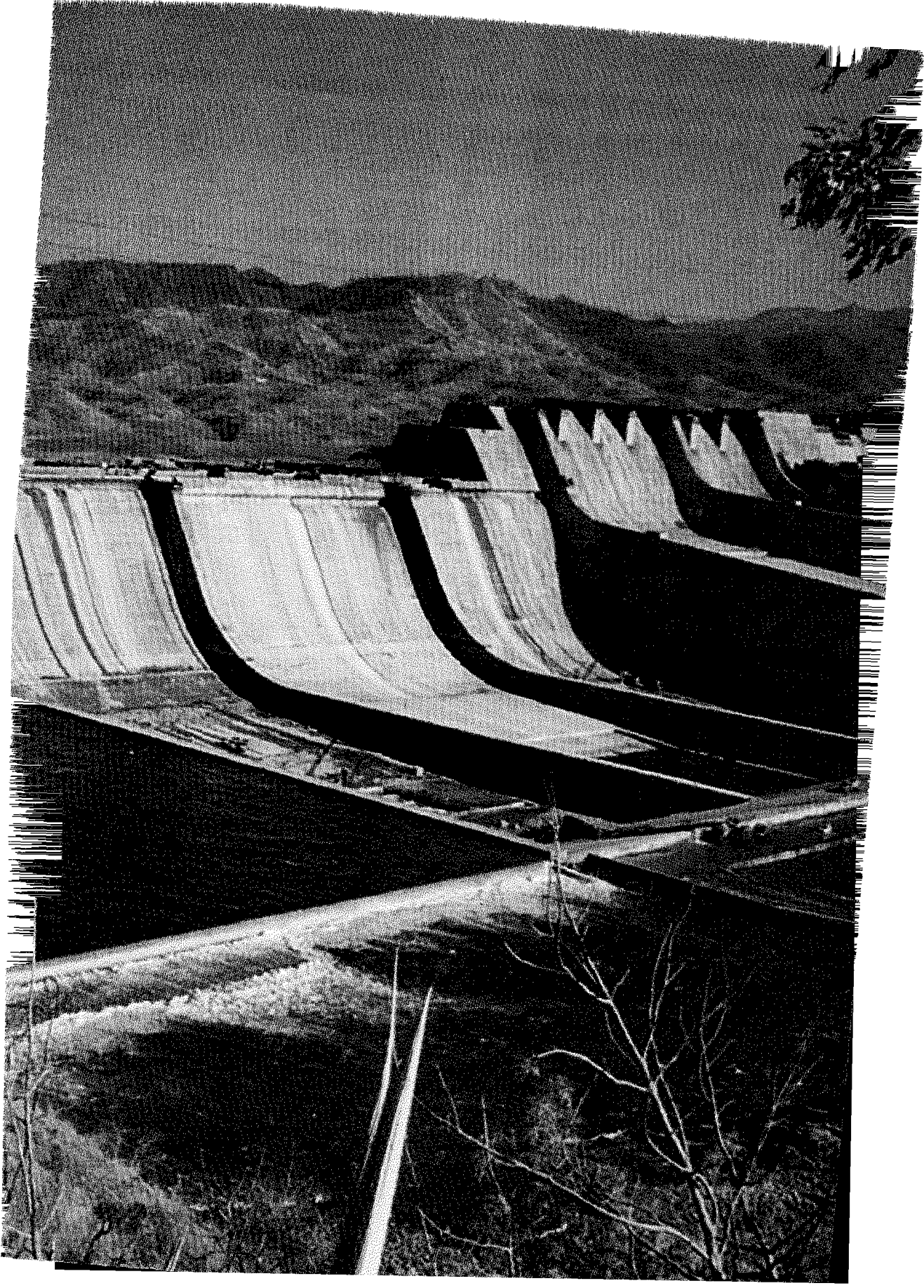


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**SARDAR SAROVAR PROJECT  
ON RIVER NARMADA**

**MEETING  
THE CHALLENGES OF  
DEVELOPMENT**

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## **SARDAR SAROVAR PROJECT ON RIVER NARMADA**

# **MEETING THE CHALLENGES OF DEVELOPMENT**

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### **SARDAR SAROVAR NARMADA NIGAM LTD.**

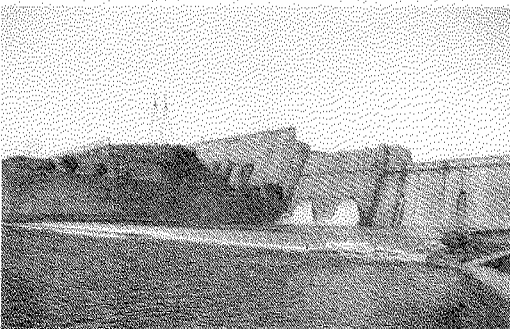
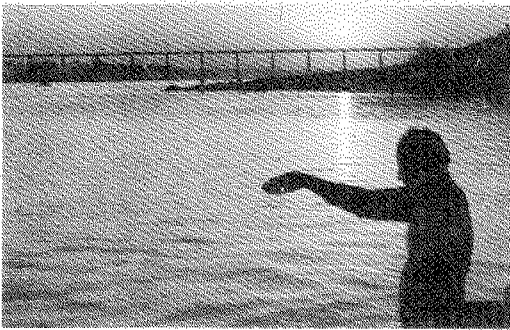
(Govt. of Gujarat undertaking)

Block No.12, New Sachivalaya Complex, Gandhinagar - 382 010. (Gujarat)



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**Keshubhai Patel**  
Chief Minister, Gujarat State.



## MESSAGE

Sardar Sarovar Project to conserve the water of the major river Narmada is a multi purpose inter-State Project for the benefit of Madhya Pradesh, Gujarat, Maharashtra and Rajasthan. A dam on Narmada river at Kevadia just before its confluence with sea is one of the unique engineering works in India. Its salient feature makes it a project of National importance.

Sardar Sarovar Project will bring water to irrigate the arid regions of Gujarat and Rajasthan. It will provide hygienic drinking water and remove the curse of recurrent droughts. The power generated by this Hydro Project would not only meet the requirement of power in four states namely, Madhya Pradesh, Maharashtra, Gujarat and Rajasthan but will accelerate agricultural, industrial and cursory sector development.

The people of all these States have been eagerly waiting for the completion of the Project so that it can bring about a major change in the economics of the participating States.

Sardar Sarovar Project on Narmada is perhaps the most studied project examined from all angles and evaluated repeatedly as controversies have been generated by those who are opposed to this development project. Unfortunately the critics of the project failed to see the positive side of the project and are highlighting issues which in proper perspective

could be resolved very easily. All the State Govts. have been fully committed to rehabilitate the families who will have to shift on account of submergence. The package offered by Gujarat has fulfilled all the criteria laid down in the award of the tribunal.

When a sustained campaign of dis-information and pressure tactics are deployed, the publication of this book will provide authentic data for a rational debate on project related issues. Sardar Sarovar Narmada Nigam Ltd. has given a holistic view of the cost and benefit of the project. I hope that this would create greater awareness about our efforts to implement this project. I would like to state that let us discuss the issues keeping the national and international perspective before us.

I appeal to those who have expressed the reservations to think rationally and behave responsibly giving the top priority of our national interest. I once again congratulate the Chairman and all officials of Sardar Sarovar Narmada Nigam Ltd. for their dedicated efforts and spirit of service.

  
(Keshubhai Patel)



**Jay Narayan Vyas**  
Minister, Narmada &  
Major Irrigation Projects.



## FOREWORD

Even while economists have been debating merits of alternative development strategies which could have been adopted for India's Five Year Plans, there is a unanimity of view about the wisdom of our planners in according high priority to harnessing river waters for spreading irrigation and augmenting food production. If today India can keep her head erect in the international economic community, we owe it to water resources projects from Bhakhra Nangal to Ukai, which constitute the backbone of our self-sufficiency in food and other agriculture raw materials.

It is against this background that the ongoing as well as future water resources projects of our country have to be viewed. While we can take comfort in our green revolution, and continue our endeavour to keep pace with growing population, our more serious concern today should be to build a similar capability for meeting energy needs of our country. Fortunately India has vast unexploited hydropower potential (estimated at 84,000 MW) which if properly harnessed can relieve us from the heavy burden of foreign exchange outflow and dependence on imported fuel for generating electricity.

The interstate Narmada Project is unique in many respects. It is one Project which was deliberation by a Tribunal headed by a sitting Judge of the Supreme Court and assisted by a galaxy of eminent technocrats, economists and hydrologists of our country to arrive at a most comprehensive and judicious plan for harnessing waters of Narmada for benefit of the people of the four States. It is also a project, which has been taken up for implementation in the era of acute environmental awareness and also after the Forest Conservation Act came into effect. While this inevitably caused some delay in starting project implementation, the positive side is that having undergone a rigorous scrutiny from environmental angle,



and also having fulfilled all the requirements of the Forest Conservation Act, the project can confidently proceed in harnessing river waters for improving quality of life of the people, and at the same time generate a positive impact on environment ecology and forest conservation in totality.

The complete plan of harnessing Narmada waters hinges on two pivotal projects viz. Sardar Sarovar Project in Gujarat and Indira Sagar Project in Madhya Pradesh. The Government of Gujarat has the honour of implementing the former on behalf of the participating States namely Madhya Pradesh, Maharashtra, Gujarat and Rajasthan. Our government has undertaken this task with a sense of responsibility and commitment to complete this project as a dedication to the national economic development. The project is enjoying complete support of the people of Gujarat and all the political parties, which has made it possible for the Government to allocate requisite financial, technical and managerial resources for its effective implementation. A few interest groups, mostly acting at the behest of international anti-dam lobby have been creating misinformation and foul cry against the Narmada Project. Some of this anti-dam campaign elements are such as to remind us of a similar campaign the Aswan High Dam of Egypt had to face.

This small book, which attempts to make a brief but succinct presentation of various facets of the project, will help in its better understanding. While the presentation is factual and the book does not purport to dwell on broader controversial issues raised against large dams, its author Shri V. B. Buch, who besides being the Vice Chairman of the Sardar Sarovar Narmada Nigam, having also held senior positions in Industries, Finance, Agriculture, Rural Development and in Food & Civil Supplies Sectors, has been able to put the facts in overall perspective to facilitate their appreciation in proper context.

I am happy that the Sardar Sarovar Narmada Nigam is publishing this book at a time when the project is at a very advance stage of implementation and increasing globalisation of Indian economy has made it imperative for us to speed up implementation of projects of this kind, as we enter the twenty first century which is expected to be a century of international economic integration and competition.

  
(JAY NARAYAN VYAS)



**Bhupendrasinh Chudasama**

Chairman  
Sardar Sarovar Narmada Nigam Ltd.



## **PREFACE**

Implementation of the Sardar Sarovar Project has reached a decisive stage thanks to the determination and popular will of the people of Gujarat as well as systematic and sustained efforts of the project administration to complete the scheme at the earliest. And at this juncture the horizon of Gujarat future looks rosy as if by a rising Sun of Economic Progress. Many obstacles engineered at national and international levels have come in way of Narmada Project but fortunately the people of Gujarat and the State Administration have risen to the occasions to counter those obstacles. In fact, even in the last one year Government have amply demonstrated with tact and initiative and with co-operation and help of all social organisations, political parties and hundred of well-wishers of the Narmada Project. Such problems can be effectively countered. And it has also demonstrated that with such determination and political will power the State Government and the SSNNL are not only committed but are also capable of completing the project expeditiously. Some of the achievements of last year which inspired the confidence are resumption of the construction of the main dam, notable progress in construction of canals, arrival of imported hydro generating sets for the River Bed Power House and countering of disinformation campaign of NBA and its followers.

Opponents of Narmada Project initially raised the issues of environment and resettlement. Now they have started disinformation campaign in the name of human rights. What is the real human right issue ? In one sense, the State Government by assuring an ideal rehabilitation package to the displaced tribal families has adequately protected human

rights of the masses of rural areas in Kachchh, Saurashtra, North Gujarat and Bhal regions, which are affected by water crisis and where availability of water is an issue of survival for the human life as well as for the animals. The State Government is determined to protect human rights on both these fronts.

A pertinent question is what kind of human rights are protected by perpetuating backwardness of any sections of society ? Issue of human rights with reference to SSP becomes irrelevant if one looks at the systematic efforts made by the State Government to improve the quality of life of each displaced family. They are in a position to enjoy much better standard of living and also civic amenities like health and education than what they had earlier.

An equally important aspect is that if anybody is really concerned about human rights it has to give as much thought to the thirsty land, thirsty people and thirsty animals of the water starved regions of Gujarat.

Hundreds of villages in Kachchh and Saurashtra have to struggle for every drop of water. Because of acute water problem there has been large-scale migration from Bhal region and several areas of Kachchh and Saurashtra. It has been their recurring problem. If they look forward to Narmada water for quenching their thirst it has also to be viewed as their human right. A responsible Government has to take care of human rights not of one section but of all the sections of the society. The Gujarat Government by carrying out proper rehabilitation of displaced persons and opening new opportunities of better life for them has protected their rights and at the same time tried to protect the rights of people of drought prone area by proceeding with implementation of the project.

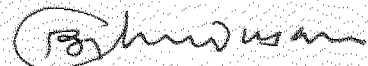
Our country's population, which has already touched one billion, is still growing. The Prime Minister's Five Points Programme therefore rightly envisages doubling of food production in next ten years. If we do not succeed in this, the country may compromise its economic independence and honour by having to depend upon outside help for feeding our people. This makes project like Sardar Sarovar essential. Narmada basin has very large water flow which is going unused for all these years. For all round economic development



of western region, harnessing of this water flow is an essential step. The Narmada Water Disputes Tribunal has gone into all aspects of harnessing water flow of Narmada basin and has decided the parameters within which various projects are taken up by the beneficiary States. The Sardar Sarovar Project being implemented by the Government of Gujarat for benefits of four States namely Madhya Pradesh, Maharashtra, Gujarat and Rajasthan is a part of this larger development perspective.

This small book not only contains all relevant factual data about SSP but also describes in some detail how the project is being implemented with full regard to the economic, technological, environmental and human issues involved. I am thankful to Shri V.B. Buch, I.A.S. a distinguished civil servant, who has been able to bring a wider perspective and multi-dimensional focus on this subject on account of his varied experiences at senior positions in Agriculture, Rural Development, Finance, Industries etc. I am sure, this book will be a useful reference source and would also provide comprehensive and authentic information to all those who are interested in knowing more about the Project.

I am happy to dedicate this book to all those who are interested in the economic progress and well being of the people of our country.



(Bhupendrasinh Chudasama)

# PROLOGUE

**V. B. Buch, IAS (Retd.)**

Vice Chairman

Post 2nd World War - 20th Century is marked by the end of colonial era. Countries small and big, after attaining political freedom, embarked on an ambitious programme of economic development. The twin problems of under employment and poverty have been the most difficult challenge that they have been facing. They are no doubt, endowed with diverse natural resources which have remained unharnessed. Burgeoning population has thrown up an army of unemployed young people who are an asset if gainfully used, but an explosive liability if kept idle. The crucial task for the planners and leaders of these countries is to channelise the unharnessed natural resources - land, water, minerals, forests, sea wealth and so on and the idle manpower so as to transform them into productive wealth for the people.

Arable land and fresh water are two important resources of India. China which is 3 times larger than India in size has farm land nearly half that of India. India's surface water estimated at 1952 BCM is about two third that of China. India's northern region makes up the World's largest alluvial plain and the soils rank among the most fertile in the World.

And yet India remains poor and underfed : Then, what is the handicap? It is two-fold - first our arable land is spread out stretching from Kachchh to Brahmaputra valley and from Deccan trap to plains of Punjab, while bulk of surface water sources are concentrated in about a dozen river basins; second 80 to 90% of surface water is available only in monsoon months which flows down the sea if not impounded. Therefore neither water nor land is utilised optimally, depriving the country of their full benefits.

The Sardar Sarovar Project, or any other large water resources project for that matter, has to be viewed in this national perspective.

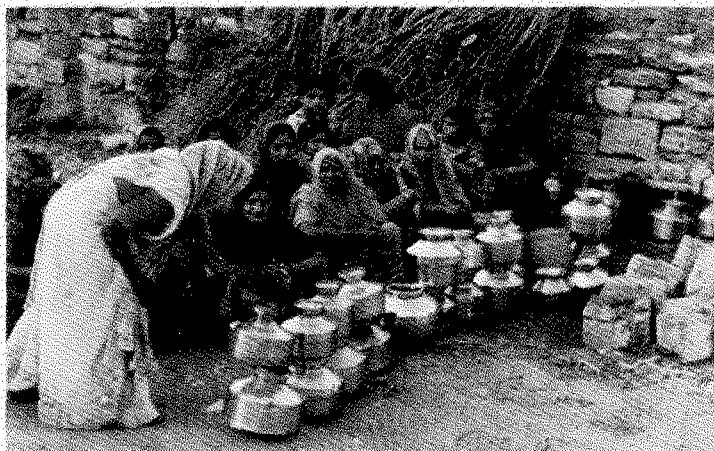
In course of 50 years of planned economic development of our country, we have taken tremendous strides in agriculture sector. Our country which had to depend upon imports to feed even a population of 35 crores when we became independent, has attained a position of self sufficiency with some exportable surplus even with a population of 99 crores today. This has been made possible by harnessing waters of major rivers of our country with a chain of large multipurpose projects starting from Bhakhara Nangal, Hirakud, Nagarjuna Sagar, Tungabhadra etc. India's population continues to grow notwithstanding our all out efforts on



family planning front. Various studies indicate that country's population might cross 120 crores by 2020 A.D. Thus we shall have additional 25 crores people to be accommodated in our production basket of food grains, sugar, cotton, edible oil and so on. This can be possible only by creating more Bhakhara Nangals and more Hirakuds. Harnessing the entire water resources of the country is the only way to sustain our self sufficiency in basic requirement of food and clothing. Other countries of the World have also done the same. And the faster we go on this path the better assured we shall be on the food security and keeping poverty and hunger at bay, improving the quality of life and providing electricity to light the rural homes and energise the wheels of Cottage Industries.

