation Policy for compensation and resettlement of the affected families.

Clarification : Rehabilitation work was commenced by the Irrigation Department of Govt. of Uttar Pradesh in the year 1976. The Rehabilitation Policy including the location of the New Tehri Town, had been evolved and decided by the State Govt. at the highest level after interaction with the representatives of the local population. After the formation of the Tehri Hydro Development Corporation (THDC), Rehabilitation Policy, as evolved by the State Govt., was fully adopted, and at the same time further improved by enhancing the compensation, wherever considered necessary.

2. No care have been taken in the Rehabilitation Policy for the oustees.

Clarification : THDC has taken great care to rehabilitate the affected people. Some of the features of the Rehabilitation Policy are:

- Rural oustees are compensated through allotment of agricultural land or cash in lieu thereof.
- The rural oustees are settled in large block so that their social life remains intact.

- Oustees or their representatives are involved to the extent possible, in selecting the rehabilitation centres.
- Consideration is given to the preference of the oustees for settlement at a particular centre.
- Community facilities are provided at each of the rural rehabilitation centres at the cost of the project even, if these did not exist at their earlier settlement.
- Within the framework of the above broad principles, the Rehabilitation Package has been evolved and further improved from time to time for rehabilitation of the affected population. The efforts of the THDC would be to take measures to resettle and rehabilitate the project affected persons with the objective of improving their standard of living.
- Displaced entitled families of old Tehri Town are given the choice of being settled either at NTT, Dehradun, or Rishikesh, where new colonies have been developed for the purpose.

3. *Movement of the affected families to the new sites will adversely affect their social and economic life.*

Clarification : Efforts have been made that dam-affected people of one village are resettled together so that the fabric of their social life does not get disturbed. Further, the dam affected families are able to evolve and strengthen their cultural and social bonds and heritage in a better way.

Regarding the social and economical aspects a Socio-Economic study was conducted by the Administrative Staff College of India. The study has revealed that the quality of life of the rehabilitated families is far better than what it was before the families were rehabilitated. New settlements have been provided with furnished schools, hospitals/dispensaries, wide pucca roads, electricity, street lights, irrigation facilities, tapped drinking water, community centres etc. The

value of assets of oustees have increased, agricultural income has also increased. New houses are modern and bigger than what were used by the oustees earlier.

Moreover, it may be mentioned that the Estimates Committee of the U.P. Legislature had visited some of the resettlement colonies in 1989. The extract reproduced below clearly brings out that the Tehri rehabilitees at the new sites are enjoying facilities which are not available in other Indian villages.

After touring the rehabilitated areas at Bhaniyawala, Raiwala & Pathri Block, the Committee found that these colonies have better facilities than the other villages in the region. The roads are pacca and lighted and better facilities are available for irrigation, drinking water, hospital and education.

4. No basic amenities and other facilities have been provided to the population relocated at the resettlement sets.

Clarification : For urban population, a well planned town has been developed as New Tehri Town, which has all the facilities that are available in a modern town like an electronic telephone exchange, bituminous and planned roads, drinking water, electricity for homes/building & street lighting, hospitals, schools, colleges, temples, mosque, community facilities, post office, commercial complexes, district court etc., all built with high quality construction.

For rural population, water for irrigation and drinking, electricity, roads, schools, seed stores, post office, police chowki, Kanji house, panchayat ghar etc. are provided. Moreover, it may also be mentioned that out of 37 fully displaced villages, only 15 villages were getting tapped drinking water. But after rehabilitation, all displaced families are getting tapped drinking water facilities.

5. *Affected population have not been consulted on matters related to rehabilitation.*

Clarification : The Rehabilitation Policy has been evolved over the years in close interaction with the affected population. All the decisions regarding Rehabilitation Policy, whether concerning the location of the New Tehri Town, or other rural rehabilitation sites, or the quantum of allotment of agriculture land to an oustee family, grant of other reliefs and ex-gratia payments etc., were taken by the State Govt. after close interaction with the affected people at project level, Commissioner level, Minister's level and the State Chief Minister's level. The Rehabilitation Policy so evolved has been fully adopted by TGDC. The compensation package has been further improved, taking into consideration the demands of affected population in view of rising costs and inflation.

6. *125 villages will be submerged by the Tehri Dam.*

Clarification : Apart from old Tehri Dam will fully submerge 15 villages in Phase-I and 7 villages in Phase-II. Besides 13 fully affected villages are to be relocated due to the construction of NTT, project works and colonies. Thus, only 35 villages are fully affected and 74 villages will only be partially submerged by the Tehri Dam. The Koteswar Dam Project will fully submerge 2 villages and 14 villages would be partially affected.

7. *No care has been taken to protect the cultural heritage of Tehri.*

Clarification : THDC has constructed / is constructing the respective religious places in New Tehri Town or at other suitable places in consultation with their priests/managing committees. The respective idols will be reinstalled at new places of worship. Also a library has been constructed to preserve the literature.

8. *Rehabilitation Package of Sardar Sarovar Project is far superior than that of Tehri Project.*

Clarification : A comparison of the rehabilitation package of Tehri Project and Sardar Sarovar Project was carried out by the Administrative Staff College of India, Hyderabad, a premier management consultancy organisation. This study has concluded that cost of package of rehabilitation per family in Sardar Sarovar Project is Rs.1,43,660/- as against Rs.3,32,800/- in Tehri Project.

9. *Due to the storage of water in the Tehri Dam reservoir, quality of water will be spoiled.*

Clarification : Studies conducted by the University of Roorkee have confirmed that water quality will not go down. Moreover, the water of River Ganga is considered very pure in Hindu mythology and people store it for years and use it in religious ceremonies as well. Hence question of deteriorating the water quality does not arise.

10. *Due to construction of dam, soil erosion in the catchment area will increase.*

Clarification : Tehri Project is treating the catchment area on priority basis. The Catchment Area Treatment (CAT) Plan is intended to reduce silt and debris flow to the dam reservoir for enhancing its life span, to conserve the environment, to gradually rehabilitate the trees, shrubs, grass cover in the catchment, to improve the pastures so that higher quantity and better quality of fodder is available to cattle and to check and control land-slides by soil conservation works. The project authorities are carrying out the Catchment Area Treatment Plan prepared by the Land Survey Department of Govt. of U.P. This plan is being implemented by the Forest Deptt. of Govt. of U.P. w.e.f. 1981-82.

The Corporation had undertaken scientific reassessment of critically degraded area of the catchment for treatment on the basis of satellite imagery taken in March, 1989 by the

Remote Sensing Application Centre (RSAC), Lucknow.

As per the RSAC assessment, an area of 21335 ha of very high erodibility classification was requiring treatment in the whole catchment.

Meanwhile, it was noted that the works adverse impact of the project during the construction phase, alongwith work on the direct draining subwatershed for improving the carrying capacity of the degraded/highly degraded lands along the reservoir should also be carried out at the project cost, *paripassu* with the construction programme of the project. Based on the RSAC assessment, critically degraded was found which needs treatment. This is in addition to 22703 ha. earlier treated by Project funds under the CAT Plan prepared by the Land Survey Directorate of Forest Deptt. of GOUP. The work as per RSAC survey is being undertaken as per the plan. So far, 321 lac trees including 70 lac fruit trees have been planted in the catchment area.

11. Tehri Dam Project will spoil the flora and fauna.

Clarification : Study of flora and fauna was entrusted to the Botanical Survey of India (BSI) and Zoological Survey of India (ZSI) respectively.

The study report of the BSI on flora of the region has revealed that no rare species come under submergence of the reservoir. They have recommended planting of certain species during afforestation programme, which are being taken care of under CAT Plan and is being implemented through Forest Department of GOUP.

The report of the ZSI has revealed that there is no adverse impact on the fauna of the area due to the construction of the Tehri Dam and reservoir except for Mahaseer Fish, whose movement in upstream for spawning purposes may be restricted due to construction of dam, THP has formulated an Action Plan for propagation of Mahaseer Fish in the upstream and downstream of Tehri Dam through reputed

consultants. The Action Plan proposes establishment of a fish farm for artificial breeding of Mahaseer Fish. The fingerlings produced at the farm would be mechanically taken upstream of the dam and stocked in the Tehri Reservoir, which would migrate to the upstream reaches of the River Bhagirathi, Bhilangana and other tributaries. Other components of the Action Plan are: raising of reservoir fisheries, construction of aquarium at Tehri Dam site and creating facilities for spot fishing. These components shall be taken up during the operational phase of the project.

The ZSI has recommended plantation of fruit trees in the area. A minimum of 20 percent of fruit trees are already being planted under CAT works. They have also advised that the common host plants in the 'Trauma Zone', which is likely to be submerged, can be grown only in damp and humid environment and these would be planted only when the impoundment of reservoir takes place.

12. The Tehri Dam Project has destroyed most of the forest cover due to the submergence area, the project colonies, and New Tehri Town.

Clarification : The formation of Tehri Dam Reservoir affects only 2582.9 ha of forest land, out of which the reserve forest is only 271.5 ha & civil soyam 2311.4 ha. These areas have intensity of 19 trees per ha. Ministry of Environment and Forest had granted environment clearance in June, 1987 for diversion of forest land for construction of the Tehri Dam with the stipulation that the project authorities will carry out compensatory afforestation in an area of 3815 ha. GOUP had planned to carry out compensatory afforestation in an area of 4540 ha. in the Districts of Jhansi and Lalitpur and the same policy has been continued by THDC. For compensatory afforestation, non-forest land in an area of 3902 ha in 153 vilages of Distt. Lalitpur and 638 ha in 7 villages of Distt. Jhansi has been acquired by GOUP on behalf of THDC. Till now an area of 603 ha in Distt. Jhansi

and 3732 ha. in Distt. Lalitpur have already been planted. All the work will be completed by the end of monsoon of 1995. Thereafter, only main-tenance and protection measures will continue for preservation of forest potential created. Thus, it may be seen that against not more than 19 trees/ha. in submergence, potential of 2000 trees/ha. has been provided for quantum jump in the forest wealth of the country.

