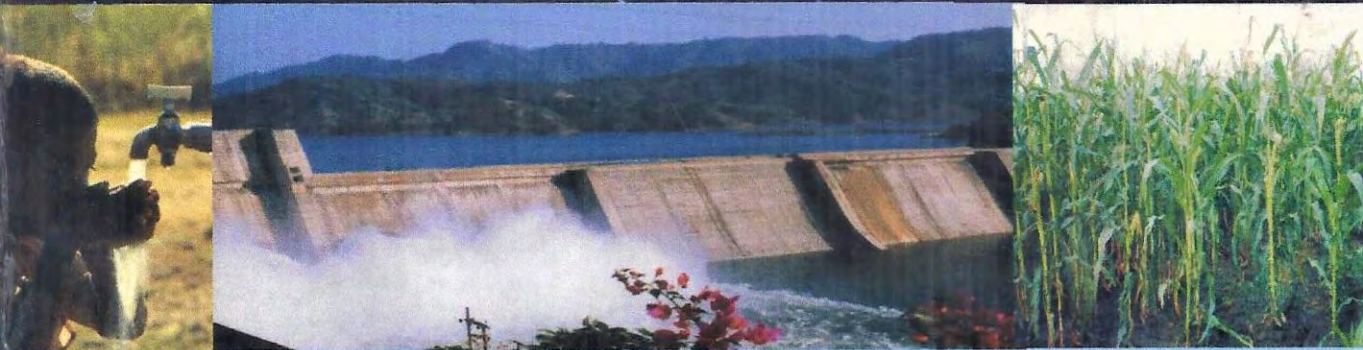
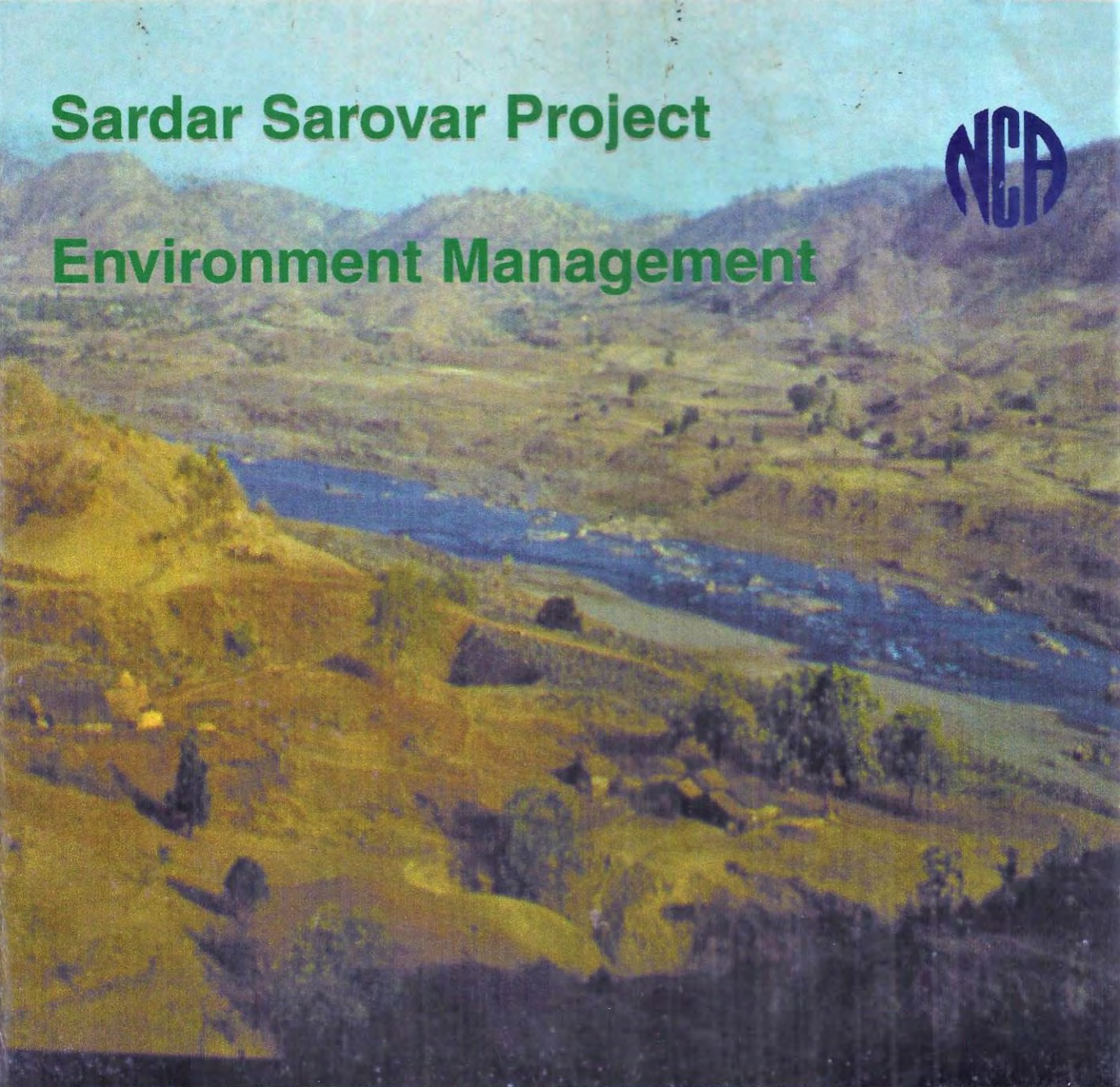