The mean annual flow of Narmada river is more than combined flow of Ravi, Beas and Sutlaj rivers. These three Punjab rivers have not only taken Punjab and Haryana and North Rajasthan on the path of green revolution, but have provided a granary to the nation. Narmada river has potential of transforming Madhya Pradesh, Gujarat and Southern part of Rajasthan in the same way. It is imperative for the nation to make best use of this water. SSP aims to meet this imperative.

A matter of equal concern is the sufferings of millions of people residing in water deficit areas. The womenfolk have to walk long distance for minimum requirement of water for drinking and domestic use. This impairs their productive capacity and health. In many of these regions they are forced to use salinity affected, fluoride affected and nitrite affected water. There is also human distress in



terms of poverty, unemployment and migration on account of non-availability of minimum water supply. Water deficiency also aggravates environmental degradation, ingress of salinity and lack of green cover. As has been done in USA, Israel and elsewhere, there is no option but to transfer water as a basic necessity of life from surplus to deficit areas. Such a transfer can

be made only by techno-economically feasible large dams and transmission system of canals. The Narmada Project is just this.

Hydro power is environment friendly and relatively cheaper energy. It does not involve import of petroleum fuel and hence spares our country from the burden of foreign exchange outflow. It also reduces our dependence and vulnerability to petroleum exporting countries. During 1950s and 1960s the share of hydro power in the total installed capacity of electricity generation could be raised from 32% to 47% due to construction of large dams in our country. Unfortunately, in the subsequent years, progress of large dams has been delayed and after 1967-68 the share of hydro power has been declining and to-day it is only about 26-26%. As compared to that there are many countries in

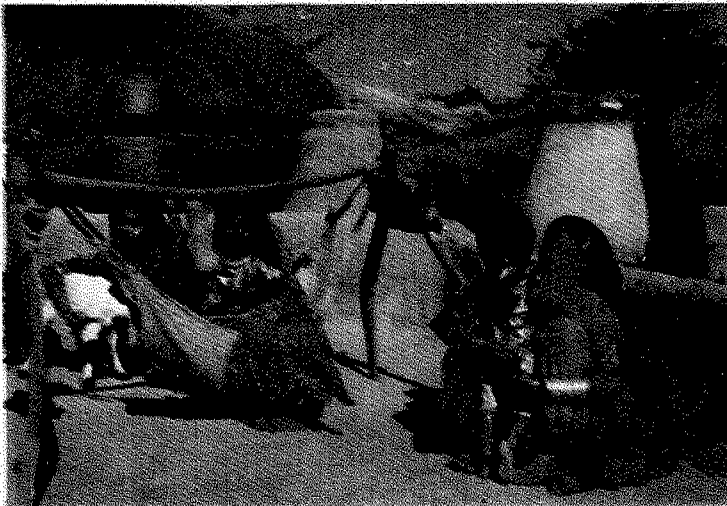


the world like Canada, Switzerland, Austria, Sweden where the share of hydro power is more than 60% and the agriculture and industries of those countries are enjoying the benefits of cheaper energy. It is in our country's interest to maximise hydro power generation which is truly renewable and indigenous source of energy. The Narmada Project assumes a special national importance in this perspective.

Every development project has its cost. While economic cost/benefit analysis is being traditionally done, there is a greater emphasis these days on human and environment cost. During the hey days of Industrial and Technological revolutions, the mills of economic development of western world ground fast and fine, not caring either for human rights or for ecological consequences. With accumulation of wealth and affluence, finer sentiments of human rights and environment are now surfacing. And what is good for G-7 has to be good for the rest of the World! So our urbanite elite have also adopted human and environmental issues as the State of the Art evaluation angle.

This is not to say that human and environment aspects should be overlooked. They must be examined. But not only cost but also benefits. And not only cost implementing a project, but the *cost of not implementing it!* This is because, for countries of Asia and Africa, where basic amenities of life such as potable drinking water, minimum food, fuel and lighting are yet a far cry for large sections of population, the cost of non-implementation of a project can be perpetuating these miseries! How can we ignore it!

For instance, as shown in Chapter III and VI, miseries of water starved regions, even in normal years, and aggravated in drought years have to be weighed against the trauma of displacement of families which will have to move out. Similarly the degradation of environment and onslaught on ecology of arid regions due to advancement of desert, salinity ingress, loss of green cover and biotic life etc. have to be considered against the disturbance in ecology and environment of submerging areas.



To comprehend the human miseries and the human cost of not constructing the dam, we have to recall the three consecutive years of drought 1985-86-87, which wrecked havoc on economy and rural life of Saurashtra - Kachchh and North Gujarat. Farmers - large and small including their womenfolk had to work on scarcity relief works opened by the Government to sustain their livelihood. A number of

labourers on relief works (in Saurashtra - Kachchh, Mehsana and Banaskantha districts) in April - May months of these years, ranged from 8.64 lakhs to 14.61 lakhs. Water Specials (Trains) had to be run to sustain bare minimum drinking water supply !

Even in a normal year, drinking water problem becomes acute in large towns also, not to talk of villages. This summer (1999) for instance, Surendranagar, a district headquarter town, was getting water once in four days and Jamnagar, a Corporation Town, once in three days !

50, out of 62 talukas of Gujarat, to benefit from Narmada irrigation suffer from fundamental resource backwardness - partially or wholly - like drought proneness (36) desert (8), tribal talukas (5), tribal pockets (2), coastal areas (8), basic backwardness (10), economically backward (10), industrially backward (40) and geographically backward (13). For these fundamentally backward 50 talukas, Narmada Project is the only hope for productive employment generation and upgrading standard of living.

Suggestions like water harnessing, small dams, watershed development etc. often flaunted by anti dam activists which may look deceptively simple, become totally irrelevant and grossly inadequate to meet such situations and for such arid areas for which transfer of water from surplus regions can only provide a real and lasting remedy. Sardar Sarovar Project is essentially a vehicle for taking plentiful waters of Narmada basin which are today flowing down the sea, to the water starved regions of Saurashtra, Kachchh, North Gujarat and Rajasthan. It can be compared with transfer of water from Central USA to the arid areas of West USA.



Such water transfers also enable optimum use of arable land and water when they are apart from each other. While land cannot be transferred, water can be flown to distant places. Otherwise land remains on one side and water away at other place, both remain unused, unproductive. *And if in face of hunger and poverty, water and land are allowed to remain separated and unused, it can be regarded as a crime against humanity!* The core issue of development in a country is to manage its natural resources. And as Development Economists often say, a country is poor, not because it does not have resources, but because it does not have either will or ability to manage its resources.

In Sardar Sarovar Project we have undertaken this task of managing our water resources for National interest - our food security, energy security and upgrading the quality of life - including that of people who would be required to shift from submergence areas. It is a national project in the true sense.

This small book is intended to present the factual details and basic data relating to the project, also highlighting its multidimensional contribution to welfare of the people of the participating States - e.g. Madhya Pradesh, Maharashtra, Gujarat and Rajasthan and to the national economy.

Like many other projects of developing countries from Aswan of Egypt to the Lesotho Highlands water scheme of South Africa and Tehri in India, Sardar Sarovar Project has also become a focus of a concentrated international anti dam campaign, carried out by its local loyal supporters, resorting to disinformation intended to create confusion in public mind. Chapter VI is therefore added to answer points repeatedly made against the SSP. As has happened in the case of Aswan Dam in Egypt, time will vindicate the wisdom of planners and leaders who have helped in pushing ahead with this project with determination and commitment.

I wish to acknowledge encouragement and guidance given by the Hon. Minister (Narmada & Major Irrigation Project) Shri Jay Narayan Vyas for undertaking writing of this book and also valuable assistance of Dr. Rajiv Gupta, Executive Director of the Nigam and other officers in preparing layout, collecting data, photographs etc. I have drawn upon 'facts' on the project, compiled by my predecessor Shri P. A. Raj, a distinguished engineer, and I am indebted to him for that.



V. B. Buch, IAS  
Vice Chairman, SSNNL.



## HIGHLIGHTS

- *Narmada Basin has utilisable water resources per capita per year of 3020 M<sup>3</sup> as against 180 M<sup>3</sup> of Sabarmati Basin.*
- *SSP is the terminal dam on Narmada river system.*
- *Envisioned by Late Sardar Patel, the Iron Man, and maker of modern India in 1946, but taken up for implementation in 1980s based on Narmada Water Dispute Tribunal.*
- *Located in Gujarat and implemented by GOG, it is an interstate project of four States - MP, Maharashtra, Gujarat & Rajasthan.*
- *It would be the largest water resources project of India.*
- *Dam's spillway discharging capacity (30.7 lakh cusecs) would be 3rd highest in the world (indicates flood discharge of the river)*
- *With 1133 cumecs (40,000 cusecs) capacity at the head regulator, and 532 km. length, the Narmada Main Canal would be the largest irrigation canal in the world.*
- *The project would provide irrigation coverage to 17.9 lakh ha. spread over 3393 villages of 14 districts in Gujarat. This would be more than existing total irrigation potential of all major, medium and small irrigation projects of Gujarat put together (e.g. 15.72 lakh ha.)*
- *Maharashtra tribal areas and Rajasthan drought prone areas also to get irrigation benefits.*
- *The project will generate between 856 to 1007 million units per year of cheap and eco-friendly, indigenous hydro power.*
- *Project would meet the drinking water needs of 8215 villages and 135 urban centres which are today suffering from acute shortage of water.*

- *The project will benefit areas like Bhal - affected by high impact of saline soil/water.*
- *Benefit to three sanctuaries.*
- *SSP has the lowest ratio of submergence to area irrigated - being 1.65% of CCA against an average of 4 to 5 % of other major irrigation projects.*
- *With only 40727 families (1,27,446 persons) being affected by pondage as well as temporary backwaters effect, it has the lowest ratio vis-a-vis water storage.*
- *Land based and community group based resettlement programme being adopted for the displaced families is the first of its type in India.*
- *2 ha. of land in command area is being given not only to the displaced landlosers but also to agricultural labourers, encroachers and their major sons.*
- *An autonomous organisation free from bureaucratic constraints looking after resettlement of displaced families with allotment of agriculture land, pucca house and all amenities in colonies being specially developed.*
- *Project funded by contributions from GOI, the four participating States, and mobilisation from open market.*
- *This project would contribute to food security and energy self sufficiency of our country.*
- *An amount of Rs. 7980 crores already invested in dam, power house, canal system and resettlement.*

## CHAPTER - I

# HARNESSING THE NARMADA BASIN

॥ नमामि देवि नर्मदे ॥

**1.1** Narmada, the largest west flowing river in India and the fifth largest of all rivers of the country rises near Amarkantak range of mountains in the far eastern part of Madhya Pradesh, near the border of Uttar Pradesh. Traversing 1312 KM through MP, Maharashtra and Gujarat, it meets with the sea in the Gulf of Cambay.

The bank of Narmada has been home of ancient civilisations and kingdoms which have flourished over thousands of years in India. It was on the bank of this river near its conjunction with the Gulf of Cambay that the King of Asuras Bali performed his Yagna visited by Lord Vaman as per our ancient scriptures. This episode according to Hindu mythology took place more than 5000 years ago. In the upper reaches of the river, the region known as Vindhya, finds mention in ancient literature as the land of valour and culture. A rockshelter painting from Bhimbetka, sculpted on the crest of the Vindhyan heights between Bhopal and Hosangabad depicts what our historians describe as a dyke in the Narmada Valley, one of the oldest sites of human habitation in India. It is not surprising that Adi Shankaracharya while on



his way from south India to north India chose to make a special visit of river Narmada, calling it 'the holiest of the holy rivers'.

### THE RIVER BASIN

**1.2** River basin being the basic hydrological unit, India has been divided into 20 river basins of which 14 are major basins. In terms of flow of water, Narmada basin is the 8th largest but in terms of utilisable flow it occupies 5th position after Ganga, Indus, Godavari, Krishna and Mahanadi. The Narmada basin is bounded on the north by the Vindhyas, on the east by the Maikala, on the south by Satpuras and on the west by Arabian Sea. The basin has an elongated shape with a maximum length of 953 KM from the east to west and maximum width of 234 KM from north to south. The basin can be divided into five well defined physiographic zones. The

upper hilly areas being well forested and with high rainfall, while the middle and lower plain are broad and fertile areas well suited for cultivation.

The total area of the river basin is 97410 sq.km. Mean annual rainfall is 112 cms. Utilisation of Narmada river basin today is hardly about 10%. Large quantity of waters of Narmada continue to flow to sea unused.



**1.3** Although harnessing of Narmada basin was envisioned by late Shri Sardar Patel as early as in 1946 for irrigation and power generation. Seven projects were identified during the initial survey. But this being an interstate river, various major projects could not come to implementation stage on account of differences amongst the riparian states viz. Madhya Pradesh, Gujarat and Maharashtra.

To resolve the disputes about use of Narmada waters, the GOI appointed in 1964, an expert committee under the Chairmanship of Dr. Khosla which, inter alia, recommended construction of a high dam with FRL of 500 ft. near the present site of Sardar Sarovar Project. However Khosla Committee's recommendations did not find acceptance with Madhya Pradesh and Maharashtra. The GOI therefore constituted in 1969 the Narmada Water Disputes Tribunal (NWDT) under the Interstates Water Disputes Act 1956.

### TRIBUNAL AWARD

**1.4** The NWDT which was chaired by a sitting judge of the Supreme Court of India, with competent help of technical experts and Panels made exhaustive and detailed study of various alternatives for making best beneficial use of Narmada waters in interest of the country in general and riparian States in particular. It gave a comprehensive Award in 1979, which can be considered as a landmark Award. As per the Narmada basin planning recommended by the NWDT in all 30 major dams, 135



medium dams and 3000 minor dams are to be constructed on the main river as well as on its tributaries and branches. Of this chain of dams, the SSP in Gujarat would be the terminal dam while remaining 29 major projects and all other medium and minor dams would be in Madhya Pradesh of which the Narmadasagar Project (NSP) in Madhya Pradesh being the biggest and a key storage dam. Four major dams viz. Tava, Bargi, Barna and Kolar have already been completed in Narmada catchment area. Another major dam on Kolar tributary of Narmada is also nearing completion. Similarly Man and Jobat tributary projects are also at an advanced stage of construction.

The main parameters of NWDT Award were as under :

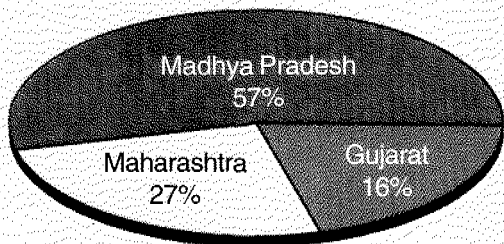
(a) Allocation of Water (at 75% dependable yields) amongst the States.

Allocation in MAF (million acre feet)  
1 MAF = 1219 MCM

Madhya Pradesh	18.25
Gujarat	9.00
Maharashtra	0.25
Rajasthan	0.50
Total	28.00

- (b) Height of the terminal dam i.e. the SSP : 455 ft.
- (c) FSL of the Main Canal 300 ft.
- (d) Hydro power generation - 2 power houses are proposed :

One at the canal head with 250 MW installed capacity, the second River Bed Power House with 1200 MW capacity. The power generated would be distributed to the 3 States in the following ratio :



- (e) While the live storage capacity of SSP would be 4.75 MAF there will be regulated releases from NSP about 300 km upstream located in Madhya Pradesh so as to meet the water allocation made to Gujarat and Rajasthan.

### LANDMARK AWARD

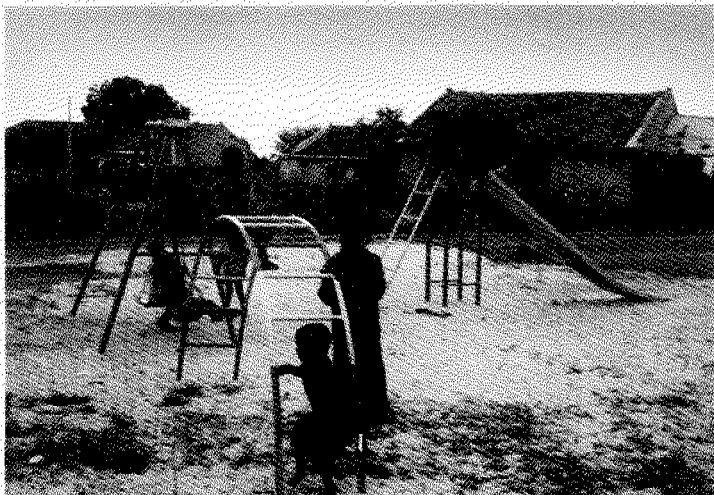
**1.5** The Tribunal instead of confining its adjudication to sharing of water and hydro power benefit, has taken special care to make comprehensive provisions about resettlement of people to be moved out of submergence area. The Tribunal was indeed much ahead of its time in prescribing a liberal and complete package of land for land and all other living amenities for resettlement of these oustees. The oustees from Madhya Pradesh and Maharashtra are to be resettled in the command areas of Gujarat,

thereby making them beneficiaries of the project. The award is indeed a landmark in this respect.