8. Chronological Sequence of Development

- 1949 – A dam on river Bhagirathi conceived.
- 1961 – Investigations started for site selection
- 1969 – Detailed Project Report (DPR) submitted by U.P. Irrigation Deptt. envisaging construction of a Rockfill Dam, having installed capacity of 600MW.
- 1972 – Planning Commission approved the project for execution by Govt. of U.P.
- 1976 – Govt. of U.P. accorded the administrative approval.
- 1978 – The construction commenced at site.
- 1979 – The project design was reviewed and revised DPR envisaging installed capacity of 1000 MW submitted.
- Dec. 1979 – Working group constituted by the Deptt. of to Science and Technology, Govt. of India, Aug. 1986 concluded that dam as designed was safe . A separate report by Chairman did not give any recommendation.
- Jan. 1983 – Techno-economic clearance accorded by the Central Water Commission (CWC) and Central Electricity Authority (CEA).

- 1985 – Planning Commission accorded clearance for the power portion of the project.
- Oct. 1986 – Meeting of the experts, convened by the Chairman, CWC on the directions of the Committee of Secretaries, concluded that adequate data and studies had been made for a safe and economic structure.
- Nov. 1986 – The Union Cabinet approved the execution of Tehri Hydro Complex as a Joint Venture of Govt. of India and Govt. of U.P., seeking Soviet assistance.
- Nov. 1986 – A bilateral agreement for Techno-economic co-operation was signed between India and erstwhile USSR.
- Jan. 1987 – Press Notice by Ministry of Environment and Forests stating that environmental and safety aspects have been gone into thoroughly and the project was sanctioned.
- July 1988 – Tehri Hydro Development Corporation Ltd., (THDC) was incorporated as a Joint venture of Govt. of India and Govt. of U.P. for implementation of Tehri Hydro Power Complex.
- June 1989 – Project works transferred by Govt. of U.P. to THDC Ltd.
- March-April 1990 – High Level Committee (HLC) of experts constituted by the Committee of Secretaries, unanimously concluded that the proposed dam section was safe even for the worst scenario of an earthquake of + 8 magnitude in the Richter Scale occurring right under the dam at 15 Km. depth.

- May 1990 – HLC considered the Supplementary Report on observations of Dr. Brune of USA, conveyed by Dr. V.K. Gaur, and reconfirmed its earlier view.
- January- June 1990 – River Bhagirathi diverted through right bank diversion tunnels. Foundation seat of upstream Cofferdam raised upto EL. + 615.0 (15 metre above river bed level)
- August- Sept. 1990 – Reference by the Deptt. of Mines, Govt. of India, of an independent expert of international repute, Prof. Jai Krishna recommended that the proposed dam section of Tehri was safe from the point of view of the seismicity of the region.
- 1990 – Soviet experts from Hydro Project Institute, Moscow independently carried out studies for seismic status of the region, tested the damfill materials in their laboratories and carried detailed dynamic stability analysis. The dam was checked for a PGA of 0.5g corresponding to magnitude + 8 earthquake and found to be safe.
- Jan.- June 1991 – Foundation seat of main dam raised upto EL. + 615 (15 metre above river bed level)
- July 1991 – Meeting of group of experts by Director General, GSI on the direction of Deptt. of mines recommended that the report of HLC of review given by Prof. Jai Krishna, be accepted immediately.
- Aug. 1991 – The Deptt. of Mines conveyed to Cabinet Secretariat that the recommendations of Prof. Jai Krishna, that the proposed Tehri Project was safe from the point of seismicity of the region was accepted. It also recommended

carrying out micro-seismic studies and testing dam against Gazli Earthquake for PGA of more than 0.5g as a matter of scientific interest.

- Oct. 1991 – Uttarkashi Earthquake occurred on 20.10.1991. No damage to the dam foundation was noticed. Even surfacial cracks were not observed anywhere in the dam area.
- Nov. 1991 – Seismic stability of Tehri Dam against actual accelerogram of Gazli Earth quake with vertical acceleration of 1.36g and horizontal acceleration of 0.72g checked by Hydro Project Institute, Moscow and dam was found to be safe.
- Jan. 1992 – Public Investment Board (PIB) recommended the project for consideration by the Cabinet Committee on Economic Affairs (CCEA) on 23.1.1992.
- May 1992 – The Prime Minister chaired the review meetings with seismic experts and the environmentalists in two sittings.
- Mar. 1994 – Govt. of India approved the implementation of Stage-I of the project, i.e. Tehri Dam and HPP (1000 MW), alongwith compulsory works of PSP and Koteswar, at the estimated cost of Rs. 2963.67 crore.
- Oct.- Nov.94 – Coffor Dam civil works contract for 3 packages awarded.
- January 95 – Strike of State Government employees called off.
- Feb.- Mar.95 – Start of Coffor dam construction. Planned to be raised upto EL 650 m by June'95 due to loss of working season.

- 14-4-95 – Shri Sunder Lal Bahuguna sat on Dharna on approach road to Dam site. Work had to be suspended.
- 10-5-95 – Shri Bahuguna removed from Dharna site and shifted to Saharanpur/Lucknow by State Admn. Goes on indefinite hunger strike. Work on Coffor Dam resumed.
- May'95 – Government imposes ban on shifting of population of Old Tehri Town till decision is taken on rehabilitation.
- 22-5-95 – Shri Bahuguna reached Tehri after his release from hospital at Lucknow. Continued hunger strike.
- 26.5.95 – Due to impending monsoon, coffer dam construction stopped at EL 622 m.. Period from 27-5-95 to mid-July utilised to put the protection works over the coffer dam to safeguard against flood damage.
- June '95 – A group of opposition leaders called on the Prime Minister on 20-6-95 and 24-6-95 for discussions connected with Shri Bahuguna's hunger strike. Former PM, Shri V.P. Singh called on Shri Bahuguna on 21-6-95.
- 27-6-95 – Shri Bahuguna called off his fast/dharna at the intervention of the Government.
- 28-7-95 – In the meeting taken by Principal Secretary to PM, it was desired that study of history of agitation at the time of construction of Ganga Canal be prepared. It was also desired that educational videos relating to safety aspects, environmental protection and resettlement issues; and list of often made public complaints against dam and replies thereto be prepared.

- Oct '95 – Cofferdam construction resumed on 15-10-95 after the end of monsoon.
- Uttrakhand agitation continues with intermittent stoppages of work and office working.
- Nov '95 – LOI for Power House Complex civil works awarded.
- Jan'96 – Civil construction work of Power House Complex started on 5.1.96.
- Mar'96 – LOI for Spillways stripping awarded on 4-3-96 and work commenced on 18-3-96.
- 13-4-96 – Shri Bahuguna goes on Upvaas and Manu-Varta in support of his demands. Cofferdam construction work continues.
- 25-6-96 – Shri Bahuguna breaks his fast in the presence of the Prime Minister on assurance of review of safety, ecological and rehabilitation aspects.
- June'96 – Government constitutes an Expert Group to examine technical aspects relating to Safety of the Tehri Dam.
- Sep'96 – Government constitutes an Expert Committee headed by Prof. Hanumantha Rao to go into Environmental and Rehabilitation aspects.
- 3-1-97 – Government, on review, lifts ban on shifting of institutions, offices and willing population from Old Tehri Dam.
- Jun'97 – Award of Contract for Main Dam.
- Mar'97 – Work on Main Dam Commences.
- Apr'97 – Award of Contract for Power House, E&M Equipment and Control Systems to Consortium of manufacturers from Russia/

Ukrain and ABB-Germany with Buyers'/suppliers' Credit.

- May'97 – Loan Agreement signed with KfW, Germany for financing of goods to be supplied by ABB.
- Oct'97 – Dr. Hanumantha Rao signs the report on environmental and Rehabilitation aspects.
- 26 Nov.97 – Temporary ban for two months on blasting and movement of heavy vehicular traffic at the dam site by THDC in deference to the demands of Shri Sunder Lal Bahuguna who called off his 56 day fast.

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Part-II

NARMADA VALLEY PROJECT

1. Origin and Background

It was in 1946 that Sardar Patel put forward the idea of developing the water resources of the Narmada river basin. The basin extends over an area of 98,796 km², which is nearly 3 per cent of the geographical area of the country. It is bounded on the north by the Vindhyas, on the east by the Maikala Range, on the south by the Satpuras, and on the west by the Arabian Sea. The basin lies in the states of Madhya Pradesh, Gujarat, and Maharashtra, the distribution of the drainage area being 85,859, 11,399 and 1538 km², respectively. The river rises near Amarkantak in MP, at an elevation of above 900 m, and flows for about 1,312 km before flowing into the Arabian Sea through the Gulf of Cambay. Till date less than 5 per cent of Narmada's average annual flow of 41,000 million cubic meters (MCM) has been exploited.

The A.N. Khosla Expert Committee's recommendations (1965) on sharing of the Narmada water were not accepted by Madhya Pradesh and Maharashtra. In 1969, the matter was referred for adjudication to a tribunal consisting of three judges for an equitable apportionment of the river water between four states : Madhya Pradesh, Gujarat, Maharashtra and Rajasthan. The river valley project became an interstate river dispute, dogged by the politics of dam height (Khosla Committee) and of distribution of its water among the states (Narmada Tribunal).

The total annual yield (with a 75 per cent dependability) is estimated to be 34.57 billion cubic meters (BCM). According to the Narmada Water Dispute Tribunal award (NWDA), the share of Madhya Pradesh is 23.53 BCM, that of Gujarat 11.11 BCM, Rajasthan 0.62 BCM, and Maharashtra 0.31 BCM. The award has also stipulated that the states concerned utilise this potential by 2024 AD.

In Madhya Pradesh, 29 major and several medium and minor projects have been planned to utilise 19.56 BCM for

irrigation and power generation. The balance 2.98 BCM will be put to domestic and industrial use. Three major projects – Barna, Tawa, and Sukta – have been completed; the Bargi and Kolar projects are nearing completion .