Sardar Sarovar Project



Environment Management



OCTOBER 2000

Narmada Control Authority
INDORE

Sardar Sarovar Project



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PREFACE

The mean annual flow of River Narmada is more than combined mean annual flows of Ravi, Beas and Sutlej rivers. The water of River Narmada and its tributaries need to be harnessed & utilised for the benefit of millions of people, who are eager to share socio-economic benefits of development not only within the valley but also in the adjoining contiguous areas of Gujarat and Rajasthan. Narmada River has been subjected to several investigations, however, the master plan for her development has been drawn up, during December 1979, according to the directions given by the Narmada Water Disputes Tribunal Award. The award determined the Full Reservoir Level (FRL) of the Sardar Sarovar Dam, issued directions regarding submergence of land, Rehabilitation and setting up of a machinery for implementing the decision of the Tribunal.

The SSP, a terminal dam on the main stream of the River Narmada in Gujarat, is a multipurpose project with irrigation, power and drinking water benefits. It is being executed as a joint venture of Gujarat, Madhya Pradesh, Maharashtra and Rajasthan.

The Sardar Sarovar Project was formulated and was forwarded to Central Water Commission by the Government of Gujarat. The history of assessment of the environmental impacts of the SSP dates back to 1980 when the project was conceived and was viewed in accordance with the relevant guidelines in-force.

During April 1983, Environmental Appraisal Committee of the Department of Environment of the Government of India approved the Project in principle. During January 1987, Ministry of Environment & Forests had recommended clearance to the Sardar Sarovar and Indira Sagar Project from environmental angle with certain riders. On 3 June 1987, the NCA, which originally constituted during October, 1980 was entrusted with the added responsibilities for planning, implementation and monitoring of Environmental Safeguards. Upon reconstitution of the authority, the Indira Sagar Project and Sardar Sarovar Project were accorded environmental clearance. The clearance was issued on the principle that environmental conservation, improvement and development of river valley projects were compatible and by incorporating mitigative measures for ill effects of the project, the overall environmental conditions could be improved. The clearance order had set four conditions, which were basically guidelines for completing survey, studies and preparation of Action Plans for mitigative measures for the identified parameters.