While entrusting the responsibility of constructing the interstate Sardar Sarovar Project to the Government of Gujarat, the Award has also prescribed various regulatory and administrative authorities so as to ensure smooth implementation and effective compliance of all provisions of the Award, under Govt. of India's stewardship and participation of all the four States.

The Award is also path breaking in adopting a national perspective for harnessing water resources, by allocating 5 lakh acre feet waters to Rajasthan though not being a riparian State, for its drought prone Barmer and Jalore districts which have no other dependable source of water.

This Award was accepted and notified by the Government of India in December 1979, giving it a status of finality and binding to all parties, as mandated by Article 262 of the Indian Constitution and the Interstate Water Disputes Act of 1956.



## CHAPTER - II

# SARDAR SAROVAR PROJECT - THE SSP

**2.1** The NWDT award paved way for harnessing of the water resources of Narmada basin for India's economic development. Within its frame work, the State Government of Gujarat and Madhya Pradesh, with cooperation and participation of Maharashtra and Rajasthan embarked upon various projects. The SSP in Gujarat and the NSP (later named as Indira Sagar Project) in M.P. being the two principal major projects (see plate-I) Implementation of the SSP rests with the Government of Gujarat;

under overall supervision and monitoring of the Narmada Control Authority, and sharing of cost and benefit by all the four States. The ISP is executed by the GOMP, but it being a feeder project for the SSP, a part of its cost is funded by the later.

**2.2** The SSP has been designed, based on the parameters fixed by the NWDT, with a view to derive best benefits of irrigation and hydropower under different situations. Its main features are as under :

### A. MAIN DAM

1. Length of main concrete gravity dam	:	1210.00 m.
2. Max. height above deepest foundation level	:	163.00 m.
3. Top R. L. of dam	:	146.50 m.
4. Catchment area of river above dam site	:	88,000 sq. km.
5. Gross storage capacity 7.7 MAF	:	9497.07 mcm
Live storage capacity 4.75 MAF	:	5859.80 mcm
6. Length of reservoir	:	214.00 km
Maximum width	:	16.10 km
Average width	:	1.77 km
7. Spillway gates		
Chute spillway 7 nos. (60' x 55')	:	18.3 mtrs. x 18 mtrs
Service spillway 23 nos (60' x 55')	:	18.3 mtrs. x 16.75 mtrs.
8. Spillway capacity (30 lac cusecs)	:	84949.25 cumecs

### B. MAIN CANAL

1. Full supply level (FSL) at H.R.	:	91.44 m (300')
2. Length upto Gujarat - Rajasthan border	:	458.00 km
Length in Rajasthan	:	74.00 km
3. Base width in head reach	:	73.01 m
4. Full supply depth (FSD) in head reach	:	7.60 m
5. Design discharge capacity		
(a) In head reach	:	1133 cumecs (40,000 cusecs)
(b) at Gujarat - Rajasthan border	:	71 cumecs (2500 cusecs)



## C. DISTRIBUTION SYSTEM

1. No. of branches (Gujarat)	:	42
2. Length of distribution system Network	:	66000 km
3. Annual irrigation Gujarat	:	18.00 lac ha.
Rajasthan	:	0.75 lac ha.

## D. POWER GENERATION

(i) River bed power house	:	1200 MW
(ii) Canal head power house	:	250 MW

The submergence at FRL is 37,533 ha. (86,088 acres) which comprises 11,279 ha. agricultural land, 13,385 ha. forests and 12,869 ha. river bed and waste land. In all, 245 villages of three states viz. 193 villages of MP, 33 villages of Maharashtra and 19 villages of Gujarat are affected. Only 3 villages of Gujarat and 1 village of MP are fully submerged while remaining 241 villages are partly affected. In MP, out of 193 villages affected more than 10% agricultural land will be submerged only in 81 villages, in 82 villages less than 10% agricultural land or only houses will be submerged under FRL due to back water of 1 in 100 years flood. In 9 villages only Government waste land will be submerged.

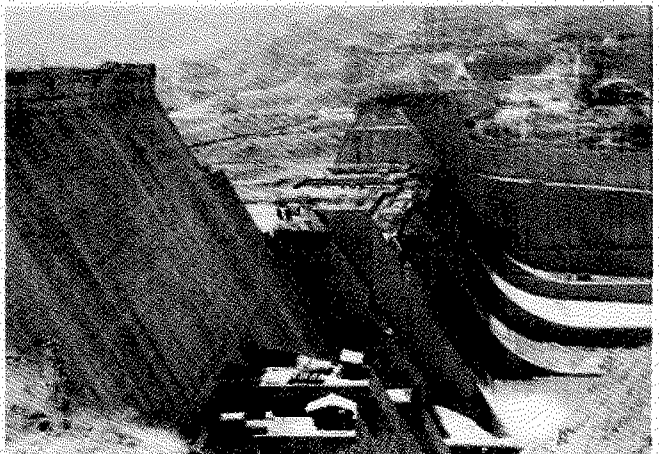
### SSP HAS SEVERAL UNIQUE FEATURES

**2.3** This dam will be India's third highest concrete dam (163 M); after Bhakhra (226 M) and Lakhwar (192 M) of Uttar Pradesh. But it has also the lowest ratio of area submerged to area irrigated being only 1.5% as against the average of 4 to 5% in major projects. This is due to Narmada river flowing mostly in deep gorges so that most of the water will be impounded within this

deep river valley, giving one of the lowest land/people affected ratio for the volume of water impounded.

In terms of the volume of concrete involved for gravity dams, this dam will be ranking as the second largest in the world with an aggregate volume of 6.82 million cu.m. The first is Grand Coule Dam in USA with total volume of 8.0 million cu.m. This dam with its spillway discharging capacity of 87,000 cumecs (30.70 lac cusecs) will be the third in the world. Gazenba (1.13 lac cumecs) in China and Tucurri (1.0 lac cumecs) in Brazil being the first two.

For chute spillway Radial Gates, 7 in number and size (60' x 60') 18.3 mtrs. x 18.3 mtrs. and for



service spillway, 23 radial gates of size (60' x 55') 18.3 mtrs. x 16.75 mtrs. are to be provided to negotiate the design flood. The design of the dam allows for a horizontal seismic coefficient of 0.125 g and it also covers an additional risk due to reservoir induced seismicity if any. Most sophisticated seismological instruments for monitoring and evaluation of the stresses in the body of the dam as well as the effect on the periphery of the reservoir are installed.

## **NARMADA MAIN CANAL**

**2.4** The Narmada Main Canal (NMC) would be 458 km long upto Gujarat Rajasthan border and further 74 km in Rajasthan. Its capacity at the head of 1133 cusecs (40000 cusecs) would make it world's largest canal, and will taper down to about 71 cumecs (2500 cusecs) at the Gujarat Rajasthan border. The cross section at its head is 73.1 m (240 ft) bed width and 7.6 m (25 ft) full supply depth.

NMC would have 10 cm to 12.5 cm thick concrete lining done with mechanised pavers, adopting the state of the art technology. The Branch canals and distributaries would also have concrete lining - hand placed. This lining would minimise loss of water and friction, and ensure efficient operation without causing water logging through seepage of water. The canal in its journey upto Rajasthan border will traverse through regions with diverse agro climatic and soil characteristics and will cross



numerous streams and major rivers. In all 582 structures of various type viz. cross drainage works, canal crossings, regulating and control structures, are proposed to be constructed along the main canal. Some of these would be the largest aqueducts and syphons so far constructed in India.

## **CANAL DISTRIBUTION SYSTEM & THEIR OPERATION** (figures refer to Gujarat only)

**2.5** Water for irrigation will be conveyed to 8 ha. blocks through a 66,000 km. Network of conveyance and distribution system consisting of branch canals, distributaries, minors and sub minors. There will be 42 branch canals off taking from main canal, out of which Miyagam, Vadodara, Saurashtra and Kachchh branch canals will be the major branches having a capacity of more than 75 cumecs (2650 cusecs). The distribution system would cover gross

command area of 34.28 lakh ha. (84.72 lakh acres) spread over in 3393 villages in 62 talukas of 12 districts of Gujarat. The branch canals and the distributary system network upto 8 ha. block will be lined.

## **INNOVATIVE FEATURES OF CANAL DISTRIBUTION SYSTEM**

**2.6** Irrigation water in the command area of SSP would be delivered to farmers' groups (cooperatives or other forms) and not to individual farmers. It would be for the farmers' groups to manage distribution within their block

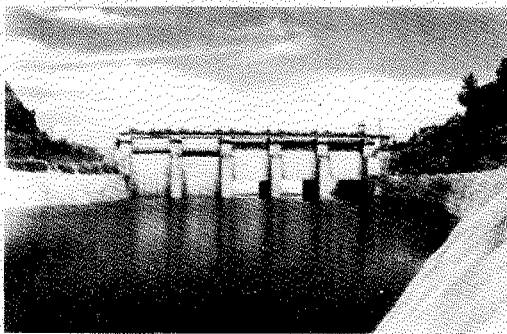
called Village Service Area (VSA). The corollary of this management is that the sub minors and field channels will be owned and looked after by these irrigators' groups.

The other important feature would be volumetric supply of water instead of area approach. The system of volumetric supply would be operating on computer control to ensure equitable flow in all areas - upper reaches and lower reaches. This would guard against the most commonly observed problem of over use of water by initial command blocks, leaving less supplies to the areas down the canal.

The system would be fully computerised and remotely operated upto the level of 300 cusecs capacity. Thus since the demands of farmers associations are known at the level of 300 cusecs

branch capacity reasonably in advance, the computerised system would ensure that the required water flow which is an aggregation of the demands of village level associations is delivered accurately.

The remotely controlled system would make automatic adjustments in respect of stroking of gates in the main canal and branches such that the system runs smoothly and safely. In fact, the basic purpose of computerising the operations is to make the systems more responsive, accurate and easy to operate. The response time is extremely important for timely deliveries of water to remote areas of Kachchh,



North Gujarat and Saurashtra. In case of SSP, the response time will be less than 24 hours which conventionally would be several days. For all this, of course, prior detailed work for designing a good hardware and software is required and this is being done.

The farmers associations are also required to operate systems on rotational delivery principles within the village areas in weekly rotations as is being done in Punjab, Haryana, parts of Rajasthan, part of UP and also some projects in Gujarat. The distribution follows allocation of water flow in hours per ha. of

commanded area which the farmers understand very easily. The entire flow within village systems is distributed proportionately without any manual intervention. Thus the farmers have not

to do any gate operation and have only to regulate the hours per ha. of individual farmers.

## CONJUNCTIVE USE OF GROUND WATER

**2.7** An interesting as well as innovative feature of SSP's irrigation plan is to supplement canal water supply by conjunctive use of ground water. This would augment total water availability and stretch the irrigation benefit to more area. It will also prevent water logging by recycling excess ground water into the canal system.

Entire command area is divided into 13 agro climatic zones and each zone is sub divided into irrigation and drainage development blocks

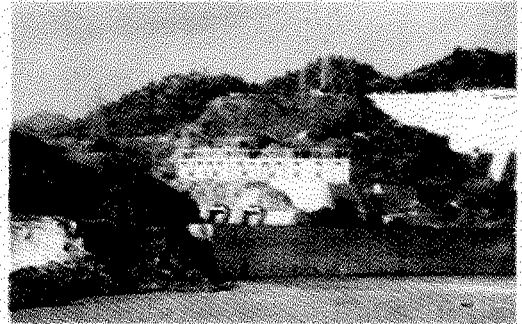
ranging from 4000 to 10,000 ha. Ground water would be introduced into canal system at Village Service Area (VSA) level. At full development, ground water is expected to contribute about 2.7 MAF i.e. nearly 25% of total water availability at macro level, the actual quantity varying from block to block based on natural annual recharge from rainfall, additional recharge from irrigation and geohydrological conditions.

## POWER HOUSES

**2.8** There will be two power houses for the SSP. 1200 MW river bed power house and a 250 MW canal head power house. Power benefits will be shared among MP, Maharashtra and Gujarat in the ratio of 57:27:16 respectively.

### RIVER BED POWER HOUSE

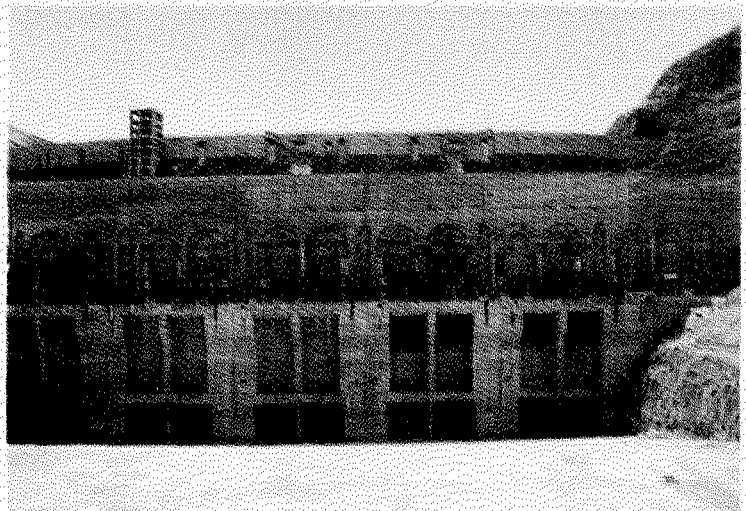
The river bed power house would be an underground power station on right bank of the river located about 165 m. downstream of the dam. It will have 6 units of 200 MW each deploying Francis type reversible turbine generators. For affording pondage required for pumping operation a weir about 28 m. high and 990 m long will be constructed across river Narmada near Garudeshwar, about 12 km downstream of main dam. The river bed power house will have the largest installed capacity among pumped storage schemes in India. Size of the power generating units will also be the



largest of this type in the country. The runner for this pumped storage unit would have a diameter of 6.95 m (23 ft) weighing 120 tonnes and are being produced in one piece.

### CANAL HEAD POWER HOUSE

The canal head power house, also on right bank, is a surface power house to accommodate 5 units of conventional Kaplan type generators each of 50 MW capacity. The canal head power house is located at the toe of Vadgam Saddle dam which will house the intake arrangement for power house.



## CHAPTER-III

# SSP'S CONTRIBUTION TO THE NATIONAL & STATES' ECONOMIES

**3.1** SSP aims at harnessing the vast water flow of Narmada river for benefits to the National Economy as well as to the economies of the four participating States.

The SSP on completion would generate following benefits :

**IRRIGATION :**

**3.2** The Sardar Sarovar Project will provide irrigation facilities to 17.93 lac ha. of land, covering 3360 villages of 62 talukas in 14 districts of Gujarat. It will also irrigate 75,000 ha. of land in the strategic desert districts of Barmer and Jalore in Rajasthan and 37,500 ha. in the tribal hilly tract of Maharashtra through lift. About 75% of the command area in Gujarat is drought prone while the entire command area (75,000 ha) in Rajasthan is drought prone. Assured water supply will soon make this area drought proof.

Majority of the farmers who will get irrigation benefits are small and marginal and a sizeable number are scheduled caste and scheduled tribe farmers as is seen from the following break up :

- Marginal farmers (<1 ha.) .....28.0%
- Small farmers (1 to 2 ha.).....24.4%
- Scheduled Tribe farmers.....8.7%
- Scheduled Caste farmers.....9.1 %

**DRINKING WATER SUPPLY**

**3.3** The single most important contribution of the SSP to improve the Quality of Life of people would be a dependable supply of potable drinking water.

1. The Project envisages to supply water to 8215 villages and 135 towns for domestic and industrial consumption in Saurashtra region located on the west coast, the Kachchh region, which is the arid zone and the North Gujarat region nearing to Rajasthan which is water scarce.

2. Narmada tribunal has allocated 1.06 MAF (3582 MLD) of water for domestic and industrial use out of the 9 MAF water allocation from the Narmada Dam.

Out of this 1.06 MAF water, 0.86 MAF (2921 MLD) has been allocated for the drinking water needs of 8215 villages and 135 urban centres (as detailed in table 1 below), 0.20 MAF (661 MLD) has been allocated for the industrial use.

**TABLE - 1 : NO. OF VILLAGES AND TOWNS PLANNED TO BE COVERED**

SR.NO.	DISTRICT	VILLAGES	TOWNS
1.	Saurashtra & Kachchh	5825	100
2.	Ahmedabad	377	12
3.	Mehsana	542	13
4.	Banaskantha	490	03
5.	Sabarkantha	568	04
6.	Panchmahal	413	03
	<b>TOTAL</b>	<b>8215</b>	<b>135</b>

The canal based drinking water supply plan for the Saurashtra, Kachchh, North Gujarat region, including Panchmahal District has been conceived taking into consideration the population projection of the project area in the year 2011 and 2021. The project aims at supplying drinking water at the rate of 70 litre per capita day (lpcd) in the rural area and 100 to 140 litre per capita day (lpcd) in the urban area.