The Narmada Valley Project provides a most important case for study in terms of maturation, environmental movement and dynamics related to the politics of development fuelled by high level of information, political mobilisation and grassroot activism. The controversy surrounding this project has engulfed all levels of government authority. It has helped forge linkages between NGOs operating at the grassroots, national and international levels, thus becoming the ideo-political nursery for greening the politics of India. The Sardar Sarovar Project is one of the largest river projects in India and involves the largest man-made lake in the world. It is notable for its liberal package of rehabilitation for affected persons. Some pictures (Fig.1-9) of various dimensions of the project and of developments in the river basin.

2. Project Description

The Narmada Valley Project consists of the Narmada Sagar Complex (NSC) in Madhya Pradesh and the Sardar Sarovar Project (SSP) in Gujarat (Fig.1). NSC will provide annual irrigation to an area of 1.69 lakh ha and will generate 1,000 mw of power in Madhya Pradesh. SSP will provide annual irrigation to 17.92 lakh ha in Gujarat and 0.73 lakh ha in Rajasthan. It is expected to generate about 1,450 mw of power, to be shared by Madhya Pradesh, Maharashtra and Gujarat in the ratio of 57:27:16 respectively.

Three reservoirs, in series, constitute the Narmada Sagar Complex. These three reservoirs will be created one below the other at Punasa, Omkareshwar and Maheswar in western Madhya Pradesh on the Narmada river, before it enters Gujarat. The biggest of these will be Indira Sagar at Punasa,

with a live storage of 9.75 BCM and a water spread of 913 km² at FRL 262.13. The foundation stone of the Indira Sagar dam was laid by the late Prime Minister Smt. Indira Gandhi on 23 October 1984. It is designed to irrigate 1,45,360 ha on the left bank and 1,06,434 ha on the right bank, and to generate about 4,000 Gwh of power annually. About 0.49 BCM of water will be provided for domestic and industrial uses, both within the basin and to important urban areas outside like Indore, Mhow etc.

Water will be released downstream from Indira Sagar to Sardar Sarovar in Gujarat. The Sardar Sarovar will have a live storage of 5.8 BCM and a water spread of 370 Km² at FRL 138.68. The portion of Sardar Sarovar tailing back into MP will submerge 20,822 ha and is designed for irrigation and power production.

3. Official Parameters/Data

3.1 Salient Features of Sardar Sarovar Project

A. Location

- | | |
|-------------------|---|
| • State | Gujarat |
| • District | Bharuch |
| • Taluka | Nanded |
| • River | Narmada |
| • Site of Dam | 5.63 Km (3.5 Miles) upstream of Navagam village, 120 Km. (75 Miles) upstream of Bharuch city. |
| • Location of Dam | 73°45'E Longitude
21°50'N Latitude |

D. Reservoir

- Full reservoir level (FRL) +138.68 m (+455 ft)
- Maximum water level +140.21 m (+460 ft)
- Minimum drawdown level +110.64 m (+363 ft)
(MDDL)
- Normal tail water level +25.91 m (+85 ft)
(NTWL)

E. Dam

- Type Concrete gravity
- Length of main dam 1210.02 m (3970 ft)
- Top RL of dam 146.50 m (480.6 ft)
- Maximum height above deepest foundation level 163.00 m (535.0 ft)
(-16.5 to +146.50 m Top RL)
- Spillway:
 - a) Type Ogee
 - b) Energy dissipation arrangement Stilling basin with sloping apron
 - c) Crest level of spillway RL+121.92m(+400 ft)
 - d) Gates:
 - i) Type Radial
 - ii) Number & size:
 - for Chute spillway 7 nos.
18.30 m x 18.30 m
(60 ft x 60 ft)
 - for service spillway 23 nos
18.30 m x 16.76 m
(60 ft x 55 ft)

- e) Clear waterway at crest 558m (1831 ft)
- Spillway capacity 84949.25 cumecs
(30 lac cusecs)
 - Gross storage capacity 0.95 Mham (7.70 MAF)
 - Dead storage capacity 0.37 M ham
(below minimum draw
down level) (2.97 MAF)
 - Live storage capacity 0.58 M ham
(4.72 MAF)
 - Annual evaporation 0.06 M ham
(0.50 MAF)
 - Submergence at 34867 ha (86088 acres)
FRL+138.68m (+455ft)
 - Submergence details

a) No. of villages affected in the State

	Fully	Partially	Total
Madhya Pradesh	1	192	193
Maharashtra	None	33	33
Gujarat	3	16	19

b) No. families affected in the states

- | | |
|----------------|-------|
| Madhya Pradesh | 33014 |
| Maharashtra | 3113 |
| Gujarat | 4600 |
- Length of reservoir 214 km (133 miles)
 - Maximum width of reservoir 16.1 km (10 miles)
 - Average width of reservoir 1.77 km (1.1 miles)

F. Power installation

	River Bed Power house	Canal Head Power house
• No. of Units	6	5
• Rated capacity of each unit	200 MW	50 MW
• Installed capacity	1200 MW	250 MW
• Type of turbines	Francis vertical (reversible)	Kaplan (conventional)
• Type of power house	Underground	Surface
• Penstocks		
a) Number	6 Nos.	5 Nos
b) Diameter	7.6 m (25ft)	6.7m (22ft)

G. Canal System

- Main Canal
 - a) FSL at HR : +91.44m (+300.0ft)
 - b) FSL at Gujarat-Rajasthan state Border : +44.96m (+147.5ft)
 - c) Length : 458 km (287.67 miles)
 - d) Whether perennial, seasonal or two seasonal : Two-seasonal (Kharif & Rabi)
 - e) Whether contour or ridge canal : Contour canal
 - f) Whether lined or unlined : Lined canal
 - g) Base width in head reach : 73.1 m (239.83 ft)

- h) FSD in head reach : 7.6 m (25ft)
- i) Design discharge : 1133.00 cumecs
capacity in head reach (40,000 cusecs)
- Gross command area : 34.20 lakh ha
(GCA) (84.50 lakh acres)
- Culturable command : 21.20 lakh ha.
area (CCA) (53.17 lakh acres)
- Annual irrigation : 17.92 lakh ha.
(44.30 lakh acres)

H. Direct benefits

- a) Irrigation : 17.94 lakh ha.
(44.30 lakh acres)
- b) Increase in agricultural : 82.0 lakh tonne/annum
production and its value Rs.392.33 crores/annum
- c) Hydro power : Average power generation
 - 1st Stage 625 MW
 - 2nd stage 301 MW
 - 3rd stage 144 MW
- d) Flood control : Partial

I. Cost estimation

(as per 86-87 prices level) (Rs. in crores)

- a) Cost of unit-I Dam and : 936
appurtenant works
- b) Cost of Unit-II Main : 4107
Canal and Branches
- c) Cost of Unit-III Hydro- : 980
electric installations
- d) Conjunctive use and : 277
drainage

e) Schemes on enroute: 23
rivers

f) Cost of Narmada : 83
Sagar debitable to
Sardar Sarovar.

Total : 6406

(Note: Cost estimates under revision)

3.2 Rehabilitation Programme

- 1) Total submergence – 37,534 ha.
Forest land – 13,386 ha.
River bed and other – 12,869 ha.
Govt. land.
Cultivable land – 11,279 ha.
- 2) Submergence – 1.65 per cent of total CC ~
percentage against upto 25% allowed in
some other project
- 3) Affected villages
Gujarat – 19 villages
Maharashtra – 33 villages
Madhya Pradesh – 193 villages
- 4) PAP of Maharashtra – They are offered land in
and Madhya Pradesh Gujarat – SSP Command
Area. If they want to stay in
their states, all expenditure of
R & R will be borne by Govt
of Gujarat.
- 5) Grant – Every PAP is given grant in
addition to compensation and
free residential plot – 90 ft. x
60 ft.

- 6) Civic Amenities – Drinking water well , primary school, panchayat office, village pond, seed store, internal roads, external approach road to nearest highway. etc.
- 7) Landless PAP – Free residential plot, R & R grant & employment opportunity.

Special Liberalisation by Govt. of Gujarat

- 1. All PAP including agricultural labourer, every – All given min. 2 ha. major son also.
- 2. Unauthorised cultivators and landless labourers. – 2 ha. min. land
- 3. Additional subsidy – Higher rate of subsidy upto 100% (Rs. 5000) to take advantage of development programme in other sectors of tribal development plan.
- 4. Subsistence allowance – @ Rs. 15 per family for 25 days in a month for one year at new place.
- 5. Resettlement grant – @ Rs. 750/- per family with an increase of 8 % per annum with January 1980 as base year
- 6. Insurance facility – Life insurance of Rs. 6000/- and insurance of Rs. 5000/- for damage to a house and Rs. 1,000/- for a damage to household kits.

7. Private land – Govt. of Gujarat has arranged purchase of private land for PAP and has agreed to pay difference of cost of compensation and the actual cost of private land.
8. Surplus – Govt. of Gujarat will acquire surplus land over irrigated ceiling area from beneficiaries.
9. Govt. of Gujarat – These are the most liberal in the country and norms in the world.

3.3 Evaluation and Monitoring

1. E & M Programme – For the first time in India in SSP, E&M Programme undertaken on scientific basis through independent academic institutions comprising social scientists, anthropologists and economists. This E & M has commenced and is being done every six months. This will continue till the project is completed. Corrective measures are being taken as per advice of the institution.
2. Land Purchase (LP) Committee – This Committee, headed by Addition Collector and assisted by MPs, MLAs, Distt, Panchayat President, Tal. Panchayat President, members from NGOs, members from

PAP. Available private lands are first shown to PAP. The L. P. committee negotiates with landlords, NGOs may assist PAP in such process of settlement.

3. Training

- PAPs are mostly tribals from scattered hamlets. They will be now staying together, will have community lifestyle which will also ensure security for the society.