During September 1987 the Ministry of Environment & Forest, Government of India under Forest (Conservation)-Act-1980, approved the diversion of forestland coming under submergence of SSP. By October 1988 the Planning Commission, Government of India approved investment of Rs. 6,406 crores on SSP. The works on the project commenced thereafter with a schedule that envisaged completion of the dam by May 1994 and completion of the canal network in Gujarat by mid 1998. However, for various reasons, the construction works on the project could not proceed as scheduled. Some of the studies pertaining to planning and implementation of the environment safeguard measures also slipped by. By now, most of these studies are in place. Action Plans on the suggested parameters have also been drawn up for their implementation *pari-passu* with progress of construction works on the project. A substantial progress has been achieved in the areas of compensatory plantations, catchment treatment, seismicity, archaeology etc. and it is hoped that it would be possible to implement the suggested safeguards *pari-passu* with the construction works on the project.

The present document gives an insight into the intricacies of the works related to implementation of the suggested safeguards for ensuring that SSP adheres to the requirement of the environmental management, under the overall guidance of the MOEF/NCA. After reading this document, a reader would know as to what the SSP is, the manner it exerts influence on its surrounding environment, the studies on various environmental parameters and their outcome, suggested strategies to mitigate negative impacts and the plans for implementation of the needed safeguard measures besides the works which remains to be done at this stage of the project development.

This document has been compiled by the experts in the Environment Wing of NCA, based on the monitoring exercises carried-out by them and the reports and studies received from Central and State agencies.

Due to limited scope of this document, It was not possible to cover every facet and details related to the environmental aspects of the project. As such, it may leave an appetite with the reader for more and for them, exhaustive documentation on environmental planning of the SSP is available in the libraries of the State Governments and NCA. It is hoped that the environmental planning of the SSP would go a long way to serve as a model for future projects.

(N.D. TIWARI)
Member (E&R)

SARDAR SAROVAR PROJECT

Environment Management

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LIST OF ABBREVIATIONS

AISLUSO	All India Soil & Land Use Survey Organisation
AnSI	Anthropological Survey of India
ASI	Archaeological Survey of India
BES	Bureau of Economics and Statistics
BIS	Bureau of Indian Standards
BSI	Botanical Survey of India
CAD	Command Area Development
CAF	Compensatory Afforestation
CAP	Canal-Affected Persons
CAT	Catchment Area Treatment
CCA	Cultivable Command Area
CHPH	Canal Head Power House
CICFRI	Central Inland Capture Fisheries Research Institute
COF	Commissariat of Fisheries
CPCB	Central Pollution Control Board
CSS	Central for Social Studies
CSSRI	Central Soil Salinity Research Institute
CWC	Central Water Commission
CWPRS	Central Water & Power Research Station
DBE	Design Basis Earthquake
EAC	Environment Appraisal Committee
EDC	Environment Development Cell
EIA	Environment Impact Assessment
EPA	Environment Protection Act