The project will provide water to a projected population of 24.3 million in the year 2011 and 29.26 million in 2021. The project will provide safe and potable drinking water to 7491 "No Source" villages and out of which 2218 villages have excessive fluorides, 551 have excessive nitrates and 641 villages are under the grip of salinity.



The project envisages to supply 1751 mld water to the rural and urban areas on the basis of 2011 population and 2937 mld based on 2021 population. This water demand has been adopted taking into consideration the water available from the existing ground water and surface water sources in the project area and also its depletion over a period of time.

671 mld water is planned to be supplied to industries that are coming up in Jamnagar, Bhavnagar, Kachchh, Sabarkantha, Panchmahals and Ahmedabad districts and the Ports located on the Saurashtra and Kachchh coastline.

Water to the industries will be made available on sale basis at rates to be decided by the Government, adopting the philosophy of cross subsidization of the domestic sector by the industrial sector.

### **BENEFITS TO THE PEOPLE**

**3.4** The project would provide drinking water to the community in the water scarce areas of Saurashtra and Kachchh. The project would

serve a projected population of 24.33 million in the year 2011 and 29.26 million by the year 2021, on a reliable and sustainable basis.

Community will get fluoride free and salinity free potable drinking water. Community will be relieved from the effect of excessive fluorosis and would thereby improve their health conditions.

At present in most of the places, the supply of water is either through hand pumps and even by motorised road tankers during summer, which costs around Rs. 60-70 per cubic meter which is a very high cost. Such wasteful expenditure will not be required.

On completion of the project, the project area and the population covered, shall not face drinking water crisis and related hardships every 3rd and 4th year.

### **EMANCIPATION OF WOMEN**

**3.5** This would have a very positive effect on the community, more specifically the women.

At present the rural women in the project area have to spend majority of their time and energy in fetching water from a distance to meet with the water supply needs of their family.

Women do not get sufficient time to engage themselves in income generating activities.





Once the project is completed, the women in the project area would be able to spend time on income generating activities including agriculture. This will improve their socio economic condition.



### **POWER**

The SSP will generate renewable and environment friendly hydropower to the tune of 1007 million kWh in a surplus year and 856 million kWh even in a deficit rain year. While this energy output of 85.6 to 100 crores units per year can be valued at Rs. 400 to 500 crores, its real value is much more on account of it being totally indigenous and saving import of petroleum, making India self reliant in energy to that extent.

This power generation will also be free from air pollution. A 1450 MW coal based thermal power plant, even after observing the environment control regulations on permissible limits of emission would throw out in air, 10780 tonnes of suspended particulate matter and 25700 MT of sulphur dioxide per year. The SSP would thus, save the atmosphere from pollution of this large magnitude by generating pollution free hydro power.

### **FLOOD PROTECTION**

It will also provide flood protection to riverine reaches measuring 30,000 ha. covering 210 villages and Bharuch city and a population of 4.0 lac in Gujarat.

### **FOOD SECURITY AND AGRICULTURAL PRODUCTION**

Like other projects such as Bhakra Nangal, Hirakud, Nagarjun Sagar, Cauvery project etc. which have developed granaries for our country and made us self sufficient during the last 40 years, SSP, by drought proofing and irrigating about 46 lac acres of fertile land in the three States would assure production of food grains, edible oil and cotton equivalent to about

four million tons. It would help our country maintain its self sufficiency in face of growing population.

### **OTHER BENEFITS**

Generation of one million jobs - mostly in rural areas, development of fisheries, spreading of green cover, development of agro based industries and big boost to economy of over 3500 villages of command area and improving the quality of their life would be other important benefits.

### **CONTRIBUTION TO ENVIRONMENT AND ECOLOGY :**

**3.6** Conservation of ecology and economic development have to go together. Sustainable development can be achieved only with adequate attention to protection and in fact upgradation of environment. After all, quality of life depends as much on healthy environment as on rising standard of living.

SSP is the first major river valley project which is subjected to exacting environmental conditions by the Ministry of Environment, Government of India. This was partly because, unlike the earlier projects, SSP took shape in 1980s when the Forest Conservation Act had just come on our statute book and the environmental consciousness had also become the call of the day. The World Bank which sanctioned funding for the project also contributed a good deal by way of expert guidance and insistence on various studies, in making this project a most studied project. SSP also happens to be one of the first projects for which Environmental impact Assessment had been undertaken through expert agencies even when the project was in planning phase.

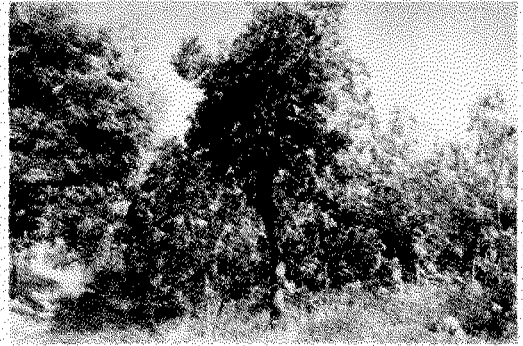
The measures specifically aimed at neutralizing or offsetting negative impact of the dam include compensatory afforestation, regeneration of forests in degraded forest land and wild life conservation programme. As against submergence of 4523 ha. of forest land under the dam in Gujarat, compensatory forests over 4650 ha. of non forest land notified as forest land, have been grown. In addition, 9300 ha. of degraded forests in nearby districts have been rejuvenated.



To mitigate the likely damage to the green cover, 551 ha. area in the vicinity of the dam has been afforested.

### IMPACT OF COMPENSATORY AFFORESTATION :

**3.7** The impact of various environmental efforts have been extremely positive. Compensatory Afforestation carried out in



highly arid areas of Kachchh have been quite successful belying all skeptics. These plantations have established as excellent woodlots with very good undergrowth and grass, where nothing existed earlier. Impact of this has been very encouraging. As against one Chinkara sighted in 1982, now there is a group of more than 40 Chinkaras, in one of the areas of Nalia. Where hardly any birds were seen, many

of the Compensatory Afforestation areas are now showing the presence of Great Indian Bustard, Black partridges and lot of other avi-faunal diversity.

### IMPACT OF CATCHMENT AREA TREATMENT :

**3.8** Similarly, the catchment area plantations completed long back, has established itself into multi storeyed and

multi layered forest eco-system. There has been sustained improvement in the floral as well as faunal diversity. Rare, endangered trees like Creya Arborea, Coclospermum Religiosum, Oroxylum Indicum, Ougenia Oobeinensis, Casea Tomentosa, Boswellia serrata have flourished. With the protection from soil erosion, better grasses like Themeda, Appluda and Dicanthium have replaced poor species like Aristid, Erogostris, Hetropogan and others.

The faunal bio-diversity have also increased with the improvement in vegetation. Panther, Hyena, Jackal, Porcupine and few Four horned antelope can now easily be seen. With the increase in the density of tree cover, birds like Golden Oriole, Treepic, Drongo, White Breasted Kingfisher, Muniyas, and Iora can now be seen.

A remote sensing study of Catchment Area Treatment (CAT) areas of SSP was carried out by GEER Foundation, Gandhinagar. Remote sensing data of 1985-86 and 1994 was used and visual interpretation method was used to analyse the data. It is observed that closed forest and open forest area have increased by 3,273 ha. and 3,001 ha. respectively. The degraded forest area has decreased considerably from 12,746 ha. to 7019 ha.

### **BENEFITS TO SANCTUARIES :**

**3.9** The various sanctuaries in Gujarat will receive the benefits of Narmada water. Narmada canal will provide an opportunity to develop the bets of Wild Ass Sanctuary in the Rann of Kachchh like Pung, Jilondar, Mardak, Shedwa. Canal water can be supplied through pipelines on conservative basis. Besides this, project envisages fodder development, planting of

Salvodara, control and removal of Prosopis Juliflora at appropriate sites and in Bet areas. Habitat Conservation programme will help in restricting Wild Asses inside the Sanctuary area.

Part of Shoolpaneshwar sanctuary forms the catchment area of Narmada river. It was therefore studied as a Project in detail and various recommendations were made. Taking into the consideration studies conducted in the sanctuary, various steps have already been taken or are being undertaken by the Forest Department.

Most of these recommendations made by SSNNL study are being implemented with the improvement in habitat conditions & reduction in biotic pressures, there has been suitable increase in some rare wildlife viz. Barking Deer, Four Horned Antelope, Slothbear, Giant Squirrel, Grey Hornbill, Grey Jungle Fowl etc.

Though the Narmada Canal does not pass through Nal Sarovar area, study was conducted to assess its impact and how it can benefit this unique wetland eco-system.

Project proposes that Saurashtra Branch Canal can be linked with Nal Lake, so that during the years of drought, water can be supplied in the lake and the winter bird migration can continue



unhindered. This will also help maintaining aquatic vegetation of this wetland eco system and the fish life supported by it. All this forms are important food for visiting migratory birds. Moreover increasing vegetation on some of the isles will provide roosting and nesting place for many migratory birds. With availability of canal water during the drought, there is likelihood of constant annual migration of birds, helping in tourism and indirectly helping in livelihood of local population.

Though canal is not passing through the Velavadar National Park in Gujarat, some of its branch canals and distributories surround the park area. A study was therefore conducted, to assess its impact on this eco-system. As a part of recommendations of the study, some measures, as stated below, were initiated in the park area. These included removal of Prosopis in stages, uprooting of Prosopis regeneration from grassland area, protection of denning sites of Wolf and plantation of scattered groups of natural residence species i.e. Salvadora spp.

Some of the positive impacts due to these efforts include:

- (1) With great improvement in the grassland species, increase in palatable grasses and herbs, Velavadar now holds a healthy, stable population of Black-Buck (*Antelope cervicapra*) one of the largest populations in the world (Census 1996, 1514 in park area.)
- (2) Population of Lesser Florican (*Sypheotides indica*) has increased from just one Florican in 1987, to over forty in last ten years, as a result of grassland improvement, which has become a very important breeding ground for these birds.
- (3) As a result of grassland improvement world's largest communal roost of wintering Harriers now migrate to Velavadar park every year (Clark R, 1996)
- (4) Wolf, a natural predator for keeping the ecological balance for Black Buck have also increased.

When Narmada waters reach branch canal near the park, it will supply water regularly to the park animals, and thus will enhance the eco system further.



## CHAPTER - IV

# REHABILITATION & RESETTLEMENT OF PEOPLE AFFECTED BY SUBMERGENCE

**4.1** The R&R indeed forms a crucial component of the SSP. The submergence is spread over three States viz. Madhya Pradesh, Maharashtra and Gujarat. According to the Tribunal's direction, Gujarat has to resettle all project affected persons - PAPs, including those from the adjoining two States who are willing to resettle in Gujarat. For PAPs not willing to resettle in Gujarat, the concerned state has to resettle them. The liberal policy laid down by the Tribunal has been further liberalised by the three States. The primary objective of the policy is that the economic condition of the PAPs must improve significantly after resettlement. The Government of Gujarat has put into place a R&R

policy keeping in view the directives contained in the NWDT award, and going much beyond them, with an aim to transform the project affected families into project benefitted families.

### EXTENT OF SUBMERGENCE LAND AFFECTED

**4.2** The total land coming under submergence is around 37533 ha spread over the three states of Gujarat, Maharashtra and Madhya Pradesh ie. 7112 ha in Gujarat, 9599 ha in Maharashtra and 20822 ha in Madhya Pradesh.

In Madhya Pradesh the area may change to some extent on verification at field level.



### VILLAGES AND FAMILIES AFFECTED

**4.3** As per the revised implementation schedule of Dam on December, 1989 approved by the Sardar Sarovar Construction Advisory Committee (SSCAC), a total of 245 villages will be affected in the states of Gujarat, Maharashtra and Madhya

*The statewise different category of land coming under submergence are as given below:*

SR.NO.	TYPE OF LAND	STATE			TOTAL
		Gujarat	Maharashtra	Madhya Pradesh	
1.	Cultivated land	1877	1519	7883	11279
2.	Forest land	4166	6488	2731	13385
3.	Other land including river bed	1069	1592	10208	12869
	Total land	7112	9599	20822	37533









Pradesh. The villages in Gujarat, Maharashtra and M.P. are being affected both due to pondage and back water effect corresponding to 1 in 100 year flood. The lowest level of huts/farms of the villages are considered for estimating the number of villages affected each year for planning R&R works. The lowest level of huts and farms in each submergence village are being taken into account while ascertaining the impact of submergence.

Resurvey of all the affected villages have been completed in all the three States. As per the latest information, about 40727 families would be affected due to submergence and back water effect at full height of dam (FRL EL 455 ft.)

*Statewise break up of affected villages and number of affected families (PAFs) are given below:*

States	Villages affected			Families to be rehabilitated including major sons / daughters. As per latest information (Dec.94)	No. of PAFs	
	Full	Partial	Total		Population affected 1991 Census	
M.P.	1	192	193	33014	89796	
Mah.	-	33	33	3113	19650	
Gujarat	3	16	19	4600	18000	
Total	4	241	245	40727	127446	

Out of 193 submergence villages of Madhya Pradesh, in 82 villages less than 10%, in 32 villages 11% to 25%, in 30 villages 26% to 50%, in 14 villages 51% to 75%, in 4 villages 76% to 90%, and in 1 village 100% agricultural land will be submerged. In 21 villages only abadi (habitation) will be affected due to back water, in 9 villages only Government waste land will be submerged. Out of 33 villages coming under submergence in Maharashtra, 12 villages have less than 25 ha. of private land getting submerged, 6 have less than 50 ha. and one

village is deserted. Thus 19 villages out of 33 are only being marginally affected.

### CATEGORYWISE PAFs RESETTLEMENT PACKAGE AND PLAN

As per NWDT stipulations, each project affected person from whom more than 25% of land holding is acquired, has to be offered an equivalent area (subject to minimum 2 ha) land in the command area of the project. Gujarat has to accommodate all the people willing to migrate to that State from the States of Maharashtra and Madhya Pradesh so that the benefits of the project are shared by the people who get dislocated due to the reservoir submergence. In case of Maharashtra and

Madhya Pradesh PAFs who are unwilling to resettle in Gujarat, they have to be resettled in their respective territories on similar land based policy.

Joint holders are also eligible for land equal

to his share subject to minimum of 2 ha. Joint holder and major sons will be considered as co-sharer of acquired land. Government of



Gujarat has further liberalised the rehabilitation package so as to make even encroachers, landless agricultural labourers also entitled to 2 ha of agricultural land. Major sons of all category of PAFs



with 1.1.1987 as cut off date are eligible for 2 ha of agricultural lands. Thus on the one hand, agricultural labourers become independent farmers, and on the other hand the 2nd generation issue is taken care by allotment of 2 ha. of land to major sons also. Considering the requirement and taking into account, the life style of PAF, 500 sq.m. of residential plot is allotted, which not only help to accommodate the cattle heads but also provide for expansion of the house on need base. Rs.750/- per family

requirement of PAF arranged for sufficient grant to help stabilize in the new environment and meet with his requirement. Free transportation is provided to PAF for his salvageable material from the submerging area

to R&R site. Lands and structures coming under submergence is compensated for as per the provision of Land Acquisition Act. And now as per latest liberalisation house of approx 45 sq. mt. the cost of Rs. 45000/- in lieu of finished plinth and roof tiles is provided free of charge.

#### GROUP SETTLEMENT :

To facilitate resettlement of PAFs in groups so as to maintain their social life, rehabilitation sites are developed with all living amenities like approach road, internal roads, drinking water,

in which house plots are laid and allotted to PAFs. These sites are made self contained in civic amenities like approach road, primary school, dispensary, children park, tree plantation,

drinking water facilities, electrification etc.

The affected families are resettled as village section (paras), falias, community groups, village units as far as possible as per their preference.

*Different category of PAFs in three States are as given below:*

STATE	DIFFERENT CATEGORY OF PAFs						
	Land	Cosharer	Encroachers	Major sons	landless Agri.Labourers	Other landless labourers	Total
Gujarat	647	850	487	2204	392	20	4600
Mah.	1472	-	-	893	748	-	3113
M.P.	9985	-	-	15018	5776	2235	33014
Total	12104	850	487	18115	6916	2255	40727

with an increase of 8% per year worked out with January, 1980 as base is given as resettlement grant. Grant-in-aid upto Rs. 7,000/- for purchase of productive assets are given. Gujarat has considering the immediate

## **JOIN THE MAINSTREAM :**

Apart from providing all these facilities, other services like registration in electoral roll, issuance of ration card, accessibility to Cooperative Society and arrangement of vocational training for PAF are looked after. While PAFs are familiarised with modern techniques of farming their participation in the local self-government and social forestry is encouraged.

Even by way of periodical health camps, cultural programmes and introduction of state sponsored programmes every attempt is made to accelerate the process of assimilation of PAFs into the mainstream of the Society.

The resettlement approach aims that psychological trauma to PAF due to involuntary displacement is minimised if could not be neutralised.