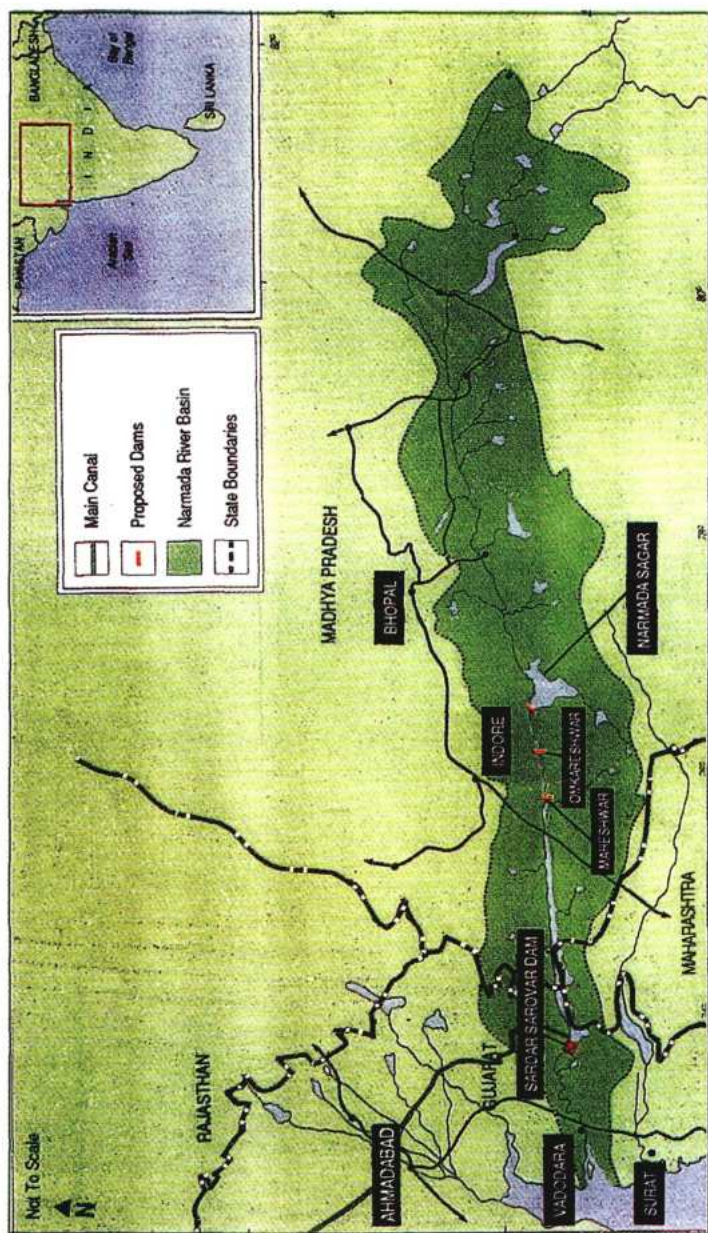
Govt. of Gujarat has established training facility in vocational disciplines for youth among PAPs in 16 trades. All education facilities, fishing activity, vocational training etc. will open new vistas for uplift of tribals.

3.4. Present Status of R & R

Table - 3.4.1

Land Area (ha) under Submergence

	Agri. Waste land	Forest land	Govt.	Total	Remarks
Gujarat	1877	4166	1069	7112	1.65% of
Madhya Pradesh	7883	2731	10208	20822	CCA.
Maharashtra	1519	6489	1592	9600	-
Total	11279	13386	12869	37534	



1. Narmada River Valley and Water Reservoirs



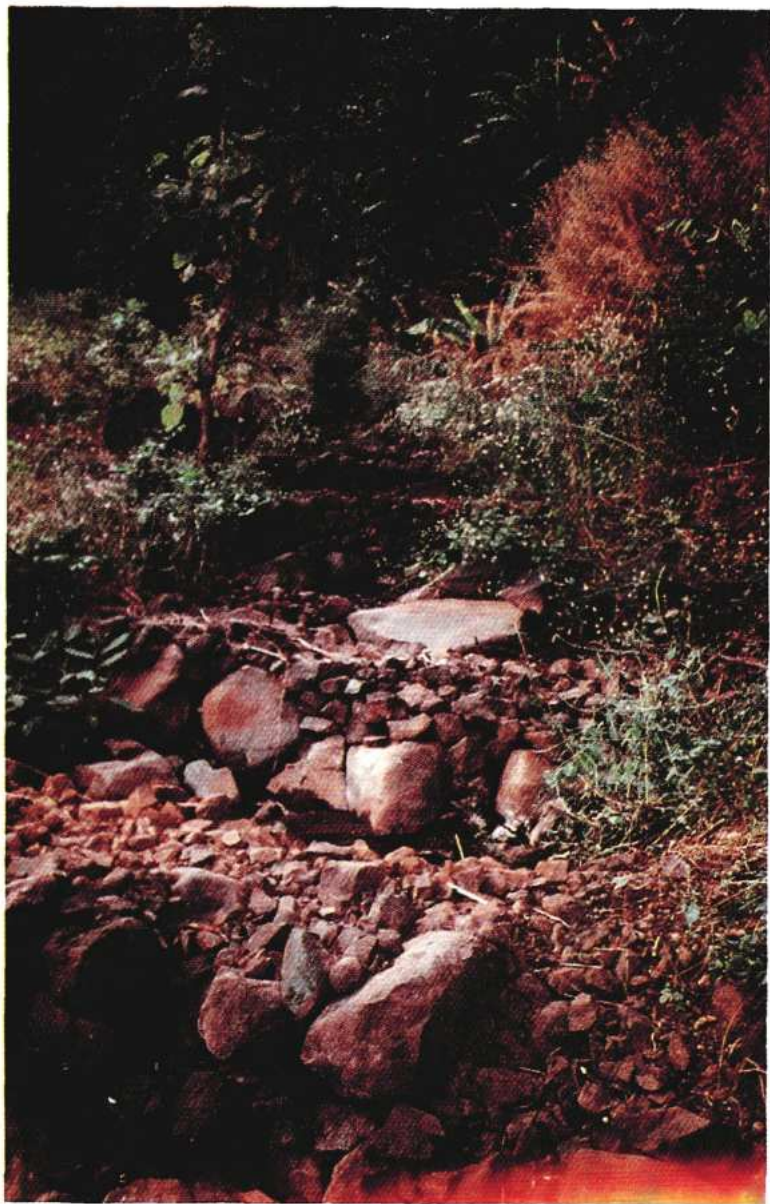
2. Narmada Microwatersheds and Priority areas for Catchment area Treatment



3. Dam Construction site, Indira Sagar Project, M.P.



4. Intake portion for Right Bank Power House of Sardar Sarovar Project, Gujarat



5. Soil Conservation Work in Degraded Forest Areas in Dhula District, Maharashtra



6. Stream Runoff Management Structure in District Manawar, M.P.



7. Compensatory Afforestation in District Khandwa, M.P.



8. School Building on the left and commercial agriculture for project affected people at Village Thuvavi in Maharashtra

9. Old Shoolpaneshwar Temple (A) has been relocated as at (B) and Idol installed



(A)



(B)

Table - 3.4.2

Villages and families affected due to submergence

	Villages Fully submerged	Villages Partially submerged	No. of families affected
Gujarat	3	16	4600
Madhya Pradesh	1	192	33014*
Maharashtra	-	33	3113
Total	4	245	40727

Note: Includes, 6140 families affected for very short duration in back water effect and all categories of project affected families (PAF)

3.5 Environmental Preservation

Several other steps are taken for preservation of environment as per following cost of survey and studies and their implementation :-

A) Expenditure by project authorities :

Table - 3.5.1

Cost of Survey & Studies (in lacs of Rs.)

S.No.	Component	Estimate/Actual Expenditure				Total
		GOG	GOM	GOMP	NCA/ GOR	
1.	Compensatory	4.52	5.29	2.44	—	12.20
	Afforestation	4.52	5.29	2.44	—	12.20
2.	Catchment Area	8.77	7.00	3.28	—	19.00
	Treatment	8.77	7.00	2.20	—	18.5
3.	Flora & Fauna	101.84	38.00	20.33	15.27	175.44
		0.47	16.00	17.63	15.27	129.37
4.	Health	2.50	10.00	29.63	—	42.13
		2.50	2.50	27.84	—	32.84
5.	Archaeology/	1.30	NA	59.00	—	60.3
	Anthropology	0.60		36.33	—	36.93
6.	Seismicity &	5.05	NA	23.00	1.98	30.03
	Rim Stability	5.07		12.50	1.98	19.55
7.	Command Area	11.25	—	—	NA	11.25
	Development	11.25				11.25
Total - (i)						350.45
						360.75

Table - 3.5.2

Cost of Implementation (in lacs of Rs.)

S.No.	Component	Estimate/Actual Expenditure				Total
		GOG	GOM	GOMP	NCA/ GOR	
1.	Compensatory	1809.10	2116.00	1800.00	-	1725.10
	Afforestation	1722.82	1650.27	831.16	-	204.25
2.	Catchment Area	3509.00	2894.67	8835.05	-	15238.72
	Treatment	2776.67	2218.267	3008.53	-	8003.467
3.	Flora & Fauna	75.31	117	NA	-	192.31
	including	64.42	2335.26	Nil		2399.68
	Shoolpaneshwar Sanctuary					
3.1)	Fisheries	-	102.10	-	-	102.10
4.	Health (incre-	3800.00	546.60	1354.63	-	5701.23
	mental expendi-	192.28	9.26	521.20	-	722.74
	ture) for 10 yrs.					
5.	Archaeology/	156.00	-	700	-	856.00
	Anthropology	95.55		12.97		108.52
6.	Seismicity &	219.57	-	-		219.57
	Rim Stability	318.55				318.55
7.	Command Area					
	Development	NA	-	-	NA	
Total - (ii)						23932.93
						15757.207
Total-(i & ii)						25283.38
						16217.957

4. Key Environmental Issues

Several critical issues connected with the project have been debated in depth on the following counts :

- i. Rehabilitation problems involving human rights
- ii. Environmental degradation
- iii. Benefit-cost ratio and economic viability
- iv. Water yield of the river and dam height
- v. Inadequate distribution of irrigation benefits among regions and classes

Non-governmental organisations (NGOs), the World Bank, Narmada Control Authority, and the Ministry of Environment and Forests (MoEF) all played important role in the progressive modification and maturation of the Sardar Sarovar Project. At the same time, the Government of Gujarat and the Sardar Sarovar Narmada Nigam (SSNN) were also open to the informed points of criticism of some important aspects of the original Sardar Sarovar Project plan. Most of the constructive and critical inputs provided by various agencies and organisations for modifying the project were incorporated. For example, catchment and command area, public health and medical care, human settlement and rehabilitation, limnology and water quality, fisheries, flora and fauna, and forest and wildlife have been given adequate consideration. Environmental concerns as dealt with by the governments of Gujarat, Madhya Pradesh and Maharashtra have been included in the section on current status.