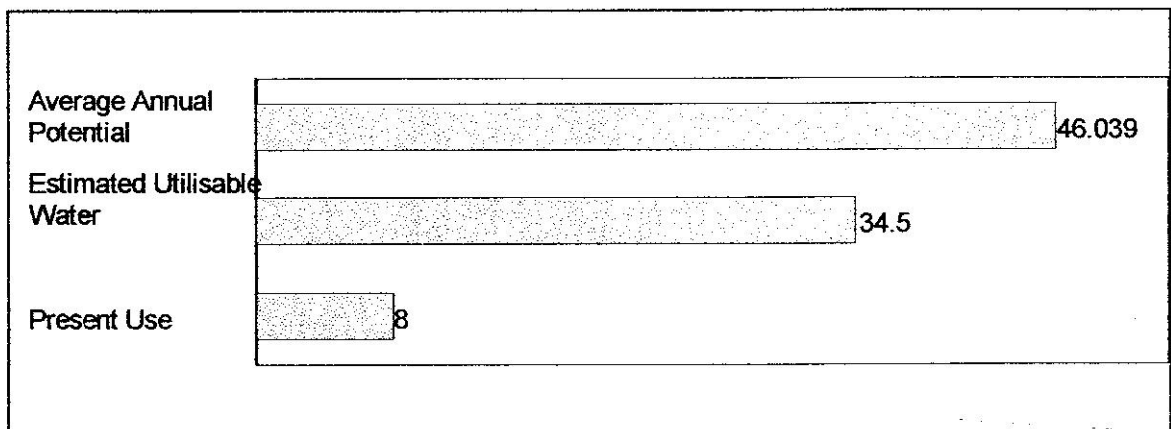
EPCO	Environment Planning & Coordination Organization (MP)
ERL	Environment Resources Limited
ESG	Environment Sub-group
FCA	Forest Conservation Act
FRI	Forest Research Institute
FRL	Full Reservoir Level
FSI	Forest Survey of India
GAU	Gujarat Agricultural University
GCA	Gross Cultivable Area
GDOF	Gujarat Department of Forests
GIS	Geographical Information Systems
GOG	Government of Gujarat
GOI	Government of India
GOM	Government of Maharashtra
GOMP	Government of Madhya Pradesh
GPCB	Gujarat Pollution Control Board
GSI	Geological Survey of India
GWRDC	Gujarat Water Resources Development Corporation Ltd.
GWSSB	Gujarat Water Supply and Sewerage Board
HSGU	Hari Singh Gour University, Sagar
HYV	High Yielding Varieties
IBRD	International Bank for Reconstruction and Development
ID	Irrigation Department of the GOG
IDA	International Development Association
IFDB	Interstate Fisheries Development Board
ILO	International Labour Organisation
IMD	Indian Meteorological Department
IRDP	Integrated Rural Development Programme
IRM	Independent Review Mission
MCE	Maximum Credible Earthquake
MDDL	Minimum Draw Down Level
M&E	Monitoring and Evaluation
MOA	Ministry of Agriculture
MOEF	Ministry of Environment & Forests
MOWR	Ministry of Water Resources
MPPNM	Madhya Pradesh Pradushan Nivaran Mandal (Pollution Control Organisation)
MRC	Malaria Research Centre
MSU	MS University of Baroda
NBDP	Narmada Basin Development Project
NCA	Narmada Control Authority
NGO	Non Government Organisation
NHP	National Health Policy
NICD	National Institute of Communicable Diseases
NICMAR	National Institute of Construction & Rural Management
NMC	Narmada Main Canal
NMEP	National Malaria Eradication Programme
NPA	Narmada Planning Agencies

APG	Narmada Planning Group
NRD	Narmada River Development
ISC	Indira Sagar Complex
ISP	Indira Sagar Project
NVDA	Narmada Valley Development Authority
NWDT	Narmada Water Dispute Tribunal
O&M	Operation and Maintenance
PAPs	Project Affected Peoples
PHC	Public Health Centre
R&R	Resettlement & Rehabilitation
RIS	Reservoir – Induced Seismicity
SCHMS	State Commissariat of Health & Medical Service
SFRI	State Forest Research Institute
SMC	Soil Moisture Conservation
SOI	Survey of India
SSCAC	Sardar Sarovar Construction Advisory Committee
SSP	Sardar Sarovar Project
SSNNL	Sardar Sarovar Narmada Nigam Ltd.
SYI	Silt Yield Index
TISS	Tata Institute of Social Sciences
ToR	Terms of Reference
WB	World Bank
WHO	World Health Organisation

1. ENVIRONMENT MANAGEMENT

1.1 INTRODUCTION

Narmada is the fifth largest river of India. It is also the Largest and the least polluted, west flowing river. It's Length from Amarkantak to Arabian Sea is - 1312 Km. The mean Annual Rainfall in the basin is 1,180 mm (46.45 inches) and Average Annual Run-Off is 41,000 M.Cum (33.21 MAF). Its catchment area is about 98,000 Sq.Km, which is spread to the State of Madhya Pradesh, Maharashtra and Gujarat. The current utilization of the Narmada water is as follows (Unit in MAF):