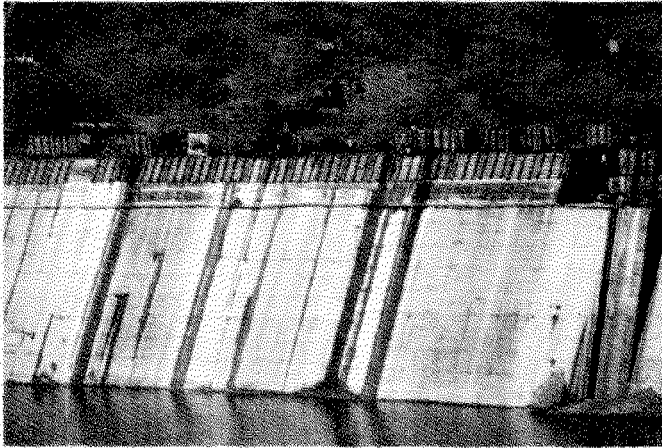


## CHAPTER - V PART - I

# PROGRESS IN WORKS - AND PRESENT STATUS OF THE PROJECT

### 5.1(C) DAM AND APPURTENANT WORKS

1. Tribunal's Award having paved the way for the SSP, the detailed Project Report (in 14 volumes) for the entire SSP was submitted in February 1980 in the Central Water Commission, GOI for obtaining the clearance of Planning



Commission. Meanwhile the project was also posed for the World Bank Assistance. Both these proposal remained under in-depth examination and analysis from engineering angle as well as from socio-economic angles by the GOI and the World Bank, added with the requisite clearances from environment consideration, which was also applied for in year 1983.

2. Agreement with the World Bank and International Development Agency were finalised in May 1985 for the loan assistance partially for Dam and hydro power works and certain canal works in Phase I area upto Mahi River.

3. Forest and Environmental Clearances were obtained from Ministry of Environment, GOI in June 1987. The Planning Commission's

approval for the investment purpose was obtained thereafter.

4. While various clearances were being obtained, excavation of foundation, foundation treatment and other preliminary works including setting up of infrastructure facilities were carried out.

5. In the initial phase of construction, various problems, ranging from intricate geological surprises in the foundation of main dam, Tunneling works of the River Bed Underground Power House, Design aspects of the Energy dissipation arrangements, high divide and side training walls, which have had no parallel precedents in certain cases, world over, have been painstakingly resolved and sorted out by our Engineers.



**6.** For Seismicity aspects and Hydraulic Model studies; help from premier institutions in India, namely School of Earthquake Engineering, Roorkee; Geological Survey of India, Central Water and Power Research Station, Khadakwasla, Pune, Central Soil and Material Research Station, New Delhi, Central Water Commission, Central Electrical Authority, National Institute of Rock Mechanics and other host of Indian Organisations in various fields was drawn to thrashout various problems being faced from time to time.

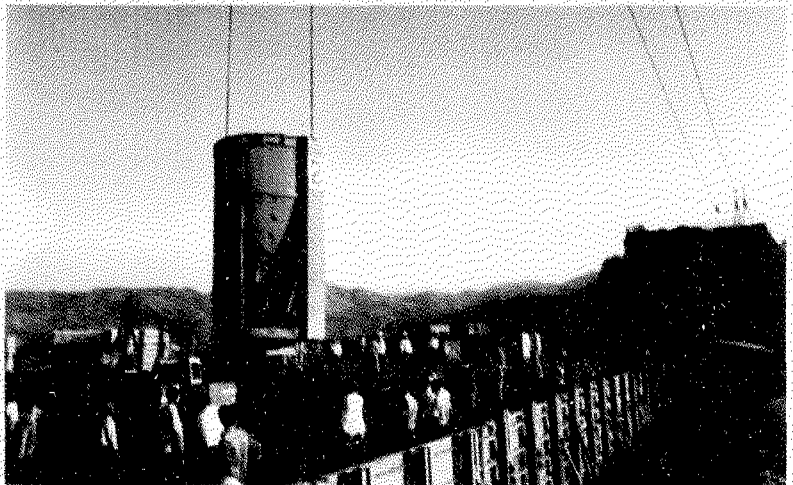
**7.** Some of the note-worthy achievements in the Design and execution of intricate problems over the years comprise; Diversion scheme, envisaging construction of submersible coffer dams under flowing water conditions across deep river channel, excavation of open cut diversion channel, providing gated construction sluices etc. Treatment of Geological fault in the foundation of the Dam, involving 2.14 lac m<sup>3</sup> of overburden material excavation; 2.50 lac m<sup>3</sup> of rock excavation, 2.56 m<sup>3</sup> of pre-cooled concrete ( 9<sup>o</sup> - 12<sup>o</sup> c placement temperature) and 53000 Tonnes of reinforcement steel, the treatment costing Rs. 20.00 crores in the year 1981-84.

**8.** Treatment of Argillaceous sandstone in two layers on the Right bank and the red bole layer on the left bank, involved providing a grid of concrete 3.0 m wide by 3.5 m deep sheer keys, parallel and perpendicular to the

axis of dam at an average depth of 30.0 m and 10.0 m from the foundation level respectively. The total length of treatment aggregating to 12.0 k.m. was completed at a total cost of Rs. 16.00 crores in year 1986-88. Such type of treatment on a much smaller scale has been carried out on Itaipu dam in Brazil.

**9.** Works on sloping struts forming an interface of spillway blocks and Energy dissipater of Sardar Sarovar Dam, involving highly sophisticated Finite - Element Analysis, which resulted in the adoption of relatively thinner and more economical sections as compared to the conventional design approach, were successfully completed in working seasons 1987 - 1990.

**10.** Alternatives ranging from solid and slotted type of roller - buckets, ski-jump bucket and chutes etc, have been studied at length. Based upon these studies energy dissipater arrangements for service spillway considered was sloping-cum-horizontal type stilling basin, whereas for the auxiliary spillway, it was split level chutes terminating into ski-jump buckets.





The stilling basin has been designed taking into consideration the macro-turbulences effects as per the current state - of - art - practised at the international level.

**11.** Based on full scale cavitation investigations conducted in erstwhile USSR, Europe and USA; Anti cavitation devices measures have been adopted on the Sardar Sarovar Dam, by providing adequately designed Aeration devices, Aeration grooves, ramps and Air supply towers in the services and the Auxiliary spillways.

**12.** Sophisticated scheme of Instrumentation has been formulated, keeping in view the long term monitoring of the Sardar Sarovar Dam, including the reservoir vicinity consisting of 9 seismological station around the periphery of the reservoir.

**5.2 (I) DAM :** The work of construction of 1210 meter long concrete gravity dam has been started in April '87. To guide the project engineers in deciding complex technical issues, Dam Safety Review Panel (DSRP) of experienced and eminent national level experts of each field has been constituted. They meet and take site visits periodically and give technical guidance to the field engineers.

In the main dam work, 58.08 lac cubic metre of cement concrete against the estimated quantity of 68.20 lac cubic metre i.e. 85.16% has been completed till April 1999.

Out of 64 blocks spanning the concrete dam, majority of the non overflow blocks on both sides have been constructed upto 140 to 146,

while auxiliary spillway blocks have reached an average height of 116 M. In service spillway five blocks have been constructed upto 105 M, whereas construction of 18 blocks of the main spillway being coordinated with progress of resettlement have been constructed upto 85 M. This is to ensure that rehabilitation of PAFs is carried out pari passu with construction of the dam.

A unique feature of SSP implementation is construction of canal system proceeding simultaneously with the dam construction. This is to minimise the time lag between creation of water storage and readiness of conveyance system without which the water can not be put to use. Alike DSRP for dam works, Board of Consultants (BOC) is constituted of national level experienced eminent experts on soil and foundation engineering, canal design, construction and irrigation management fronts. Under the technical guidance of BOC, Sardar Sarovar Narmada Nigam Limited has generated in-house expertise in design and construction of canal system and has been able to successfully take up challenge of constructing the World's largest canal having a capacity at the head of 1133 cumecs (40,000 cusecs) and bed width of 73.1 mt. (240 ft.).

Special mechanical paver machines are being used for the first time in India for cement concrete lining of the main canal about 460 km. and branch canals about 2600 km.



Instead of borrowing earth from the side width of the canal system the same is borrowed by deepening of the nearby village ponds or minor irrigation tanks or from proposed drains for earth work in banking required for the canal system. This not only effects saving in land acquisition but also avoids ugly looking borrow pits by the sides of the canal system and minimises losses through seepage and reduce health hazard due to accumulation of stagnant waters in the alongside borrow areas. The benefit of augmenting storage capacity of village tanks is an incidental advantage.

Curing of concrete for abnormally large lengths of canal is being done for the first time by chemical membrane-curing compound, instead of conventional water curing.

PVC crack inducing joint cum water stops strips have been introduced for taking care of thermal expansion and resultant cracking of concrete in lieu of providing joints by



SAURASHTRA BRANCH CANAL Earthwork in the reach from chainage 0-71 km. of Saurashtra Branch Canal (SBC) is almost completed and the works of structures

groove cutting. This would improve the rugosity co-efficient resulting in better flow condition.

### 5.3 (I) PHASE - I

Most of works of Narmada Main Canal and its Branch canals under first phase (ch. 0-144 km.) are completed. Remaining works are expected to be completed before March 2000 in all respects.

The command area of the first phase is divided in 52 blocks. The works of distributaries in 39 blocks and works of minors of 15 blocks have been taken up. Irrigation potential of 45000 ha. is created and it is planned to complete distribution works of above 2 lac ha. before June 2000. Formation of co-operative societies in different village service area is on hand.

### 5.4 (I) PHASE - II

Narmada Main Canal works under second phase (ch 144-264 kms.) are mostly completed except some structures which are also in the completion stage. Earthwork and construction of structures of 7 branches in this reach have been started and canal lining works is planned to be started during the financial year 1999-2000.

is at the stage of completion. The work of lining to SBC in initial reach of 44 km. is planned to be started during 1999-2000.

The Earthwork of SBC in the reach from 71 to 88 kms. is almost completed while the tenders for works of structures is under invitation and work is planned to be started during the financial year 1999-2000.

Earthwork and construction of structures of Malia, Narsinghpura & Vallbhipur sub branches is in progress. The above works are expected to be completed by June 2000. The works of Morbi, Dhrangadhra and Limbdi sub branches are planned to be started during 2000-2001 and to be completed upto 2003.

### **5.5 (I) WORKS BEYOND 264 KM. OF NMC**

Tender for works of canal and structures of Narmada Main Canal between ch. 264 Kms. to 357 Kms. have been invited and it is expected that works will be started during current financial year 1999-2000. It has also been planned to take up works of branch canals off taking in this reach of Main Canal simultaneously. The works of 357 Kms. onwards are under investigation and design stage.

### **5.6 (I) POWER HOUSES**

The work of Canal Head Power House is completed in all respect and is now ready for commissioning. As soon as dam height reaches 110 m, electricity generation will start.

For the main power house, to be installed at the river bed, called River Bed Power House (RBPH) having six turbine generating units each

of 200 MW would be supplied by a consortium of three Japanese companies. Two units have reached dam site in May, 1999. Remaining four units would be received in phased manner upto June, 2002. Installation of first unit will be started in March 2000 and is planned to be completed upto December 2002. It is also planned to complete installation of remaining units each at interval of four months, after December 2002.

The largest Power House Cavern for the underground Power House 23 m wide x 200 m long and 58 m high is under construction.

The units of River Bed Power House are reversible type, so that even when Madhya Pradesh and Gujarat states start using their full allocated share of water of 18.25 & 9 MAF respectively, and surplus water is not available for power generation, the RBPH can be operated for as a peakload power station, generating electricity in peak hours, and putting back the water into reservoir in lean load hours.

Thus RBPH would provide very valuable peaking capacity of 1200 MW under Western Grid on permanent basis. It is pertinent to note that hydropower is the most economic and convenient peak load power station as it can be operated at short notice any time.



## STATUS

Progress of different works narrated in the foregoing paras can be seen in figures as under :

### STATEMENT SHOWING PROGRESS OF MAJOR ITEMS UPTO JULY '99

Sr. No.	Particulars	Unit	Total Revised Quantity	Progress upto July. '99	% Progress
1.	<b>Main Dam</b>				
	a. Excavation	LCM	64.00	63.24	98.81
	b. Concreting	LCM	68.20	58.44	85.69
2.	<b>River Bed Power House (Civil Works)</b>				
	a. Open Excavation	LCM	17.34	16.62	95.85
	b. Under Ground Excavation	LCM	6.63	6.03	90.75
3.	<b>Canal Head Power House (Civil Works)</b>				
	a. Concreting	LCM	1.29	1.29	100.00
4.	<b>Vadgam Saddle Dam Works</b>				
	a. Concreting	LCM	2.11	2.11	100.00
	<b>CANAL SYSTEMS :</b>				
	<b>Phase - I</b>				
5.	<b>Main Canal (0-144 Km.)</b>				
	a. Earthwork (Exc. Only)	LCM	771.33	767.23	99.47
	b. Lining	LSM	150.58	150.55	99.98
	c. Concreting	LCM	20.15	20.42	95.14
6.	<b>Branch Canals (0-144 Km.)</b>				
	a. Earthwork	LCM	360.48	359.39	99.70
	b. Lining (Conc. + Brick)	LSM	93.93	86.13	91.70
	c. Concrete	LCM	4.63	4.47	96.47
7.	<b>Distribution System (0-144 Km.)</b>				
	a. Earthwork	LCM	216.30	186.29	86.13
	b. Lining	LSM	39.26	36.48	92.91
	c. Concrete	LCM	3.50	3.28	93.97
	<b>Phase - II</b>				
8.	<b>Main Canal (144-264 Km.)</b>				
I.	a. Earthwork (Exc. Only)	LCM	657.90	609.38	92.63
	b. Lining	LSM	126.14	115.81	91.81
	c. Concrete	LCM	4.58	4.36	95.20
II.	<b>Seven Major Structures</b>				
	a. Excavation (Struct.)	LCM	31.92	30.04	94.11
	b. Lining	LSM	1.08	0.56	51.85
	c. Structure Concrete	LCM	8.72	7.63	87.50
9.	<b>Branch Canals (144-264 Km.)</b>				
	a. Earthwork	LCM	89.71	64.36	71.74
	b. Concrete	LCM	1.52	0.67	44.08
10.	<b>Saurashtra Branch Canal &amp; Its Branches</b>				
	a. Earthwork	LCM	478.27	422.31	88.30
	b. Concrete	LCM	9.78	5.80	59.30
11.	<b>Shedhi Branch Canals</b>				
	a. Earthwork	LCM	82.33	78.89	95.82
	b. Lining	LSM	22.60	22.33	98.81
	c. Concrete	LCM	0.91	0.90	98.90

**CHAPTER - V PART-II**  
**PROGRESS OF RESETTLEMENT OF PAFs -**  
**A SAGA OF HUMAN ENTERPRISE**

**5.1 (II)** Resettlement of families affected by submergence is a forerunner of the project implementation. It has to move ahead of construction of the dam. In fact the construction programme of the dam is decided by the authorities with reference to progress achieved on resettlement of people likely to be affected by

submergence as the water level rises. Here again, not only those whose land/houses might come under submergence of pondage, but also those whose land/house might get affected by high flood waters of rare severity are also included in resettlement before the dam height is raised.

*Progress achieved in resettlement of PAFs in Gujarat is shown in nutshell in following statements : (June '99)*

No.	Components	Unit	Gujarat	Maharashtra	M.P.	Total
	<b>P A F s</b>					
1	Total No.	No.	4600	3113	33014	40727
2	To be resettled in Guj	No.	4600	999	13936	19535
3	Agri.Land allotted Percentage of (2)	No. (%)	4508 98.84	686 68.67	3099 21.34	8293 42.3
4	Area allotted	Ha	8936	1347	6190	16523
5	Residential plots allotted (500 sq.m.per family-free) Percentage of (2)	No. (%)	4402 96.51	680 68.07	3091 21.88	8173 41.41
6	Total no. of residential sites	No.	110	18	52	180
7	Subsistence allowance to PAFs of Rs.4500/- for the year 1st instalment 2nd instalment 3rd instalment Resettlement amount	No.	4488 4334 4086 194.40	585 584 511 25.20	2665 2624 1970 108.80	7739 7542 6567 328.50
8	Ex-gratia for land purchase (difference amount for the land purchased and allotted to PAFs) PAF , Amount	No. Rs. Lacs	4323 3046.60	0 0	0 0	4323 3046.60
9	Productive assets (Rs. 7,000 lacs per family given for agricultural development) PAF Amount %age	No. Rs. Lacs (%)	4349 216.50 96.47	593 30.60 86.44	2313 129.60 74.64	7255 376.70



While the PAFs of Gujarat have been spread over large number of sites, as per their social links and preferences, to supplement the existing amenities in host villages, these sites are provided, 74 primary schools, 27 dispensaries, 309 drinking water wells, 44 piped water supply schemes, 106 children parks, 149 tree platforms, 56.19 km approach roads etc. PAFs coming from M.P. and Maharashtra to Gujarat have been resettled in 52 and 18 sites respectively as per group settlement approach.