Only recently, the Hon. Supreme Court rejected the Union Government's application seeking permission to raise the Narmada dam height from 81.5 to 85 m. This led to an all-party delegation from Gujarat urging the Prime Minister and the President of India for legislation to resolve the Narmada dam imbroglio.

5. Main Reports of Investigations and Studies

Table - 5

Sr.No.	Name of Study	Name of Agency
1	2	3
A) Upstream of Sardar Sarovar Dam		
1.	Simulation studies with Single Reservoir Strategy Model	Indian Institute of Management (IIM), Ahmedabad
2.	Three Reservoir Simulation for Madhya Pradesh Intervention	Operations Research Group, Vadodara (ORG)
3.	Stochastic Dynamic Programming Model for SSP Operation	ORG
4.	Simulation study of Sardar Sarovar Operation (4th Reservoir Model)	ORG
5.	Sardar Sarovar Operation for Power Benefit Assessment (Additional Study)	ORG
6.	Further extended study on Sardar Sarovar Operation for Power Benefit Assessment.	ORG
7.	Assessment of Hydro-Power potential upto Feasibility level	Jyoti Consultants Ltd. Vadodara (JCL)
8.	Additional work on assessment of Hydro-Power Potential upto Feasibility level	JCL
9.	Simulation Model for Reservoir Operation (Fourth Reservoir)	ORG

Table - (cont...)

1	2	3
10.	Studies for Optimisation of Hydro-Power installation and Pumping Units along Saurashtra Branch Canal	Premier Consultants
11.	The Sardar Sarovar Narmada Project studies on Ecology and Environment	Department of Botany M.S.University, Vadodara
12.	Studies on Rehabilitation of Submerging (19 Villages of Gujarat)	Centre for Social Villages Studies, Surat
13.	Eco-environmental & Wildlife Management Studies on Sardar Sarovar Submergence Area in Gujarat	Department of Botany M.S. University, Vadodara
14.	Wildlife Management Studies on Sardar submergence area in Gujarat	Study Group Under SSNNL Sarovar
15.	Monitoring and Evaluation of rehabilitation & resettlement programmes.	Centre for Social studies, Surat

B) Down Stream of S. S. Dam and Estuary

- | | | |
|----|---|--|
| 1. | The Sardar Sarovar Narmada Project Studies on Ecology & Environment. | Department of Botany
M.S. University,
Vadodara |
| 2. | Eco-environment & wild life management Studies in Sardar Sarovar Submergence area in Gujarat including Shoolpaneshwar Sanctuary | Department of Botany
M.S. University,
Vadodara |

Table - (cont...)

1	2	3
3.	Wildlife Management Studies in Sardar Sarovar Submergence area in Gujarat including Shoolpaneshwar sanctuary.	Study Group under SSNNL
4.	Estuary EIA Study	CWPRS, Poona & JNU, New Delhi

C) Command Area of SSP (Completed)

1.	Computer Aided planning of Conveyance & Delivery Net work	IIM
2.	Inter-regional Water Allocation & Determination of Branch Canal Capacity	ORG
3.	Mathematical Modelling of Ground Water in Baroda & Bharuch Area	ORG
4.	Survey & Investigation Ground Water Resources in Narmada Mahi Doab of SSP Command.	Gujarat Water Resources Development Corporation Ltd. Gandhinagar
5.	Mathematical Modelling of Ground Water System Single Layer Model Narmada Mahi Doab	ORG
6.	Additional Work on Mathematical Modelling of Ground Water System Single Layer Model Narmada Mahi Doab	ORG

Table - (cont...)

1	2	3
7.	Extended Study on Inter Regional Water Allocation & Determination of Branch Canal Capacity	ORG
8.	Pre-Feasibility Study for Low Level Canal (Option not-current)	Jyoti Consultant Ltd. Vadodara
9.	Pre-Feasibility level Drainage Study of Narmada Mahi Doab of SSP Command	Core Consultants Ltd. Ahmedabad
10.	Marginal Cost Study of two Typical Distributories & Two Typical Branches.	Dr. C. R. Shah, Vadodara
11.	Consultancy Work for Control, Telemetry & Communication Net Work on Narmada Canal System for Sardar Sarovar Project	Gujarat Communications & Electronics Ltd. Vadodara
12.	Socio-Economic Bench Mark Survey of 62 Talukas (Sub Districts) of Narmada Command Area	14 Different Agencies incl. Universities, Research Instt, Private Instt.
13.	Some Aspects of Role of Panchayats & Institutional Arrangement for Canal Irrigation in Two Talukas of Ahmedabad District	Institute of Cultural & Urban Anthropology, Ahmedabad

Table - (cont...)

1	2	3
14.	Population Projection & Migration Study for Narmada Command Area	ORG
15.	Cropping Pattern & Water Demand Study in Narmada Command Area	ORG
16.	Rate of Adoption of Improved Technology in Narmada Command and Rest of Gujarat State (Based on Analysis of Cropcutting Experimental Data)	ORG
17.	A Study of Settlement Pattern (6 Talukas sub Districts in the Narmada Command Area of Mehesana District of Gujarat)	Department of Geography, Gujarat University, Ahmedabad
18.	Study on Water Demand for Non-Agricultural use from Narmada Project.	Gujarat Water supply & Sewerage Board Gandhinagar
19.	Wasteland Development Project for Command Area of Narmada Canal (Region, 11 & 12)	Gujarat State Rural Development Corporation Ltd., Gandhinagar
20.	Land Use & Cropping Pattern Survey & Mapping of Narmada Command Area Zone 4A & 4B	Deptt. of Geogrpahy M.S. University, Vadodara

Table - (cont...)

1	2	3
21.	Growth of Agro-Processing Industries in phase-I of the S S P.	Gujarat Industrial & Technical Consultancy Orgn. Ltd. Ahmedabad
22.	Techno-Economic Study for Utilising village tanks as Borrow Area for Construction of Canal Net Wrok.	ORG
23.	Regionalisation of Narmada Command	ORG
24.	Consumer Expenditure, Assets & Indebtedness of Rural House holds of the Command Areas of Sardar Sarovar (Narmada) Project, 1982	Directorate of Economics & Statistics, Gandhinagar
25.	Area Development Strategies for Selected Regions adjacent to Narmada Main Canal	ORG
26.	Water Rates policy in 3 Parts:	
a)	Pricing of a Public Utility Survey of Literature	Deptt.of Economics South Gujarat Univ., Surat
b)	Financial Working of Irrigation Projects. In Case of four Projects in Gujarat.	Deptt. of Economics, Sardar Patel Univ Vallabh Vidyanagar Deptt.of Economics,

Table - (cont...)

1	2	3
	c) Some Policy Issues for Canal Water Rates in Gujarat	Sardar Patel Univ. Vallabh Vidhyanagar
27.	Survey & Investigation work of Ground Water Resources beyond River Mahi in SSP Command	Gujarat Water Resources Development Corp. Ltd., Gandhinagar
28.	Mathematical Modelling of Ground Water System for SSP Command between Rivers Shedhi and Sarabamati	Consultancy Engineering Services, New Delhi.
29.	Mathematical Modelling of Ground Water System for SSP Command Between Rivers Sabarmati & Banas	ORG
30.	Mathematical Modelling of Ground Water System for SSP Command beyond Banas upto Rajasthan Border	Dalal Consultants, Ahmedabad
31.	Prefeasibility Level Drainage Study for SSP Command beyond Mahi	Consultancy Engineering Services, New Delhi
32.	Agricultural Research Studies.	Gujarat Agricultural University Ahmedabad
33.	Action Research on people's Participation in Water Management in SSP	Gandhi Labour Instt., Ahmedabad

Table - (cont...)

1	2	3
34.	Development & Management Plan for Nal Sarovar Sanctuary	Expert Group Constituted by SSNNL
35.	Development & Management of Black Buck Sanctuary	-do-
36.	Development & Management of Wild Ass Sanctuary	-do-
37.	Development of Aliabet Island	-do-
38.	EIA Study on Water Related Diseases in SSP Command Area & downstream area.	Commissionerate of Health & Medical Services Govt. of Gujarat
39.	EIA Study of Fisheries (inland & Marine) relevant to Command Area of SSP	M.S. University, Vadodara
40.	Integrated Command area Development Plan for SSP	M/s Wamana Consultant & Pvt. Ltd. Hyderabad
41.	Updating Earlier Reservoir & 4th Reservoir Models	ORG
42.	Flora & Fauna of Command Area	These studies are undertaken by S P Univ., Gujarat Univ. & Saurashtra Univ.

Table - (cont...)

1	2	3
43.	Impact of Agricultural Run off on Quality of Ground Water in SSP Command	This study is being undertaken by Indian Agril. Research Instt. New Delhi.
44.	Review of Ground Water Studies & Problems	International Consultant (NEDECO) have positively responded to review available ground water studies. Arrangement to be firmed up by NPG with the help of GOI/ WB.
45.	Review of studies & problems on drainage	-do-
46.	Integrated soil studies for SSP command	A soil survey expert has been identified who is expected to commence work shortly as per requirements.
47.	Impact on monuments of historical/archaeological importance in SSP command	Status notes being provided by (a) Director of Archaeology, GOG, (b) Director General, Archaeological Survey of India, GOI from time to time.