1.1.1 Master Plan for The Development Of Narmada River Basin: NWDTA

In 1965, India appointed a committee to develop a master plan for the Narmada Basin. The riparian States did not accept the committee's recommendations. This impasse led to the constitution of the Narmada Water Disputes Tribunal in 1969 by Government of India under Inter State Water Dispute Act of 1956, for adjudication of water disputes of Narmada among riparian States. It's deliberations continued until 1979. The Tribunal considered the Sardar Sarovar Projects and the Narmada Sagar Projects together using the best hydrological, engineering, and other evidence available and passed the order, which was notified in Gazette on 16th December 1979.

1.1.2 NWDT Award

The Narmada Water Disputes Tribunal in its final award made many of the most fundamental decisions about the Projects. These included the dam location, regulation of flows, reservoir levels etc. There are decisions in the Tribunal award that bear on the environmental aspects of Sardar Sarovar Project which are summarised below:

- The utilizable quantum of Narmada waters at the Sardar Sarovar dam site is specified at 28 million-acre feet (MAF) at 75 per cent dependability.

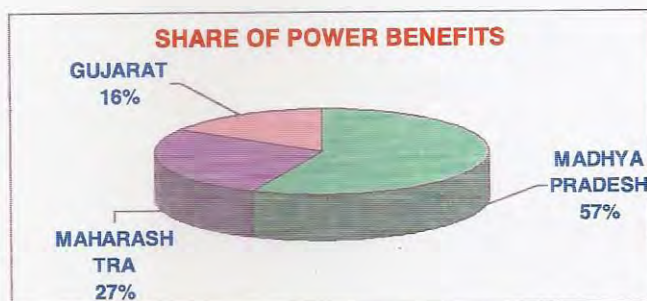
- Apportionment of water shall be 18.25 MAF to Madhya Pradesh, 9.00 MAF to Gujarat, 0.50 MAF to Rajasthan, and 0.25 MAF to Maharashtra. The apportionment/sharing of water are subject to review after 45 years
- The FSL of main canal and FRL of Sardar Sarovar are fixed. The Sardar Sarovar shall be a multi-purpose project.
- Madhya Pradesh is to provide regulated releases of water from the Narmada Sagar Projects to the Sardar Sarovar Project. Terms of the award are subject to change if there is agreement between all the States concerned.

1.1.2.1 Principal Levels and apportioning of the irrigation and power benefit's by the NWDTA

Sardar Sarovar Dam

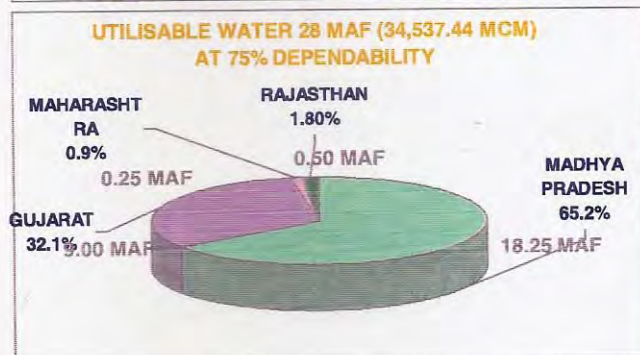
Full Reservoir Level
+ 138.68 M [+455']

Maximum Water Level
+ 140.21 M [+460']



Narmada Main Canal

Full Supply Level
+ 91.44 M [+300']



Indira Sagar Dam [M.P.].

Full Reservoir Level
+ 262.13 M [860']

Estimates of Government of Madhya Pradesh anticipate that over the next half century there will be 29 major, 135 medium, and about 3,000 minor projects in the Narmada River valley. The Sardar Sarovar, one of the first to be built on the main river, is the terminal project on the river system and its benefits and impacts, are linked to developments of Indira Sagar Project upstream.