*These sites have been provided with infrastructure and amenities as follows: (June '99)*

No.	Components	Maharashtra	M. P.
1.	Total no. of residential sites	18	52
2.	Primary School	18	51
3.	Drinking water wells	56	146
4.	Piped water supply	8	30
5.	Tree platforms	25	101
6.	Internal roads	20.96 km	76.57 km
7.	Approach roads	9.34 km	24.69 km
8.	Street light electrification	16	47
9.	Core house constructed	437	2582
10.	Children Park	18	51
11.	Dispensary	18	51

Government of Gujarat has so far procured 25013 ha of land for R&R programme and further procurement by Purchase / Acquisition is under way.

## 5.2 (II) MAHARASHTRA PAFS IN MAHARASHTRA

2114 PAFs have preferred to resettle in Maharashtra in the environment which is

ethnically and ecologically similar to their original place of stay. Taking their need preference into consideration, as a special case Govt. of India, Ministry of Environment and Forest has released 4200 ha of forest land which includes 2700 ha in Taloda Taluka and 1500 ha in Taloda and Akkalkuwa Talukas in Dhule district to settle the PAFs in similar forest ethnic environment in their own state.

Out of 2114 PAFs to be resettled in Maharashtra, 1515 families have been allotted 2293.07 ha agricultural land and 1394 families allotted house plots upto 31.12.1998. During this quarter, no PAFs have been allotted agricultural land and house plots.

## 5.3 (II) MADHYA PRADESH PAF'S IN MADHYA PRADESH

18890 families are likely to be resettled in Madhya Pradesh. These families belong to the category of PAF in which either only houses will be submerged or less than 25% of the agricultural land of the PAF will be submerged.

Hence they will be relocated in or nearby the submergence villages at higher elevation. About 2000 ha. agricultural land will be required for allotment to project affected families who are willing to resettle in Madhya Pradesh and are entitled for agricultural land.

So far survey of 83 relocation sites has been completed to accommodate the project

affected families from 109 submergence villages. Layout plans have been finalised for 71 relocation sites. PAFs from submergence village Eklera numbering 36 have already been resettled at Eklera R&R site in Barwani district. 1973 ha land for agricultural purpose have been identified. Notification under Section 4 of Land Acquisition Act (LAA) has been issued in 92 submergence villages. Notification under Section 6 & Section 9 of LAA has been issued in 87 submergence villages. Award has been passed for payment of compensation in 87 villages and 30 other cases (acquiring land for relocation sites, roads, etc.) and a sum of Rs. 14.44 crore (upto 31.12.1998) as compensation has also been distributed among the project affected families from the submergence villages. House plots have been allotted to 733 project affected families, so far, at various R & R sites. During this quarter the progress is nil.

#### **5.4 (II) MONITORING AND EVALUATION**

The Government of Gujarat and Madhya Pradesh have engaged independent Social

Science Agencies for conducting socio-economic surveys in the affected and resettled villages and for the overall Monitoring and Evaluation of the R&R programme. The Centre for Social Studies, Surat is the monitoring agency for the Government of Gujarat. In Madhya Pradesh, the task of monitoring and evaluation has been entrusted to Dr. Hari Singh Gaur University (HSGU), Sagar, Madhya Pradesh but now it had been disengaged and the engagement of a new agency is in pipeline. In Maharashtra, the M&E works have been entrusted to Operations Research Group (ORG), Mumbai.

The reports of these agencies reveal how the PAFs have adapted to the new environment and are enjoying their new status (an agricultural labourer is now a farmer; socially weaker section now on its own and free from traditional

dominance of others), have taken advantage of new economic opportunities and have established marriage and relations and contested elections to Gram Panchayats etc.



**A few findings of the latest report of the Centre of Social Studies,  
Surat and others may be of interest :**

*“In so far as access to basic amenities and services is concerned, it can be stated that the PAFs are by and large better off compared to the situation of their submerging villages”. (M&E Report 21),(Report No. 21 P. 48 & 50)*

*“The services provides by the State in the fields of education and health care are highly appreciated by the PAFs”. (Report No. 21 P.36)*

*“Crop diversification and market links are developing and yields have substantially improved compared to submerging villages”. (Report 24 P.18).*

*“While agriculture has become major economic activity after relocation, the proportion of population engaged as casual or agricultural labour has reduced. The reduced importance to labouring activities is not because of lack of opportunities but because own agriculture is able to provide for family needs adequately”.*

*“The trend of crop diversification observed after relocation, leading a shift from subsistence farming towards high value crop production for markets has been maintained in the reference year as well” (Report 24 P.38)*

*“At current prices the total annual expenditure of the households has increased about two and half times when compared to the expenditure level of the submerging villages. The improved purchasing power of household after relocation is undisputed even at constant prices”. (Report 21 P.33, Report 23 P. 30 and Report 24 P.39)*

*“During reference year about 90 percent of the PAFs have reported that their economic condition has either improved or has remained same compared to what it was in their submerging villages”. (Report 21 P. 23 and 50, Report 24 P. 35)*

## Report of Dr. Asha Singh, Sociologist, Bhopal, Dated 30/04/98

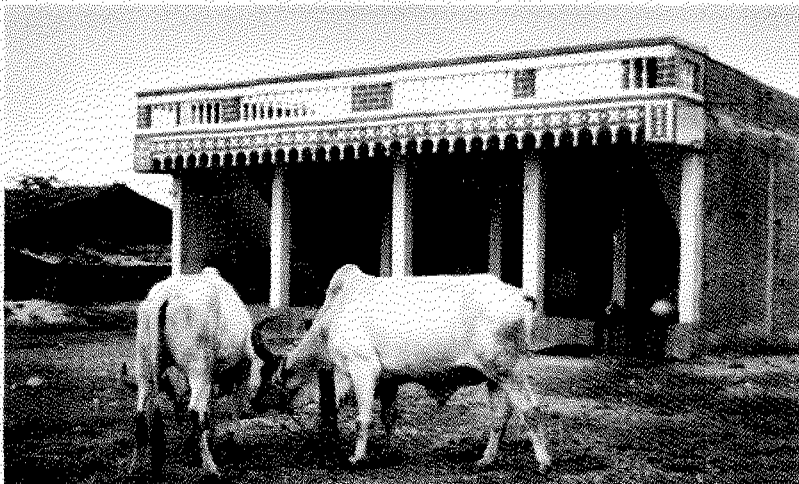
*"100 PAPs of Kakrana and Sugat village of Alirajpur Tehsil have been resettled in Khadgodara R&R site which was established in the year 1992-93. 75 PAPs have been provided IRDP benefits. There is a Primary School of 3 rooms. There is Fair Price Shop, Flour Mill and Panchayat ghar, ST Bus Stop and Post Office at host village. 62 PAPs of Kakrana have shifted here finally. 198 ha. of agricultural land has been allotted at this site which is outside the command. There are 8 tube wells at the site and 7 Tubewells are under construction. But some of the old tube wells are not in working conditions. Since this land is outside the command so alternative irrigation facilities should be provided to the PAFs. The land no doubt is very fertile giving very good crops- of Corn, Cotton, TuwarDal, Peanuts and Arandl but alternative sources of irrigation will give bumper crops to the PAFs. As per Mohan, Bhangi Bhikla, Remla Tusia, Edra and others, they are happy and contented here and at the same time they have improved their standard of living."*

### **Extracts from Biannual Report of Dr. Hari Singh Gaur University, Sagar the M & E Agency engaged by Government of Madhya Pradesh :**

*(a) "Majority of the oustees feel that their post settlement socio - economic status is almost same. However, more than one third of oustees consider their post settlement life is better than the earlier life. As such, it can be concluded that in spite of shortcomings the oustees are happy with the present situations"*

*(b) "One of the main reason behind their happiness is that shifting has changed their socio-economic status. Ousteas of these four new settlement villages were earlier either marginal farmers or labourers. Under the compensation package, each one has received two hectares of land and have become land owners."*

*(c) "Cultural change is observed among PAPs of Lilora. Hindi mixed with Gujarati is the common language of conversation among them. Economic conditions of the PAPs are much better than that in their old village."*



## CHAPTER - V PART - III

# STATUS OF ENVIRONMENTAL SAFEGUARD & PROMOTIONAL MEASURES (STIPULATED BY MOE & F, GOI IN ENVIRONMENTAL SANCTION ACCORDED TO SSP IN 1987.)

August 1999.

### 5.1 (III) CATCHMENT AREA TREATMENT WORKS

- Entire catchment in Gujarat being treated.
- Treatment in 27204 ha. forest area & 1953 ha non forest area completed.
- Minimise silt inflow.
- Remote sensing study reveals reduction of degraded forests by 22%.

### 5.2 (III) COMPENSATORY AFFORESTATION

- 4650 ha non-forest area planted and 9300 ha. forest area replenished against submergence of 4523 ha.
- Dam vicinity plantation in 551 ha and canal bank plantation in 1424 ha completed.
- 78 new tree planted against every tree felled.

### 5.3 (III) COMMAND AREA DEVELOPMENT

- 22 studies completed prior to granting of clearance, by MOEF.
- 45 Command Area Studies completed, includes, Technical, Agricultural, Environmental and Socio-Economic studies.
- 15 Upstream & Downstream studies completed, in addition.
- Recommendations have been converted into Action plans.

### 5.4 (III) FLORA, FAUNA WILD LIFE, AND CARRYING CAPACITY.

Preliminary studies/work plan completed and revised where necessary.

#### A. WILDLIFE

- Felling plan completed to avoid animals trapping
- Development plan for Shoolpaneshwar sanctuary
- No rare or endangered species affected

#### B. FISHERIES

- Preliminary Survey / work plan completed for reservoir & command area development and updated.
- Development of fish farm planned
- Seed stocking in reservoir is in progress.
- Mangrove Plantations under implementation in 110 ha.
- Establishment of IFDB agreed by concerned states.

### 5.5 (III) SEISMICITY

- RIM stability studies completed
- Dam design modified as recommended by Dam safety panel.
- 9 observation stations installed to monitor micro earth activity in the basin.

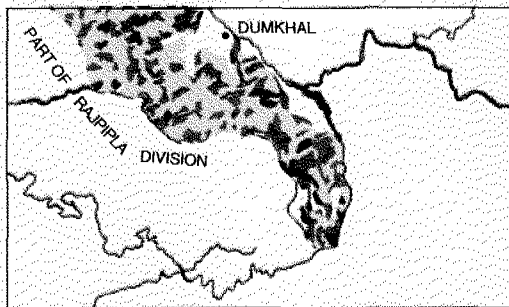
### 5.6 (III) HEALTH ASPECT

- Study reveals no threat to schistosomiasis
- Action plan completed & revised for control of Malaria.
- 25 bed hospital & Laboratory facilities established at Kevadia
- Mobile dispensary unit - facilities extended to new rehabilitation sites
- Vector control measures planned
- Preventive Health Organization established at Kevadia

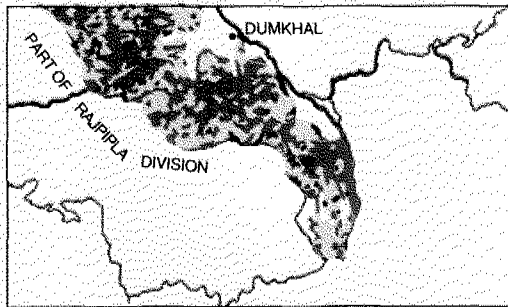
### 5.7 (III) ARCHAEOLOGICAL AND ANTHROPOLOGICAL ASPECTS

- Study reveals no submergence of any protected monuments
- Construction of New Shoolpaneshwar Temple is completed
- Construction of New Hamfeshwar Temple is under progress.





1986

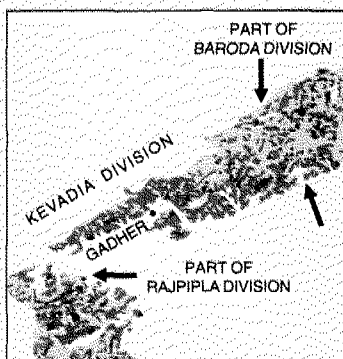


1994

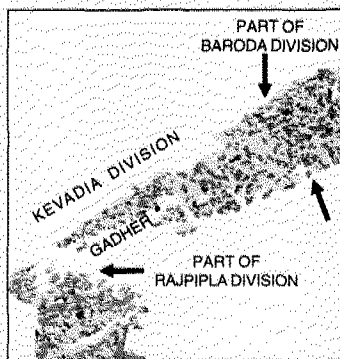
### COLOUR / CODE CLASSIFICATION

Colour	Code	Class
	1.	Closed forest area
	2.	Open forest area
	3.	Degraded forest area
	4.	Highly deg forest area/cultivation/grass growth

**Fig. 3** Changes in status of forest cover from 1986 to 1994 in SSP catchment area (Impact of afforestation in catchment area) - Part of Rajpipla division.



1986

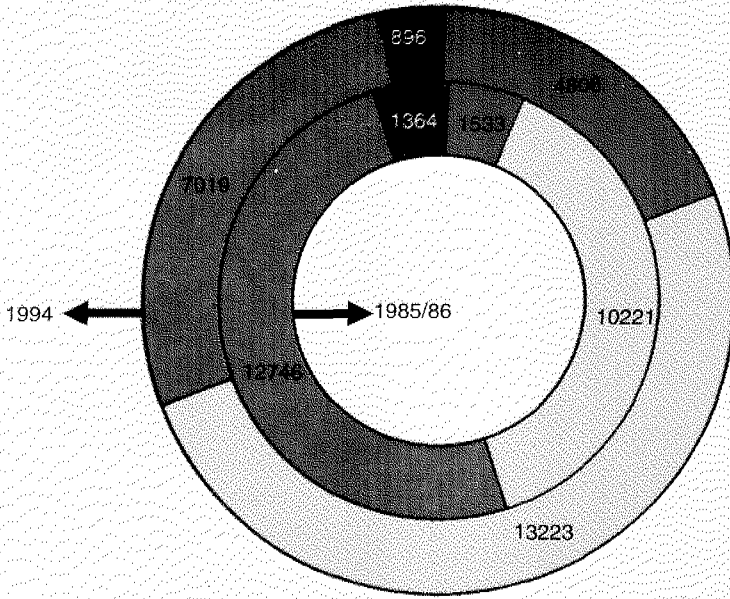


1994

### COLOUR / CODE CLASSIFICATION

Colour	Code	Class
	1.	Closed forest area
	2.	Open forest area
	3.	Degraded forest area
	4.	Highly deg forest area/cultivation/grass growth

**Fig. 4** Changes in status of forest cover from 1986 to 1994 in SSP catchment area (Impact of afforestation in catchment area) - Kevadia and part of Rajpipla division.



### COLOUR / CODE CLASSIFICATION

Colour	Code	Class
Dark Grey	1.	Closed forest area
Light Grey	2.	Open forest area
Medium Grey	3.	Degraded forest area
Black	4.	Highly deg forest area/cultivation/grass growth

**FIG. 6** Chart showing forest density classes in SSP catchment area in 1985/86 and 1994 (Area in ha.)

Remote sensing data of 1985/86 and 1994 have been used and visual interpretation method has been followed to analyse the data. It is observed that, closed forest and open forest area have been increased by 3,273 ha. and 3,001 ha. respectively. The degraded forest area has been decreased considerably from 12,746 ha. to 7,019 ha.

(Remote sensing study of CAT of SSP by ISRO and others)

## 5.8 (III) COMMAND AREA

### DEVELOPMENT :

(Including Drainage Studies)

Government of Gujarat has undertaken several studies related to the command area

development. Some of which have been completed and the remaining are in progress. Govt. of Gujarat has formed an Expert Multidisciplinary Group to coordinate the studies & for drawing up the needed plans. The various studies are listed in the table.