6. Current Status

After the withdrawal of support from the World Bank in March 1993, the Government of India appointed in August 1993 a five member group for an independent review of the project. The report of this group concluded that :

- * The estimate of the total number of persons affected by the project is not complete . A census must be immediately carried out to estimate the number of affected people in different categories.
- * The R&R master plan is not ready. Such a master plan, including the R&R provisions for the non-submergence categories of affected people, must be made ready within six months.
- * Adequate land is not available to resettle everyone (even if only those affected by submergence are included).
- * The police should be trained for resettlement work.
- * The water yield of the river appears to have been overestimated.

The World Bank submitted the Project Completion Report on March 1995 for the credits/loans given to the SSP. It pointed out that the Bank authorities had paid more attention to the engineering aspects and should have taken stronger action to correct the R & R and environmental deficiencies. In 1995, the Narmada Bachao Andolan (NBA), which had been campaigning against the Narmada projects, demanded the following :

1. The Bank must take a significant share of the moral and legal responsibility for the destruction that has occurred and is to follow from the SSP.
2. This acknowledgement of responsibility must be followed by a sincere attempt to compensate for the suffering that the people have had to undergo due to the Bank's mistakes.

[Note that compensating the people for their trauma does not mean helping their displacement.]

3. The Bank must assure the people of India that it will never fund the SSP in any form^{3/4} either directly or indirectly, through the use of sector loans. Both the Bank and the Indian government must make a public declaration to this effect.
4. The Bank must ensure that this experience is not repeated again. This can only be done by altogether abandoning the funding of large dam projects by the Bank.

The NBA also suggested alternative strategies for water and energy management, with specific reference to the SSP. It reiterated the need for international solidarity and that it will continue its struggle against these projects.

The delay in project implementation is adding to its cost everyday. It has been estimated that more than Rs. 5,000 crores have already been spent on this project. The daily interest burden on this comes to Rs. 2 crore per day. Since the work on the spillway portion was halted in February 1995, the loss of interest suffered by the nation is over Rs. 1,400 crore. These delays have been a serious impact on agricultural production, power generation and provision of drinking water.

A summary of the progress made by the concerned states on R&R, catchment area treatment, compensatory afforestation and other environmental concerns is appended for quick reference:

Table - 6A

Summary of Progress Resettlement & Rehabilitation upto March 1996

A : In Gujarat

Sl. Item No.	Unit	PAFs From			
		Gujarat	Maha-rashtra	Madhya Pradesh	total
1. Total no. of affected PAFs willing to resettle in Gujarat	No. of PAFs	4600	999	14124	19723
2. Allotment of Agricultural land	No. of PAFs Area in Ha.	4373 8680	656 1329	2551 5102	7580 15111
3. Allotment of House Plots	No. of PAFs	4331	634	2434	7399
4. Payment of subsistence Allowance	No. of PAFs	4439	527	1958	6924
5. Payment of Rehabilitation Grant	No. of PAFs	3863	234	156	4253
6. Payment of Ex-gratia	No. of PAFs	4217	294	130	4641
7. Productive assets provided	No. of PAFs	4216	515	1601	6332
8. Employment provided	No. of PAFs	356	11	13	380
9. Insurance Cover	No. of PAFs	4500	656	2551	7707
10. Civic amenities provided :					
a) Primary School	No.	41	10	27	78
b) Well	No.	46	6	16	68
c) Hand Pump	No.	215	45	82	342
d) Approach Road	Km.	50.83	6.55	17.20	74.58
e) Internal Road	Km.	104.19	6.65	60.18	181.02
f) Tree Platform	No.	110	19	50	179
g) Transit Sheds	No.	3692	615	2307	6614

Table - 6B

B : In Maharashtra

Sl. Item No.	Unit	Progress
1. Total no. of PAFs to be resettled	No. of PAFs	2114
2. Allotment of Agricultural Land	i) PAFs ii) Area in Ha.	1337 2109.86
3. Allotment of House Plots	No. of PAFs	1105
4. Payment of Subsistence Allowance	No. of PAFs	1363
5. Rehabilitation grant	No. of PAFs	993
6. Grant-in-aid	No. of PAFs	993
7. Productive assets	No. of PAFs	*
8. Employment	No. of PAFs	1
9. Insurance cover	No. of PAFs	—
10. Ex-gratia	No. of PAFs	806
11. Civic Amenities provided :		
a) Primary School	No.	
b) Hand Pump	No.	
c) Dispensary	No.	
d) Seed Store	No.	
e) panchayat Ghar	No.	
f) Transit sheds	No.	
g) Electrification	No.	
* Productive assets : Activity	No. of PAFs benefited	
a) Poultry units	58	
b) Bullork Carts	89	
c) Cow units	8	
d) Improved agri. implements	533	
e) Agri. input kits like seed and fertilizers as tribal sub-plan	148	
f) Grocery shop	1	
g) Flour Mill	1	

Table - 6C

C : In Madhya Pradesh

Sl.No.	Item	Unit	Progress	Remarks
1.	Total No. of PAFs likely to be resettled	No. of PAF	18,890	
2.	Survey of relocation sites	No.	76	to accommodate PAFs from 93 submergence villages
3.	Finalisation of Layout Plans	No. of Relocation Sites	66	
4.	Identification of Agricultural land	Ha.	1973	
5.	Issue of Notification	No. of Submergence Village		
	i) under Sec. 4		161	
	ii) under Sec. 6		160	
	iii) under Sec. 9		122	
6.	Allotment of House Plots	No. of PAF	733	
7.	Award passed for Villages payment of Compensation	No.of	78	
8.	Amount of Compensation paid	Rs. in Crore	8.29	

Table - 6D
Catchment Area Treatment & Compensatory Afforestation

(Fig. in 000 ha.)

Sl. Item No.	Sardar Sarovar Project				Narmada Sagar Project	
	Total Target/ Achievement upto 3/96	Achievement during 1995-96		Total target/ Achievement during 95-96 upto 3/96		
		GOMP	GOM			
1. Catchment Area Treatment	177.65/83.674	17.02	7.33	0.035	62.97/35.67	4.12
2. Compensatory Afforestation	46.36/45.05	0.06	0.00	0.00	61.0/63.67	3.03

Table - (cont...)

1	2	3	4	5	6
---	---	---	---	---	---

Assessment (EIA) of command area in Rajasthan portion to WAPCOS. WAPCOS have completed the work and draft final report submitted.

2. Flora, Fauna and Carrying Capacity. of study groups action plan is under preparation. Final report is being prepared by the investi-gators of Pune University in consultation with Department of Environment, GOM. Based on the recommendations of the study reports by Wild Life Institute of India and Friends of Nature Society action plans are under preparation. proposal for creation of special protection areas is under consideration of GOMP.

Table - (cont...)

1	2	3	4	5	6
3.	Seismicity	No separate studies required	No separate studies required.	Studies and instalation of seismological instruments at 8 out of 9 observatories completed.	Establishment of 10 nos. of seismic observatories taken up. CWPRS has installed an instrument to record preimpounding data for undertaking seismic studies.
4.	Health	Base line studies completed. Final state action plan submitted in 1991. National Malaria Eradication Programme (NMEP) & State Malaria Control Organisation strengthened. Evaluation Cell established. 4th six monthly monitoring report submitted by Gandhi Medical College, Bhopal.	Base line studies completed. Revised State action plan submitted in 1993. Survey of existing facilities completed. Village Hospital at Somawat resettlement village sanctioned, in addition to health centres and health units. Malaria Control guidelines of NMEP/State Irrigation Deptt being adopted. Disease monitoring	Base line studies completed. Action Plan submitted. Urban Malaria scheme proposed. Survey of existing facility completed. Establishment of Hospital at Kevadia, laboratory, drug dispensaries completed. Malaria control measures through NMEP and	Revised action plan submitted by NVDA. MoU signed with Gandhi Medical College Regarding Preventive Aspects. Further Studies proposed through the Directorate of Health Services. Bhopal Preimpoundment & Postimpoundment studies on limnological aspects complete and action plan based on these studies under formulation.

Table - (cont...)

1	2	3	4	5	6
6. Fisheries	Revised Action plan is under preparation.	Action Plan was revised covering upstream downstream & study reports available.	proposals for the command areas. Implementation earlier is being updated.		
			fishing population started to be resettled on the periphery of the reservoir or in R&R sites in Maharashtra. Some more studies on ecological aspects entrusted to CICFRI		
7. Rim Stability	NVDA had entrusted some more time bound studies to CWPRS Pune to confirm the findings of the GSL. The final Reports received.	Survey completed. No more work is required.	Survey completed. No more NVDA had entrusted some time bound studies to CWPRS Pune to confirm the findings of GSL. The final report(s) received.		

Table - 6F

Current Status on the construction of SSP upto 30.09.97

SNo.	Particulars	% of completion as on 30.09.97
1.	Main Dam	
	a) Excavating	97.39
	b) Concreting	82.58
2.	River Bed Power House (Civil Works)	
	a) Open Excavation	95.39
	b) Under Ground Excavation	90.20
3.	Canal Head Power House (Civil Works)	
	a) Concreting	100.00
4.	Vadgam Saddle Dam Works	
	a) Concreting	100.00
5.	Canal Systems :	
I.	<u>Phase-I</u>	
	— Main Canal (0-144 Km.)	
	a) Earthwork (Exc. only)	98.60
	b) Lining	97.66
	c) Concrete	85.91
	— Branch Canals (0-144 Km.)	
	a) Earthwork	87.75
	b) Lining	70.89
	c) Concrete	82.96

Table (cont...)

SNo.	Particulars	% of completion as on 30.09.97
–	Distribution system (0-144 km.)	
a)	Earthwork	74.61
b)	Lining	85.89
c)	Concrete	75.79
–	Distribution system (0-144 Km.)	
a)	Earthwork	74.61
b)	Lining	85.89
c)	Concrete	75.79
<u>II Phase-II</u>		
–	Main Canal (144-264 Km.)	
i)	a. Earthwork (Exc. only)	86.64
	b. Lining	37.58
	c. Concrete	39.30
ii)	Seven major Structures	
	a. Earthwork (Struct.)	59.74
	b. Lining	00.00
	c. Structure concrete	28.33
–	Branch Canals (144-264 Km.)	
a)	Earthwork (Exc. only)	55.87
b)	Concrete	16.45
–	Saurashtra branch Canal & its Sub Branches	

Table (cont...)