1.2 KEY DIRECTIVES BY THE NWDT ON ENVIRONMENT & REHABILITATION

Fisheries development (NWDTA clause XI, sub-clause V (6) & (7): The NWDT direction regarding this is in Para- 5 & 7 of Sub-clause V of final order and decision of NWDT in Chapter XX of the Report of Volume II. The decision is reproduced below:

- V (6) "Notwithstanding vesting in Gujarat of the lands coming under submergence, Madhya Pradesh and Maharashtra shall continue to enjoy all rights of sovereignty intact over the submerged area in the respective States".
- V (7) "Madhya Pradesh and Maharashtra respectively shall be exclusively entitled to all rights of fishing, boating and water transportation over the part of lake over the submerged land within Madhya Pradesh and Maharashtra respectively provided, however, that such right is not exercised to the prejudice of any utilities of the legitimate performance of their duties by the project personnel".
- Monitoring of the protection shifting/relocation of the monuments of archaeological significance being affected by the submergence of Sardar Sarovar, Narmada Sagar, (NWDT clause XI-sub-clause III (4) & XIV-7,8(3)(iv).
- Studies related to downstream scenario for estimating impacts of project activities (NWDT clause IX (Vii) related to indenting of water for downstream by Gujarat.
- Clause XI {sub clause I to VI, page 110-115} deals with the provision for rehabilitation of oustees (PAFs) from submergence area of Madhya Pradesh and Maharashtra who are likely to be resettled in Gujarat or in their home states.

1.3 ENVIRONMENTAL CLEARANCE

It is recognised that the creation of reservoir will bring in environmental, social and economic impacts and that there will be changes in environmental regime in the upstream, downstream and in the command basically due to submergence and displacement of people and wildlife and irrigation in the command. Such changes are required to be assessed and evaluated for taking decision before proceeding with the project.

Ministry of Water Resources the then Ministry of Irrigation & Power had developed detailed guidelines framed during October, 1980 for project formulations which included a detailed check-list by the Ministry of Environment & Forests, the then department of Environment of the department of Science & Technology of the Government of India, for assessment of environmental impact of the projects and planning for Environmental Safeguard Measures.

In accordance with the requirement of the Department of Environment, project authorities submitted the detailed project report (DPR) along with the needed information on environmental issues during February to October 1980. Environmental Appraisal Committee of the Ministry of Environment & Forests approved the project in principle during it's 12th meeting held in 1983. More information & data on certain parameters of Environmental impact & management were subsequently provided through additional documentations

over a period of time in various stages of completeness by three states i.e. Maharashtra, Gujarat and Madhya Pradesh. The information provided was also updated from-time-to-time. The studies, action plans and data were considered at levels and the projects namely Sardar Sarovar in Gujarat and Indira Sagar in Madhya Pradesh were formally cleared from environmental angle on 24th June 1987 by the Ministry of Environment & Forests, Government of India. Permission for diversion of the forestland was also subsequently accorded for both the projects separately by the MOEF during September 1987 and October 1987. The Investment Clearance for the Sardar Sarovar and Indira Sagar Project were issued by the Planning Commission during October 1988 and November 1988 respectively, thus paving the way for implementation of these projects.

Before a formal clearance by the Ministry of Environment & Forests, Narmada Control Authority was expanded and was entrusted with the increased responsibilities in the areas of environment and rehabilitation. The clearances issued subsequent to the expansion of the NCA by the Central Government departments, contained certain conditions to be complied with during the course of project implementation regarding following parameters.

- Rehabilitation master plan
- Phased catchment area treatment scheme
- Compensatory Afforestation plan
- Command area development
- Survey of flora and fauna; carrying capacity of surrounding area
- Seismicity
- Health Aspects

The Narmada Control Authority was given the responsibility to ensure that the environmental safeguard measures would be planned and implemented in depth and the pace of it's implementation would be *pari-passu* with the progress of the work on the Projects. The four conditions of the clearance were:

- The Narmada Control Authority would ensure that the environmental measures are planned and implemented *pari-passu* with the progress of the work on the project;
- The detailed surveys/studies would be done
- Catchment area treatment and rehabilitation programs would be completed ahead of reservoir filling.
- The Department of Environment would be kept informed of progress.