### STUDIES COMPLETED

No.	Studies	Name of Agency	Yr. Of Completion
1.	Pre-feasibility Study for Low Level Canal	Jyoti Consultants Ltd., Vadodara.	1981
2.	Mathematical Modeling of Ground Water System for Single Layer Model Narmada Mahi Doab.	Operations Research Group, Vadodara.	1982
3.	Pre-feasibility Level Drainage Study of Narmada Mahi Doab of SSP Command	Core Consultants Ltd. Ahmedabad	1982
4.	Some Aspects of Role of Panchayats and Institutional Arrangements for Canal Irrigation in Two Talukas of Ahmedabad District	Institute of Cultural and Urban Anthropology, Ahmedabad.	1982
5.	A Study of Settlement Pattern (6 Talukas in the Narmada Command Area of Mahesana Dist. of Gujarat).	Department of Geography, Gujarat University, Ahmedabad	1982
6.	Regionalisation of Narmada Command	Operations Research Group, Vadodara.	1982
7.	Marginal Cost Study of Two Typical Distributories and Two Typical Branches	Dr. C.R.Shah, Vadodara	1983
8.	Socio-Economic Benchmark Survey of 62 Talukas (Sub-districts) of Narmada Command Area	Fourteens different Agencies including Universities, Research Institutions etc.	Between 1982 & 1983
9.	Population Projection and Migration Study of Narmada Command Area	Operation Research Group Vadodara	1983
10.	Study on Water Demand for Non-Agricultural Use from Narmada Project.	Gujarat Water Supply and Sewerage Board, Gandhinagar	1983
11.	Consumer Expenditure, Assets and Indebtedness of Rural Households of the Command Area of Sardar Sarovar (Narmada) Project.	Directorate of Economics & Statistics, Gandhinagar	1983
12.	Wasteland Development Project for Command Area of Narmada Canal (Region 11312)	Gujarat State Rural Development Corporation Ltd., Gandhinagar	1984 (11 and 12)
13.	Mathematical Modeling of Ground Water for System Narmada Mahi Doab.	Operations Research Group, Vadodara.	1985
14.	Additional Work of Mathematical Modeling of Ground Water-System Single Layer Model Narmada Mahi Doab.	Operations Research Group, Vadodara	1985
15.	Rate of Adoption of Improved Technology in Narmada Command and Rest of Gujarat State (Based on Analysis of Crop cutting Experiments Data)	Operations Research Group, Vadodara	1985

No.	Studies	Name of Agency	Yr. Of Completion
16.	Computer Aided Planning of Conveyance and Delivery Network.	Indian Institute of Management, Ahmedabad.	1986
17.	Land Use and Cropping pattern Survey Zone 4A & 4B.	Department of Geography, M.S. University, Vadodara.	1987
18.	Survey and Investigations Work of Ground Water Resources in Narmada-Mahi Doab.	Gujarat water Resources Development Corporation Ltd., Gandhinagar.	1987
19.	Cropping Pattern and Waste Demand Study in Narmada Command Area.	Operations Research Group, Vadodara.	1987
20.	Inter-Regional Water Allocation and Determination of Branch Canal Capacity.	Operations Research Group, Vadodara.	1989
21.	Extended Study of Inter Regional Water Allocation and Determination of Branch Canal Capacity.	Operations Research Group, Vadodara.	1989
22.	Growth of Agro Processing includes in Phase of SSP	Gujarat Industrial & Technical Consultancy Organization Ltd., Vadodara.	1990 1990
23.	Consultancy Work for Control Telemetry and Communication Network on Narmada Canal System for SSP.	Gujarat Communication & Electronics Ltd., Gandhinagar.	1991
24.	Techno-Economic Study for Utilising Village Tanks as borrow area for construction of Canal Network.	Operations Research Group, Vadodara.	1992
25.	<b>Studies on Water Rates Policy</b>		
	A. Pricing of a Public Utility Survey of Literature.	Department of Economics, South Gujarat University, Surat.	1992
	B. Financial working of Irrigation Projects. A Case of four Projects in Gujarat.	Department of Economics, Sardar Patel University, Vallbh Vidyanagar.	1992
	C. Some Policy Issue for Canal Water Rates in Gujarat.	Department of Economics, Sardar Patel University. Vallbh Vidyanagar.	1992
26.	Mathematical Modelling of Ground Water System for SSP Command Between Rivers Shedhi and Sabarmati.	Consultancy Engineering Service, New Delhi.	1993
27.	Mathematical Modelling of Ground Water System for SSP Command Between Rivers Banas and Sabarmati.	Operations Research Group, Vadodara.	1993
28.	Mathematical Modelling of Ground Water System for SSP Command beyond River Banas upto Rajasthan Border.	Dalal Consultants, Ahmedabad.	1993
29.	Pre-feasibility Level Drainage Study for SSP Command Beyond river Mahi.	Consultancy Engineering Services, New Delhi.	1993
30.	Study on Preparation of a Detailed Integrated Command Area Development Plan for SSP.	M/s. Wamana Consultants Pvt. Ltd., Hyderabad.	1994

No.	Studies	Name of Agency	Yr. Of Completion
31.	Environmental Impact Assessment Studies on Inland and Marine Fisheries relevant to the Command Area of Sardar Sarovar (Narmada) Project.	M.S. University, Vadodara.	Nov. 1994
32.	Environmental Impact Assessment Studies on water related diseases in SSP Command Area including the area down stream of (Narmada) the dam.	Commissionerate of Health, Medical Services & Medical Education, Govt. of Gujarat, Gandhinagar.	Nov. 1994
33.	Study of Flora and Fauna of the Command Area of Sardar Sarovar (Narmada) Project. Lying Between the Narmada & Sabarmati Rivers. (EIA Studies)	Sardar Patel University, Vallabh Vidyanagar.	Nov. 1995.
34.	EIA on Downstream of Sardar Sarovar Dam up to Gulf of Cambay.	H.R. Wallingford, U.K.	April 1995
35.	Economic Dimension of the Sardar Sarovar Project.	S.P. Institute of Social & Economic Research, Ahmedabad.	May 1995
36.	Study on Flora and Fauna of the Command Area of Sardar Sarovar Project Lying in Saurashtra and Kachchh Area (EIA Studies).	Saurashtra University, Rajkot.	Jan. 1996.
37.	Review of Ground Water Drainage Study	H.R. Wallingford, U.K.	Feb. 1996.
38.	Agro Pollution Aspect of Command Area	H.R. Wallingford, U.K.	
39.	Environmental Impact Assessment of Black Buck National Park at Velavadar in the command area of SSP.	GEER Foundation, Gandhinagar.	Dec. 1993
40.	Study on Flora and Fauna of the Command Area of SS Project lying Between Sabarmati River and Rajasthan Border (EIA Studies.)	Gujarat University, Ahmedabad	Mar. 1998.
41.	Ecological Study of Wild Ass Sanctuary and Surrounding Area Using Remote Sensing	GEER Foundation, Gandhinagar.	May 1998.
42.	Environmental Impact Assessment of Nal Sarovar Bird sanctuary.	GEER Foundation, Gandhinagar.	Mar. 1998

### 5.9 (III) 11. ON GOING STUDIES :

1.	Agricultural Research Studies.	Gujarat Agricultural University	1987
2.	Survey and Investigation Work of Ground Water Resources Beyond River Mahi in SSP Command.	Gujarat Water Resources Development Corporation Ltd. Gandhinagar	1989
3.	Action Research in People Participation	Gujarat Labour Institute, Ahmedabad.	



## 5.10 (III) ARCHAEOLOGICAL SURVEY AND ANTHROPOLOGICAL STUDIES

### ARCHAEOLOGICAL SURVEY

In the case of SSP, where some sites may be submerged in NWD award stipulated that the entire cost of relocation and protection and projection should be chargeable to GOG. Relocation work is to be supervised by the Department of Archaeology under the provisions of the 1958 Act.

### STUDIES

Survey conducted for identification of various sites & monuments of significance has included the following.

<b>Gujarat</b>	: Archaeological Survey of Nineteen Villages Submerged by Sardar Sarovar Reservoir, 1989.
<b>Maharashtra</b>	: Survey by Department of Archaeology. Survey was carried out by the State Department of Archaeology for cultural sites in 24 villages of Akkrani taluk and nine village from Akkalkuwa Taluka, Dhule district.
<b>Madhya Pradesh</b>	: Survey by State Department of Archaeology and Museum (1992) in sixteen volumes.
<b>Anthropological Survey of India</b>	: Narmada Salvage plan.
<b>Anthropological Survey of India</b>	: People's of India.
<b>Adivasi Kala Parishad</b>	: Survey of Material Cultural in the Narmada Valley.
<b>Rashtriya Manav Sanghralaya</b>	: Narmada Salvage Plan.



## CHAPTER - V PART IV

### PROGRESS OF WATER SUPPLY PROJECT BASED ON NARMADA WATERS

This project with an ambitious plan of supplying drinking water to 8215 villages and 135 towns, is taken up for implementation under a separate Government undertaking set up for the purpose. A project proposal is prepared and the total cost estimated is Rs. 4700 crores.

The State Government has taken a policy decision to take up the implementation of the project during the period of 9th Five Year Plan.

- An outlay of Rs. 2200 crores has been made in the 9th Plan. The outlay has been approved by the Planning Commission.
- The project has been planned to be implemented in a total of 5-7 years. The project has been planned to be taken up during the 9th Five Year Plan.

The Narmada, Water Resources and Water Supply Department has planned to draw water from the Saurashtra Branch canal near Lakhtar and also from the tail ends of the Maliya and Vallibhipur branches. The Sardar Sarovar Narmada Nigam will construct the off take arrangements at these points from where water for drinking shall be drawn by laying trunk transmission pipelines.

The existing distribution networks and new networks planned as a part of the project are proposed to be connected with the trunk main and sub trunk main system so as to supply and distribute water to the domestic and industrial consumers.



## CHAPTER - VI

# ISSUES UNDER DEBATE - JUDGE FOR YOURSELF

**6.1** Developing countries have to struggle against many odds like large population, high birth rate, illiteracy and poverty in lifting their standard of living. Various international covenants like W.T.O., World Bank norms, I.P.R. initiated by developed countries put further constraints on their development options. And adding to their woes are controversies fueled and supported by some interest groups of rich countries, which create confusion and distraction on the economic development plans pursued by poor but resource rich countries.

One such controversy is regarding development effectiveness of large water resources projects. An internationally sponsored anti dam campaign, but with its local counterparts in developing countries is out to predict

dismal consequences of building large dams. It is alright that USA, Canada, Europe, Japan etc. have dammed all their rivers and enjoy benefits of cheap hydro energy and irrigated agriculture. The

USA for instance has increased its hydro power generation from 16 billion kwh in 1920 to 280 billions kwh in 1990; Canada gets about 62% of its electricity from hydro sources; similar is the position of several other countries like Sweden, Switzerland, Austria etc. But interest groups financed and supported by organisations of these countries are placing



hurdles against other countries using their river flows by construction of dams.

Narmada basin being one of the large river flows of India remained untapped so far, has been made a focus of such anti dam campaign. Since the Government of Gujarat is pushing ahead with determination and resource back up, execution of the SSP, the anti dam lobbyists are evidently mounting attacks with maximum ferocity on this project.

## 6.2 LET US EXAMINE THE ISSUES THEY ARE RAISING AGAINST THE SSP.

**ISSUE :** Water availability is over estimated ?

**(1)** The availability of water in Narmada river has been assessed in the most sophisticated and systematic manner in consultation with the

Central Water Commission (CWC) the highest expert technical body of the nation by utilising rainfall series from 1891 to 1992 and actual river flow series from 1948 to 1992. The actual rainfall series for 45 years is not adequate

for planning mega project with a life of more than 100 years and a large catchment with co-efficient of annual flow variations of 0.35 which may need minimum 130 years data of both rainfall and river flows. Therefore combined actual and hind cast available data of about 100 years is used as per international standard

practice. Based on this method, 75% dependable availability is 27.22 MAFT and not 22.69 MAFT estimated by the opponents of the dam.

Further it is to be added that water availability of the project has been assessed by eminent national and international experts at different points of time and all have come to a conclusion that water availability as assessed is quite in order. They are Khosla Committee of 1965; official level discussion participated by experts from all Party States and Government of India in 1966; Engineers of Madhya Pradesh before Narmada Water Disputes Tribunal in 1974; World Bank Hydrologists while appraising the project in 1985; Shri D. N. Thapar, Member, Narmada Valley Development Authority, Madhya Pradesh in 1991 and Central Water Commission in 1993.

**(2)** It is feared that command area of the project would suffer from water logging and salinity of soil would come to surface, making land unfit for cultivation.

Waterlogging due to excessive ground water accumulation can be a side effect of canal irrigation over a long period. It can be prevented by appropriate water management practices. In the SSP, following specific measures have been built in the system, and would ensure that there would not be any problem of waterlogging or salinity surfacing :

1. Lining main canal, branch and entire canal net work upto 8 ha. block to minimise seepage.
2. Limited water delta of 53 cm (21") against normal 75 cm in existing projects.

3. Simultaneous command area development.
4. Conjunctive use of surface and ground water.
5. Remote Controlled Automatic Canal Operation.
6. Volumetric and rotational water supply by Warabandhi.
7. Minimum borrow areas by the side of canal due to borrowing earth from village tanks and drains, thus reducing seepage.
8. Water application allowance based on agro-climatic zoning.
9. Better water management practices and active participation of farmers.
10. Encouragement of drip, sprinkle and other water conservation high tech agro practices.
11. Water balance and salt balance studies and monitoring.

**(3)** Irrigation efficiency assumed is unrealistic and hence actual coverage of irrigation would be lesser !

This apprehension is unfounded. Water management aspects mentioned in the previous para, and particularly computerised automatic control and volumetric distribution of water, supply of water to groups of farmers and not individual, would help attain better efficiency. Gujarat has proved efficiency in water management under conventional system also, by capturing national productivity award for five consecutive years. This criticism perhaps shows a mindset that India can never attain high efficiency !

**(4)** The project would benefit rich farmers, while tribal population being displaced would suffer.

This is an emotive myth, a misinformation propagated by anti dam lobby to arouse opposition to the dam. The farmers who will get the benefit of irrigation from SSP in Gujarat would be -

Marginal farmers (< 1 ha)	28.0%
Small farmers (1-2 ha)	24.4%
Schedule Caste farmers	8.7%
Schedule Tribe farmers	9.1%

Further the project is designed to benefit about 75% of the drought prone areas. And as far as affected population is concerned, tribal people constitute less than half (63223 persons out of 127446).

It is pertinent to note that 50 out of 62 talukas to benefit from Narmada irrigation suffer from fundamental resource backwardness - partially or wholly - like drought prone areas (36), desert (8), tribal talukas (5), tribal pockets (2), coastal areas (8) basic backwardness (10), economically backward (10), industrially backward (40) and geographically backward (13). For these fundamentally backward 50



talukas, Narmada Project is the only hope for productive employment generation and upgrading standard of living.

### **(5) SEISMICITY AND SAFETY**

Investigation to determine the seismic design parameters of SSP have been carried out through established authorities of the country. National and International standards have been followed. The theoretical techniques of dynamic analysis as per state-of-art technology are adequately deployed to assess the behavior of designed dam section. Adequate advice of consultants at National and International level has been availed for scrutiny and vetting of designs, to ensure that the dam would serve the best interest of beneficiaries for centuries even under the severe attack of a worst possible earthquake. The Sardar Sarovar Dam design and sections have been evolved and analysed meticulously by competent experts and debated in Expert Panels consisting of renowned and experienced professionals. All safety requirements are ensured as per the requirements. Fears about adequacy of the Dam design for a severe earthquake is thus ill founded and should not cause concern to anybody.

### **(6) SILTATION AND LIFE OF THE RESERVOIR**

#### **CRITICISM :**

Actual siltation would be more than assessment, resulting into reduction of the life of the reservoir which is assumed is minimum 180 years to 357 years for different probable scenarios.



Narmada Planning Group (NPG) of Government of Gujarat has examined in detail the problem of sedimentation in Sardar Sarovar Reservoir in order to determine its feasible Service Time. Table - 1 gives the Feasible Service Time of SSR as has been estimated by using all the three different methods and for different construction schedules of SSP and NSP.

**TABLE-1**

Particulars	Feasible Service time of SSP (years)		
	Empirical Area reduction method	Area increment increment method	Trigono metric method
Case-1 SSP & NSP completed together	233	329	337
Case-2 NSP completed 5 years after the SSP	222	319	326
Case-3 NSP completed 10 years after the SSP	212	308	316
Case-4 NSP completed 15 years after the SSP	201	298	305
Case-5 NSP completed 20 years after the SSP	191	287	295
Case-6 NSP completed 25 years after the SSP	180	277	284

Table 2 gives the silt levels at the dam and corresponding live storages, losses in live storage and percentage loss of live storage after 50, 100, 150 and 200 years of impounding for cases 2 and 6 mentioned in Table 1.

**TABLE-2**

Sr. No.	Years after impo- unding	Silt level at the dam for case		Corresponding live storage of case		Loss in live storage for case		% loss of storage	
		II Mtr. (ft)	IV Mtr.(ft.)	II MCM (MAF)	VI MCM (MAF)	II MCM (MAF)	VI MCM (MAF)	II	VI
1.	50	34.75 (114)	45.12 (148)	5898 (4.558)	5522 (4.445)	163 (0.132)	339 (0.275)	2.9	5.8
2.	100	44.51 (146)	54.27 (178)	5538 (4.458)	5323 (4.284)	323 (0.262)	538 (0.436)	5.5	9.2
3.	150	53.65 (176)	62.19 (204)	5336 (4.294)	5125 (4.123)	525 (0.426)	736 (0.597)	8.9	12.5
4.	200	62.19 (204)	69.15 (228)	5125 (4.133)	4883 (3.927)	736 (0.597)	978 (0.793)	12.5	16.7

*MCM : Million Cubic Metres MAF : Million Acre Feet*

In the above estimates, sediment rate of 5.34 ha m/100 sq. km/year has been adopted as observed instead of 5 ha. m/100 sq.Km/year as suggested in Dr. M. L. Diwan Committee Report of 1985.

It would be seen from Table - 1 that the maximum life of the project can be anywhere from 233 to 337 years if completion of SSP and NSP synchronises. The minimum life can be anywhere from 180 and 284 years if the completion of NSP lags by 25 years behind SSP.

New Zero Elevation after 100 years of operation would work out to EL 57.50 meter for the silt rate of 5.34 ha. m/100 sq.km/year which is considerably lower than the bottom level of the penstocks.