SNo.	Particulars	% of completion as on 30.09.97
i)	S.B.C. (0 to 88.49 Km.)	
	a. Earthwork	67.62
ii)	S.B.C. Sub Branches	
	a. Earthwork	64.28
-	Shedhi Branch Canals	
	a) Earthwork	69.52
	b) Lining	100.00
	c) Concrete	100.00

It is expected that the Project will become partly functional by the year December, 2000/2001 A.D. subject to the necessary clearance as reported by Sardar Sarovar Narmada Nigam Ltd. on 29th Nov. 1997.

7. Key Contentious Issues *

Large Water Resources Projects involve a variety of environmental effects which need to be studied for positive and negative effects. In case of the Narmada Project multi-faceted output will trigger many changes in the basic environmental regimes of land, water and vegetation and their interface with cattle and humans. The whole project has been greatly benefitted by comprehensive guidelines prepared by various organisations like the World Bank, the Ministry of Environment and Forests, Central Water Commission, International Commission of Irrigation and Drainage at the instance of the project authorities and various pressure groups representing NGOs located particularly in Gujarat and Madhya Pradesh.

*reproduced from 'Times of India', New Delhi, March 30, 1997.

Contentious issues concerning various archeological, cultural and historical sites have been identified in advance to avoid adverse effects on these sensitive locations. The project will take ameliorative measures to enhance conservation and beautify the sites to make them as attractive places for tourists.

Due to inter-state coverage of the project, there are several key contentious issues which have been and are in debate at various levels for the last four decades and the project has assumed international importance for their redressal.

- 1) At the inter-state level, resource sharing and resettlement and rehabilitation of the project-affected persons has been a moving target finding it difficult for a settlement to be reached to the satisfaction of all concerned.
- 2) Water management issues are related to the height of SSP in Gujarat as of the submergence of forest areas takes place in Madhya Pradesh. MP govt. pleads for lowering the height of the dam while the other three states i.e. Gujarat, Maharashtra and Rajasthan are interested in taking water to far-off places and increasing their share of hydropower. While the Tribunal award is supposed to be final but various political influences are at work including the interventions by the Supreme Court. For equitable distribution of water to each cultivator a fixed quantum of water, say 53 cm (21 inches), is fixed and the supply will be regulated in phases but there are problems with regard to selection of the crops and their water requirements in different regions. Elaborate estimates have been developed involving farmers' participation for effective control of irrigation supplies and their management.
- 3) Degraded forest areas of 13,386 ha. are supposed to be lost in submergence. In Gujarat alone about 42.5 million trees are proposed to be planted against actual submergence of about 1 million trees. The World Bank

estimated that the project will bring about 40 times improvement in the environment with more afforestation and bringing more areas under green cover.

- 4) There has been a lot of debate on positive and negative effects on the environment as a whole. Several studies on Environment Impact Assessment (EIA) on a holistic basis have been undertaken; however flexibility in approach is needed in implementation of the project for suitable modifications to optimise resource use and enhance integrity of the environment.
- 5) As the project area is affected by natural hazards of floods and droughts, there will be an overall relief due to the moderation of these two natural disasters. Management of these natural hazards also requires a good monitoring network to reduce deforestation. The industrial hazards including pollution from several fertilizer industries, petro-chemical industries, dairy establishments need containment of wastes and disposal at safe levels - a difficult task. As industries in Gujarat emit highest percentage of Chlorofluorocarbons (CFCs) in the country, their participation is needed along with the catalytic role of NGOs as legislative measures are only partially successful in real-life situations.

The Sardar Sarovar Project has been the target of sustained criticism on the Rehabilitation and Environmental issues resulting from this project. The questions from public and the clarifications from the project authorities are given below:

1. The Sardar Sarovar Project (SSP) has not provided for proper rehabilitation of the oustees of the submerged area

Clarifications : The Sardar Sarovar project has provided, what is accepted to be, by even its critics, as one of the best rehabilitation packages in the World. Each Project Affected Person (PAP) will get 2 hectares of agricultural land in the

Sardar Sarovar Command Area, a household plot of 500 sq. meters, all civic amenities such as water, electricity, school building, roads, etc. at the rehabilitation site, liberal grant to enable them to defray the cost of actual shifting, financial assistance for productive assets and many others.

2. *That seems a generous package, but does it compensate it for the property lost?*

Clarifications: It compensates them fully. On an average, a PAP will get four and a half times the amount of land which he had lost as a result of submergence.

3. *But, not all the affected people get this.*

Clarification: This package is available to all persons dependent on agriculture, living in the submerged area, regardless of whether they have land or not. It covers encroachers, cosharers and landless labourers. Not only that, even the major sons of the PAPs will get these benefits.

4. *The quality of the land is poor.*

Clarification: The land is given in the command area of the SSP - good land which will be irrigated. The land lost would very likely have been in the hilly and unirrigated areas.

The assessment report of the team of Narmada Control Authority which has actually visited the sites in the October - November, 1996 has stated that "These fields were inspected and the land quality is good and has the potential to support a varieties of crops".

5. *The package appears to be good. But have all these benefits actually been given to people who have been resettled? How many people have been resettled?*

Clarification : Till now 7,760 families have been resettled and all of them have got the benefits on the above patterns.

A total area of 15465 ha. of agricultural land has actually been given. All other benefits have also been given. Subsistence allowance of Rs. 2.84 crores, productive assets for Rs. 3.25 crores, rehabilitation grant of Rs. 0.64 crores, house sites and insurance for all, complete electrification, 88 primary schools, 76 drinking water wells, 65 water pipeline schemes, 356 hand pumps, internal roads of 184 kms., approach roads of 76 kms., 157 street-lights, etc. have been provided. We feel confident that any one seeing these figures would no longer doubt the rehabilitation work done by the Gujarat Government.

6. *What about the living standard of the PAP's who have already come and resettled in Gujarat?*

Clarification : According to a survey conducted by the Centre for Social Studies, Surat, their quality of life has significantly improved as compared to their earlier condition. This is as measured by parameters such as calorific intake, health, expenditure, income, education, etc.

7. *But if the dam height is allowed to be raised, then Gujarat will not do any rehabilitation.*

Clarification : The Review Committee of the Narmada Control Authority has decided that the dam height will be raised from the present 80.30 metre to 110 metre in steps of 5 metre each. At each step, the Rehabilitation Committee headed by the Union Secretary, Welfare, Government of India, would verify whether the rehabilitation for this 5 metre has been done. Only if it is so, would the dam height be raised to that extent. Therefore, under this arrangement it is not possible to raise the dam height without the necessary rehabilitation. The Gujarat Government itself would not consider raising the dam height without proper rehabilitation as it is fully conscious of its duty in this regard.

8. *But when all these difficulties are being faced at the present height of 80.3 m (264 ft.), how can Gujarat be allowed to raise the dam height? Gujarat does not have enough land.*

Clarification : As explained earlier, if the land is not available the dam height cannot be raised. However, at present Gujarat has a land bank of more than 6,000 hectares and an additional 10,000 hectares of land are in the pipeline. And will be continuously bought and made available as the dam height is raised to ensure rehabilitation. Without the land, Gujarat cannot raise the height of the dam.

9. *The dam oustees are not being rehabilitated keeping the village as a unit.*

Clarification : During rehabilitation, we take care to see that the smaller groups which are the real groups in such villages are not split up and, by and large, we have been successful. At times, shifting the entire village as a unit may not be practical. Land for the PAPs purchased from willing sellers and not through land acquisition. The land is first approved by the officials of Madhya Pradesh & Maharashtra. The PAP then choose the land himself and resettles after considering the social and cultural factors.

10. *But will Rehabilitation Committee be impartial?*

Clarification : The Rehabilitation committee is chaired by the Secretary, Welfare, Government of India and its members represent Government of India, Madhya Pradesh, Maharashtra and Gujarat. There are also social scientists and NGOs in the body. It may be noted that in the past the Rehabilitation Committee has advised against raising of the dam if it was felt that facilities were not adequate.

11. *But even though rehabilitation is not done Gujarat wants to raise the dam height.*

Clarification : The Rehabilitation Committee after two field visits and three meetings between October 1996 and February 1997 has stated that all arrangements for rehabilitation upto 85 metres have been completed. They are in the process of giving approval for raising the dam height upto 90 metres.

12. *But even if, rehabilitation is done properly, will not the tribal way of life of the submerged area be lost?*

Clarification : The areas in which they have been rehabilitated are also tribal areas, where there is a high proportion of tribals. There is a cultural affinity between the tribals in Gujarat, Maharashtra and Madhya Pradesh. In fact, they speak a similar language. Merely by improving their standard of living, the tribal culture will not be lost. On the contrary, it will be strengthened. It is not our intention to preserve tribal culture by keeping them backward. Their practices, customs, dance, music and traditions will continue to flourish in the new settlements. They will be able to combine the best of tradition and progress. Improvement and change are part of progress and none of us are today living in the life-style of our forefathers. Therefore to say, that the tribals should remain in their original habitat and live in a backward condition is the same as saying that groups of people should continue to live in ghettos, home lands and reservations. It is an attitude of cultural superiority and the modern equivalent of the white man's burden.

13. *But the project will cause irreversible environment degradation.*

Clarification : The Sardar Sarovar Project will submerge 37,000 ha. of land of which only 13,385 ha. was officially forest land. Of this, 4523 ha. is in Gujarat. In actual fact, much of this land was degraded forest. But with the submergence of the forest, a new natural eco-system, that of water will be created which will also support a large variety of flora and fauna biodiversity on its own account. In other

words, a large variety of plants and life will thrive in this area.

14. Lacs of trees are being destroyed.

Clarification : It has been decided to plant 100 trees for every tree submerged. The total number of trees submerged in Gujarat was 8.28 lacs and as against this the Sardar Sarovar Project has already planted more than 6.31 crore trees which today have grown to mature size.