1.4 FOREST CLEARANCE

In September 1987, under the Forest (Conservation) Act, 1980 the Central government gave approval for the diversion of over 13,386 hectares of forestland for the Sardar Sarovar Projects. This approval was subject to eleven conditions in all three states, of which the following are especially relevant.

- Detailed compensatory afforestation plans would be submitted.
- A proposal for non-forest areas for rehabilitation of oustees would be submitted.
- Compensatory afforestation would be in double the area of degraded forestlands in addition to the afforestation of equivalent non-forestland, and a scheme for this would be submitted.
- A catchment area treatment plan will be prepared by November 30, 1987, failing which a central government team would be appointed at a cost to the project.

1.5 INVESTMENT CLEARANCE

The Planning Commission, Government of India approved investment for an estimate cost of Rs. 6,406 crores for SSP in Gujarat vide their letter dated 15.10.88. The Planning Commission of the Government of India granted the State of Gujarat approval for the Sardar Sarovar Projects subject to seven conditions that bear on the environment (as well as resettlement and rehabilitation) which were as follows.

- Compliance with the 1987 environmental and forestry clearances;
- Adequate funding to meet the construction schedule;
- Submission of a detailed program for drainage and ground water balance studies beyond the Mahi River;
- Adoption of measures to ensure project revenue from water rates to pay for annual operation and maintenance charges;
- Setting up an expert group to study siltation in the main canal.
- Drawing up a detailed schedule and plans for the micro-level irrigation network system; and an implementation schedule for completion of the canal network so that irrigation benefit's do, in fact, start accruing from the financial investment.

1.6 SARDAR SAROVAR PROJECT

1.6.1 Salient Features of the Project

Locations	Near village Navagam, Dist. Narmada
Height	163.00 m
Length	1,210.00 m
Gross storage	9.5 (b cum) 7.70 (MAF)
Live storage	5.8 (b cum) 4.73 (MAF)
Annual irrigation	1.865 million ha.
Installed capacity	1,450 MW (1200 MW + 250 MW)
Cost of Project Rs.6, 406.00 crore (At 1986-87 price level)	Rs.13,180.62 crore (at 1991-92 price level)
Annual irrigation per hectare of submergence of cultivable land	About 165 hectare

1.6.2 Benefits from the Project.

Irrigation		Hydropower	Flood control
Gujarat	18.65 lakh ha	1450 MW	210 villages and 750,000 population of Bharuch city
Rajasthan	17.92 lakh ha		
Maharashtra	0.73 lakh ha		

1.6.2.1 Additional benefits

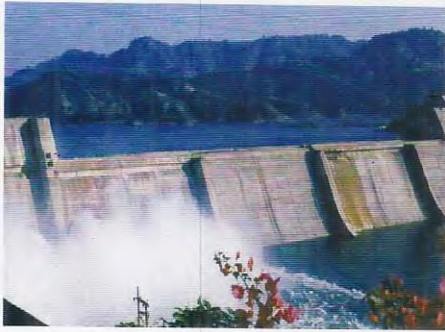
- 9 Drinking water supply to 135 urban centres and 8215 villages
- 9 Water supply for industries
- 9 Fisheries development
- 9 Wild life sanctuaries development



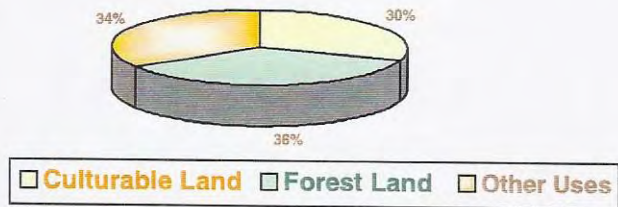
1.6.3 The Submergence

The submergence zone of the project lies within the State of Maharashtra, Madhya Pradesh & Gujarat as depicted in the table & map below.