### **MEASURES TO REDUCE SILT FLOW**

The All India Soil and Land Use Survey Organisation has identified in the case of SSP an area of about 2,83,000 ha as the area draining directly into the Sardar Sarovar Reservoir (SSR) (including water spread area) and vulnerable for erosion. Deleting the water spread area of 37,000 ha from the above identified area, directly draining sub watershed area into the reservoir is 2,46,000 ha. and about 59% of the area of sub watersheds require catchment treatment measures on priority basis. Accordingly, in case of SSP an area of 1,45,000 ha. needs treatment. Further, an area of about 1,000 ha of land used for the borrow areas and other project activities is also proposed to be covered by land treatment measures. Catchment Area Treatment is also

proposed for the Narmada Sagar Project over an area of 60,000 ha. which also influence the rate of siltation into Sardar Sarovar Reservoir.

The Forest Department prohibits cutting of trees around the periphery of the reservoir. This measure also helps to control flow of sediments into the reservoir to some extent.

In SSP and NSP, enough silt traps have also been provided.

Besides the key storage Narmada Sagar Reservoir in the valley, four major dams namely Tawa, Barna, Sukta and Bargi have already been completed in the Narmada catchment. Another major dam across Kolar a tributary to Narmada is also nearing completion. Similarly projects on Man and Jobat tributary are also in the advanced stage of construction.

Further, the overall basin planning of Narmada envisages 29 major, 135 medium and 3000 minor reservoirs in Madhya Pradesh. Thus in future several silt traps will be created by completion of the above projects spread in the entire catchment. All these projects on completion will trap sediment in the catchment and reduce the silt flow into Sardar Sarovar Reservoir.

**Conclusion :** It is thus clear that the life of the SSP is likely to be much more than what has been estimated in Table - 1 and 2 that the life of the project meets the standard set forth in IS : 12182 - 1987.

**(7)** " Assessment of ground water and conjunctive use is not realistic".

The assessment of ground water is done after detailed ground water survey and mathematical modeling for estimating recharge in the first phase area through the specialised international agency of Mac Donald.

Even in Mahi command the irrigation in the command area is 1.5 lac ha. while the ground water irrigation in the command area is 1.75 lac ha. Thus conjunctive use is quite realistic in Gujarat.

In the project as we have restricted delta for irrigation there should be no apprehension of utilisation of the ground water by the farmers themselves.

**(8)** "Sugar factories are sanctioned in command and thus water will not reach distant areas of North Gujarat, Saurashtra and Kachchh".

There are existing 14 sugar factories in Gujarat. All of them are outside command of SSP. Two factories are under consideration in the command area at Amod and Karjan, but no guarantee or assurance has been given for supply of water for sugarcane for these factories from SSP, as it does not supply water for irrigation in summer. Even the quantum of 53 cm or 21 inch delta will not be adequate for sugarcane. Since water would be given to groups of farmers for a block on volumetric basis, there would not be scope for water intensive crops like sugarcane or banana, unless drip irrigation or similar water saving technology is adopted.

## **(9) SSP IS ECONOMICALLY UNVIABLE ?**

**1.** The economic viability of the SSP has been examined critically by the independent national as well as international experts on many occasions in the past. The first economic appraisal was carried out by the Tata Economic Consultancy Services (TECS) Bombay in 1983. They have indicated that this project will confer substantially large benefits, much larger than the cost involved, with a benefit cost ratio of 1.84 an IRR of 18.3%, both evaluated at economic price.

**2.** The Staff Appraisal Report of the World Bank also estimated the Economic Rate of Return (ERR) at 13% in 1985 they had also carried out sensitivity analysis taking into account various favourable and adverse factors. This analysis provided ERR within a range of 7 to 19%. Even former is considered to be an acceptable rate of return for a project of this type serving a drought prone region in India.

**3.** The World Bank again updated its economic appraisal of SSP in 1990. This clearly indicated that the original ERR of about 12% was still correct. It may be mentioned here that Nitin Desai Committee constituted by GOI considered rate of return of 9% (7% for drought prone area) as acceptable.

**4.** The World Bank again undertook economic reappraisal based on 1991-92 price. Results of this exercise have been reported in the Project Completion Report (PCR) prepared by the World Bank in 1995. This exercise paid particular

attention to the environmental cost and benefits which might have been committed or underestimated in the original analysis. It estimated ERR or 12.2% which was found to be within the range of acceptable ERR's for project of this type. The PCR has concluded that the 'scale of benefits is large, relative to any feasible alternative, with substantial multiplier effect as well.'

5. The Narmada Planning Group had asked the Ahmedabad based Sardar Patel Institute of Economic and Social Research (SPICSR) to update the economic appraisal earlier made by TECS. This exercise was also done at 1991-92 price. The ERR estimated with three different alternative assumptions of water use efficiency and project cost works out within the range of 16 to 20%. This result should set at rest any doubt about the economic viability of this project.

### 6.3 MYTH :

"Tribals living in pristine forest area and cultivating fertile land to abandon their places and migrate uncertain future".

### REALITY :

This is widespread myth easily believed by people who are not aware of the ground realities. An extract from the note prepared by India Agri. Operations Division of World Bank in April 1990 amply clarifies this - "A widespread myth is that the tribal people to be

resettled from the submergence area are living in pristine forests in a traditional manner as hunter gatherers in harmony with the environment. This is not correct. As satellite imagery shows and field observation confirms, the tribals live in mostly farm barren, stony, steep and increasingly degraded hillsides with a small and decreasing part of their income derived from the forest land. Many of them welcome the opportunity to improve their lot in the more fertile and more sustainable command area and, while any move has considerable social costs for a family, many have quite widespread tribal connections in the resettlement areas in Gujarat which is expected to help their adjustment. A substantial proportion of tribals appear to see little future in the increasingly degrading submergence area. Indeed it is within this tribal group that

there appears to be the least opposition to the dam. *The greatest opposition is from the more wealthy non - tribal farmers.*

### MYTH :

"Dense forests would be submerged under the project, inflicting heavy damage on environment."

### REALITY :

Total area of forest land which would be submerged at full dam height would be 13385 ha. only and most of them are degraded forest. As against this, compensatory afforestation is being done in equivalent new area, and restoration of degraded forest to fill tree cover in double the area is being done.



Against every tree submerged, 78 trees have been already planted. There would be immense environmental benefit of green cover and foliage produced by irrigation. CO<sub>2</sub> fixation in the command will be 70 times that being affected in submerged area.

And then, consider diversion of forest land due to pressure of population and other reasons - Forest Survey of India (1987) gives following data of diversion of forest land between 1961 to 1980:

Purpose	Land diversion (lac. ha.)
Agriculture	26.23
River valley projects	5.02
Industrial & Urban expansion	1.34
Transmission lines & roads	0.61
Miscellaneous	10.08
Total.....	43.28

On the other hand every year 1.5 million ha. are estimated being destroyed illegally for fuel and other needs. Construction of SSP would help reducing this.

**6.4 ISSUE :** Why big dams ? Why not have small dams and watersheds development ?

This controversy is entirely uncalled for and arises from lack of understanding our water resource position as well as problem.

While it is nobody's guess that only big dam should be built, small dams are certainly no substitute for large dams. In fact for harnessing the precious and limited water resources of the country to an optimal extent all the various avenues like large, medium, and small surface storages; ground water withdrawal, conservation and reuse etc. have to be resorted

to simultaneously as an integrated, interdependent system which will ultimately be self sustaining. This is examined below in terms of availability, needs, alternatives, benefits and costs.

1. About 90% of the available water is received in just three months of monsoon, often as floods. Storages are, therefore inevitable.
2. Country's all round development requires water for industries, energy, domestic and municipal supplies, recreation etc. Flood control is also necessary as also drought proofing.

3. (a) Alternative power sources are questioned on safety ground e.g. nuclear, thermal while hydro power generation through large dams may become increasingly attractive on this consideration. The latter may be more environment friendly than the former.

(b) Hydro power is a clean and cheap power. Of the total hydro potential of 84,000 MW, only 17,650. MW of installed capacity exist at present. With ever increasing import bills for fuel oil and worsening pollution, large scale development of hydro power is inevitable for the country. This is also required for the peaking needs in the thermal system.

At present our Nation is also suffering from deficit in power generation and therefore the GOI is putting more and more stress on infrastructure development with hydro power generation. Hydro power generated from SSP would be the cleanest, cheapest and eco-friendly power. As against the cost of installation of Rs. 4.0 crores per Megawatt for other power stations, the cost for installation of Sardar



Sarovar comes to only Rs. 2.0 crores per Megawatt. It is further added here that the River Bed Power House of 1200 MW capacity has been so planned as to make possible the reversible operation and thus to provide valuable peaking energy to the western grid which is in deficit of peaking energy by 2500 MW and therefore the Central Electricity Authority (CEA) of GOI has approved this project as a part of its least cost expansion programme.

4. In the arid areas like Gujarat the rainfall is only in monsoon and that too hardly for 30-40 days with intensity and distribution erratic.

5. There are no snow melting rivers which can supply water in summer.

6. There are no winter rains.

7. The only alternative available for optimum utilisation is to store water in monsoon which is available during limited rainy days only.

8. All these objectives cannot be attained without supplementing small dams and ground water with as many big dams as possible. Big dams have the following advantages :

(a) Storage of large monsoon flows at fewer selected and most suitable sites.

(b) Much smaller area of submergence per unit of water stored.

(c) A limited number of suitable construction worth natural sites are normally available along a river and if large storages are not built there, the flood waters would be wasted as alternative suitable sites are not adequately available for small dams in replacement of a single major dam site.

(d) They are eminently suited for carry over storages and thus impart greater reliability and stability to the system.

(e) Almost inevitable for generating cheap and clean hydro power.

(f) Provided most effective way of flood regulation and control. (Ukai has not only protected Surat City but also made intensive industrialisation possible).

(g) Most reliable during drought when small storages do not get filled up and suffer excessive evaporation loss. Thus reliability of large dams is much greater. In drought years the reliability of small dam is very poor when it reduces to less than 10%.

(h) Much less evaporation loss per unit of storage.

(i) Long life as large silt pockets can be provided.

(j) Per unit of water stored or area irrigated the cost of big dams is much less as compared to that of small dams.

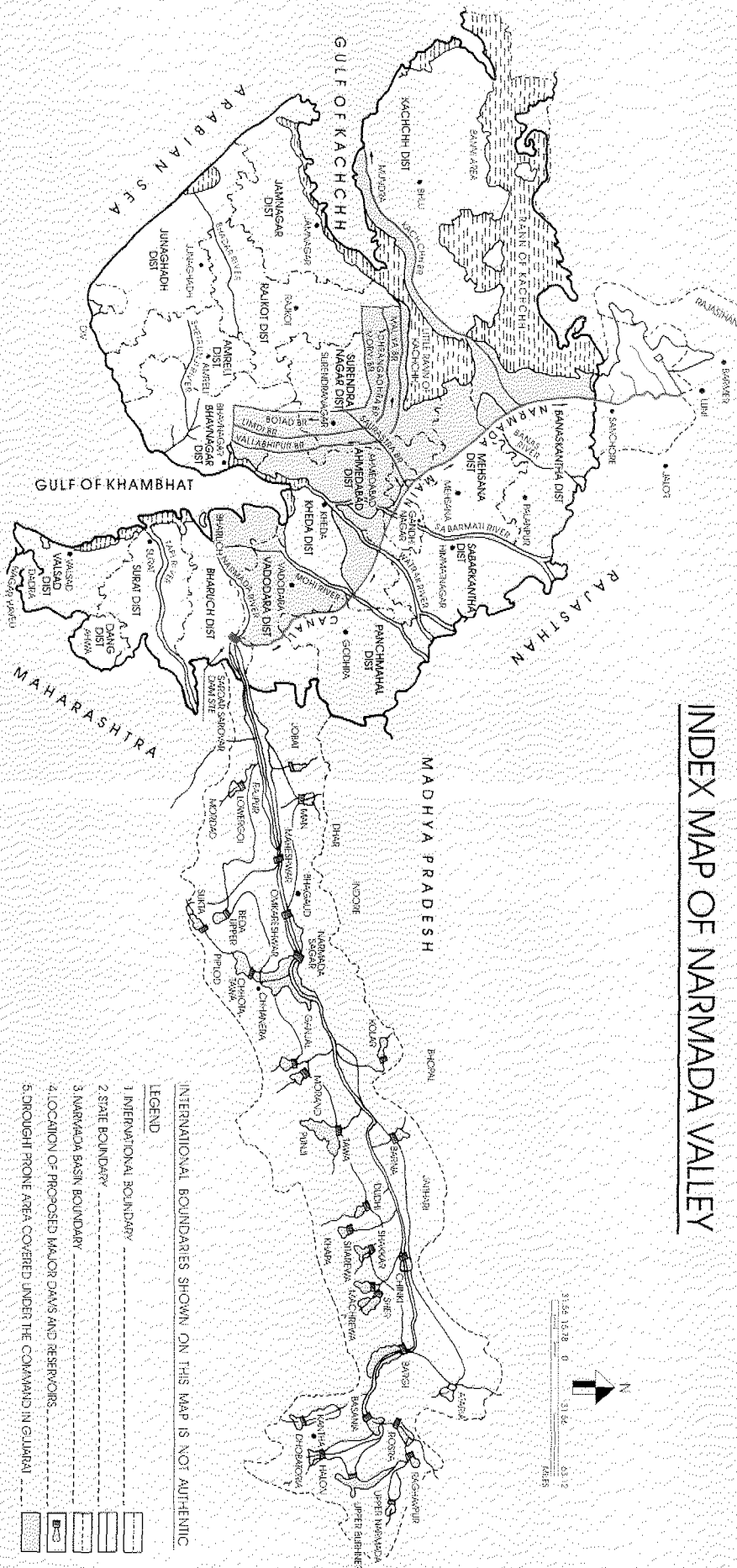
(k) Small storage dams cannot be economically built across large rivers. Also cost of protection of such small dams, each individually, against the same large flood would be enormous.

(l) Diversion and transfer of surplus water to water scarce basins can be possible only through big dams.

(m) Employment potential is better in large dams and that too mostly throughout the year. In case of small dams there is little employment potential and that too seasonal and for small local areas.

10. Small dams do have an advantage in that they take shorter construction time, small initial capital cost, shorter gestation period with early benefits spread out facilities in various regions creating a better development balance within the same constraint of resources etc. Thus they are also required as necessary supplements to big dams.

# INDEX MAP OF NARMADA VALLEY



INTERNATIONAL BOUNDARIES SHOWN ON THIS MAP IS NOT AUTHENTIC

**LEGEND**

- 1. INTERNATIONAL BOUNDARY
- 2. STATE BOUNDARY
- 3. NARMADA BASIN BOUNDARY
- 4. LOCATION OF PROPOSED MAJOR DAMS AND RESERVOIRS
- 5. DROUGHT PRONE AREA COVERED UNDER THE COMMAND IN GUJARAT

॥ नर्मदाष्टकम् ॥



सबिन्दुसिन्धुसुखलतरुः भ्रूरज्जितं द्विषन्तु पापजातजातकारिवारिसंयुतम् ।  
कृतान्तदूतकालमूतभीतिहारिवर्मदे त्वदीयपादपङ्कजं नमामि देवि नर्मदे ॥१॥

त्वदम्बुलीनदीनमीनदिव्यसंप्रदायकं कलौ मलौघभारहारि सर्वतीर्थनायकम् ।  
सुमत्स्यकच्छनक्रचक्रचक्रवाकशर्मदे त्वदीयपाद० ॥२॥

महागभीरनीरपूरपापधूतमृतल ध्वनत्समस्तपातकारिदारितापदं जवम् ।  
जगल्लये महाभये मृकण्डुसूनुहर्म्यदे त्वदीयपाद० ॥३॥

गतं तदैव मे भवं त्वदम्बु वीक्षितं यदा मृकण्डुसूनुशौनकामुरारिसेवि सर्वदा ।  
पुनर्भवाब्धिजन्मजं भवाब्बिटु खवर्मदे त्वदीयपाद० ॥४॥

अलक्षलक्षकिन्नराभरासुरादिपूजितं सुलक्षनीरतीरधीरपक्षिलक्षकूजितम् ।  
वसिष्ठशिष्टपिप्पलादिकर्दमादिशर्मदे त्वदीयपाद० ॥५॥

सनत्कुमारनाचिकतेकश्यपात्रिषट्पदैर्धृतं स्वकीयमानसेषु नारदादिपट्पदैः ।  
रवीन्दुरन्तिदेवदेवराजकर्मशर्मदे त्वदीयपाद० ॥६॥

अलक्षलक्षलक्षपापलक्षसारसायुधं ततस्तु जीवजन्तुतन्तुभुक्तिमुक्तिदायकम् ।  
विरिज्जिविष्णुशंकरस्वकीयधामवर्मदे त्वदीयपाद० ॥७॥

अहो मृतं स्वनं श्रुतं महेशकेशजातटे किरातसूतवाडवेषु पण्डिते शठे नटे ।  
दुरन्तपापतापहारिसर्वजन्तुशर्मदे त्वदीयपाद० ॥८॥

इदं तु नर्मदाष्टकं त्रिकालमेव ये सदा पठन्ति ते निरन्तरं न यान्ति दुर्गतिं कदा ।  
सुलभ्यदेहदुर्लभं महेशधामगौरवं पुनर्भवा नरा न वै विलोकयन्ति रौरवम् ।