15. The claim of planting of so many trees is imaginary.

Clarification : These have been planted in different places. 4650 ha . of previously barren land has been planted with natural forest species in Kutch as a result of which excellent forest grooves have been created. Wild life such as chinkara, the great Indian bustard and black partridges have started occupying the areas in which they were earlier not to be seen. Other areas planted are on the canal side, and in Bharuch and Panchmahal districts. In addition, the Shoolpaneshwar Sanctuary which forms the catchment of the Narmada River and covers more than 600 sq. kms. has been substantially developed. These measures include planting of trees, contour bunding, barricades, checkdams, fencing, firelines etc. and rigorous wild life protection and conservation. As a result of this, this Shoolpaneshwar Sanctuary which was earlier seriously degraded has begun to bloom. Satellite images of a part of the forest taken in 1986 and 1994 clearly shows that the trees cover has become denser. The animals found today in the Shoolpaneshwar sanctuary are panther, leopard, rusty spotted cat, jungle cat, sloth deer, four horned antelope, sambhar, porcupine, giant flying squirrels and more than 200 varieties of birds, some of them rare, replies, etc. The results of the satellite imageries are given below. It may be noted here that in terms of forest quality, the closed forest area represents the best kind of forest. These results show an increase in area under good

forests and a decrease in degraded area.

Density class		total area in ha.	
		1986	1994
1.	Closed Forest area	1058	4480
2.	Open Forest Area	12241	14438
3.	Degraded Forest Area	11459	6274
4.	Highly degraded cultivation/grass growth area.	1126	692

16. But in the command area there will be a negative impact on the environment.

Clarification : In addition to the increase in agricultural production and meeting drinking water needs, the project will have a profound positive environmental impact in the command areas. There will be a greening of the entire area. As can be seen in any irrigated area, there will be a denser tree cover, more hedges and bushes, large number of ponds and water courses all of which will result not only in more variety of plant life but also bird life, smaller animal life and water life will be richer. We have no hesitation in claiming that the project would be a greening project environmentally with an improvement in all those parameters which define environment.

17. Is there any supporting evidence for these environmental claims.

Clarification : A study carried out by ISRO (Indian Space Research Organisation) in Feb. '97 of 2 areas, one irrigated and the other nonirrigated, just 14 Kms. apart in Kheda district showed that irrigated area had 4.5 times the tree cover of unirrigated area. The ISRO estimated that the accuracy of the observation was 90%. ISRO also found that

because of the greater tree cover and water availability, the population of birds was much larger in the irrigated area. So also was the ground vegetation.

- 18. *Is there a committee similar to the Rehabilitation committee which ensures that environment measures have been taken?***

Clarification : The Environment committee of the NCA under the chairmanship of Secretary Environment & Forest, Govt. of India closely monitors the environmental steps to be taken. This Committee has also expressed its satisfaction and has recommended the raising of the dam height.

- 19. *But the project is completely unviable. It will ruin the State of Gujarat financially.***

Clarification : The World Bank appraisal mission which studied the project in great detail estimated that the project would have an Internal Rate of Return (IRR) of 12%. The subsequent escalation in the project cost does not alter this as the monetary value of the project benefits also correspondingly rises. Moreover, it is the duty of any Government to provide drinking water to its people which is the basic necessity for survival. The additional agricultural production will be approximately 4 million tons of foodgrains. In addition, there will be substantial production of Tur, groundnut, tobacco and cotton. Not only this but with the increased agricultural production, the agro processing and other industrial development will also flourish. The value of the goods and services directly produced by the SSP, i.e., agriculture, water supply and power would amount to almost Rs. 2500 crores per year. This is almost Rs. 7 crores per day.

- 20. *Even if the project comes up, it is basically to benefit the big farmers of the advanced districts. None of the water will reach the drought-prone areas or even the***

fields of the small farmers. In fact, Saurashtra, Kachchh and North Gujarat will get only 2% of the water.

Clarificaiton : Out of the command area of 18 lakh ha., more than 75 % is in the drought prone area, 54.9% being in North Gujarat, Saurashtra and Kutch regions. At the same time, of the total command area, almost 55% of the land holders are marginal farmers, small farmers, scheduled tribes and scheduled castes. The focus of the project is very clearly on the small man.

21. *Project such as the SSP are not required as local water harvesting techniques can solve water problems of Saurashtra, North Gujarat and Kachchh.*

Clarificaiton : Nowhere in the world has it been possible to meet the drinking water needs and also to modernise agriculture in a drought-prone area using water harvesting techniques.

Water harvesting techniques at the local levels cannot be a substitute in areas where the drought situation occurs repeatedly and they may not even be cheaper. For example, roof water harvesting requires a concrete underground tank below each house and also pipelines to collect the water. Desalination is expensive and unreliable. In any case, water harvesting can never provide sufficient water for irrigation. However, water harvesting methods have a role to play in alleviating drinking water shortage but it is a limited one. But even with SSP (Sardar Sarovar Project) becoming operational, rational water use based on the price mechanism will have to be encouraged.

22. *There is no need to bring more area under irrigation as India already has food self-sufficiency. In any case, the SSP will benefit only Gujarat and so the rest of India should not support it.*

Clarification : The project will actually benefit Madhya Pradesh, Maharashtra , Rajasthan & Gujarat. However, the national nature of the project does not depend solely on location of the project but on the impact it will have on the well-being of the nation. It would be recalled that the Bhakara Nangal Project is located in Punjab and its direct benefits are available only to Punjab and Haryana. But this project fired the imagination of an earlier generation of Indians because they saw it as symbol of India's march towards progress. It is surplus from the farmers of Punjab and Haryana which stocks 70% of the network of fair price shops in the country. These shops provide food security to the millions of India's poor at a reasonable cost. That is why the Bhakara Nangal was seen as a national project. In the same way, the SSP, which has a command area larger than Bhakara Nangal, will guarantee food security to the next generation of Indians. The country would be dangerously exposed to blackmail in the future if we do not have this assurance. With the completion of the SSP, the dry and presently unproductive lands of Saurashtra, North Gujarat, Kachchh, parts of Madhya Pradesh, Maharashtra and Rajasthan will turn green and the human energy released will sustain the country in the future years. This is the reason why the nation cannot afford to delay the project by even a single day.

8. Chronological Sequence of Development

- 1965 Khosla (Expert) Committee's recommendations for construction of dam 500 ft. high on sharing of water were rejected by M.P. & Maharashtra.
- 1969 The three-judge Narmada Water Dispute Tribunal (NWDT) appointed by Govt. of India for adjudication for an equitable apportionment of water resources between four states MP, Gujarat, Maharashtra and Rajasthan.
- 1979 NWDT clears the dam height of Kevadia at 455 ft

and directs MP to build the Narmada Sagar dam upto a height of 860 ft. The construction of the Narmada Sagar should go ahead side by side or earlier to the construction of the Sardar Sarovar dam at Kevadia with a view to ensuring that sufficient water as per the award is available. Moreover, the award states that it cannot be reviewed for 45 years i.e. before 2025.

- 1980 Narmada Control Authority (NCA) was set up by the Govt. of India in pursuance of the final orders of NWDT. This high level inter-state administrative authority was charged with the responsibility of securing compliance with the implementation of the decision and the directions of NWDT by Gujarat, M.P., Maharashtra and Rajasthan.
- 1983 Detailed project report in 15 vols. prepared by Narmada Planning Group (NWP), and forwarded to Govt. of India and World Bank.
- 1985 M L Dewan Committee reveals serious siltation problem in the Narmada project. World Bank enters into credit and loan agreement of \$450 million with the Central Govt.
- 1987 The project was cleared by the Govt. of India but was opposed by environmental activists. A new R & R policy was announced by Govt. of Gujarat. Narmada Bachoo Andolan group was formed and holds its first meeting with the Chairman of World Bank.
- 1990 Due to persistent pressure from NGOs, state Governments and the World Bank, the Govt. of India conceded the forest land for rehabilitation of project affected persons (PAPs). The democratic process of the political system has enabled the grass-root activists to insert the maximum corrective inputs

in the revised project plan through commendable intellectual homework, persuasive perseverance and national-international networking.

- 1991 The World Bank Review (April-May 1991) on implementation status of the Narmada underlined that R & R of Sardar Sarovar Project continues to show reasonable progress.
- 1992 The World Bank Independent Review Team (Morse) in its report was highly critical of the progress of the Narmada Project. This resulted in Govt. of India deciding not to claim further support for Sardar Sarovar Project from the World Bank.
- 1993 Medha Patkar gave an ultimatum to the Govt. that if it did not concede to review the project, Narmada Bachao Andolan (NBA) activists will resort to "Jalasamarpan" on 6 August 1993, MoEF declared in December 1993 that the project had failed in meeting the conditions regarding environmental work & resettlement.
- 1994 During December 1993, Narmada Control Authority called for stoppage of work on the project due to slow progress on Environment & R&R. The work was resumed during March 1994 on the advice of SSCAC & directives of MoWR taking note from the observations of the Prime Minister.
- 1995 Since May 1995 the work on raising the dam has been stopped as the settlement programme is lagging far behind. The target height for June 1995 was 110 m but the work was stopped at 80.3 m and the Supreme court asks review on :
 - i) Hydrology: Whether the water yield has really decreased
 - ii) The height of the dam: Whether there is need to lower the height,

- iii) The resettlement aspects: Whether R & R is possible or not
 - iv) The environmental aspects,
and directs the Review Group to submit the report in April 1995. Supreme Court orders that spillway height to be maintained at 81.5 m.
- 1996 In February 1996 the Supreme Court rejected the Union Government's application seeking permission to raise the Narmada dam height from 81.5m to 85 meters on the grounds of correcting R&R issues. Seventh meeting of Rehabilitation committee held on 11th Nov.,96 decided raising spillway level to 110m during 1996-97 construction can continue of the R&R subcommittee is satisfied with its review at every 5m level.
- 1997 One 24th February, 1997, the Supreme Court stays construction of dam beyond 81.5 m.

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