State	Culturable land (ha)	Forestland (ha)	Land under other uses (ha)	Total land (ha)	Affected number of Affected villages	Number of PAFs
Madhya Pradesh	7,883	2,731	10,208	20,822	193	33,014
Maharashtra	1,519	6,489	1,592	9,599	33	3,213
Gujarat	1,877	4,166	1,069	7,112	19	4,600
Total	11,279	13,386	12,869	37,533	245	40,827



LAND USE PATTERN OF LAND UNDER SUBMERGENCE



1.7 DEVELOPMENTS AND CURRENT STATUS OF THE MANAGEMENT OF SSP ENVIRONMENT

The environmental clearance had suggested the following parameters for Environmental Management.

1. Resettlement & Rehabilitation.
2. Catchment Area Treatment
3. Compensatory Afforestation
4. Command Area Development.
5. Flora, Fauna & Carrying Capacity of Surrounding area
6. Seismicity and Rim Stability
7. Health

In addition during the course of the project implementation and review of the environmental planning, several more issues like archaeology, anthropology,

downstream impacts, fisheries were also identified at the instance of the environment sub-group of the NCA. The State Governments have taken steps for completing surveys / studies based on the recommendations detailed and updated Action Plans have been prepared from time to time.

Environmental planning of project like SSP is a complex issue due to vastness of area, being an interstate project, and diverse nature of environmental parameters etc. NWDT Award has fixed the location of the dam, its height and other design parameters. As per the guidelines issued from time to time and specially those issued during 1985 for environmental impact assessment and environmental management of river valley projects by the MOEF, surveys, studies have been carried out and impacts have been assessed for management of Environmental Safeguard Measures.

The present report delineates the steps taken by the project authorities towards planning and execution of the environmental safeguard measures. The current status of the implementation, summary of the works remaining to be done have also been included .

the soil survey work carried out by local forestry officers. It recommended further work to identify critically degraded sub-watersheds for priority treatment and gave advice on procedure and methodology for CAT in the Narmada basin.

The MOEF clearance subsequently granted in 1987 contained two conditions pertaining to CAT, as follows:

- More detailed surveys for prioritisation of the sub catchments in the SSP area should be undertaken;
- A phased CAT programme should be prepared and implemented ahead of reservoir filling.

2.1.2 Source of Erosion and Objectives of CAT

Erosion occurs when ground surfaces, which are not stabilised by vegetative cover, are exposed to the elements of nature and topsoil is carried away by wind or rainwater run-off. The principal areas where high rates of erosion prevail in SSP catchment are:

- Soils with none or little vegetative cover within the SSP catchment.
- Steep slopes which are farmed without precautions to prevent erosion
- Areas of overgrazing.

CAT in the Narmada catchment will involve re-vegetation of barren areas and physical measures to protect unstable surfaces. These will give rise to a number of direct and indirect benefit's, including:

- Increased supply of fuel, fodder, minor forest products and small timber to the local population;
- Increase in sub-soil moisture regime;
- Increase in agricultural productivity;
- Increase in green cover and resultant increase in carrying capacity for wildlife.

2.2 IMPACTS AND MANAGEMENT

2.2.1 Studies and Findings

Studies

Surveys and studies have been undertaken to aid the development of a management plan for CAT in the SSP catchment which have dealt with the following topics:

2. CATCHMENT AREA TREATMENT

2.1 THE ISSUE

2.1.1 Context

The conservation of soil cover is a major environmental priority in the Indian sub-continent, where there is an increasing need to extend the area under cultivation and to improve efficiency in agricultural practice. Much of the land area under cultivation is former forest. Use of this land, plus the overexploitation of the remaining forest for fuel wood and timber has caused deforestation, particularly in heavily populated areas. Forest fires, overgrazing and inappropriate agricultural practice have in turn lead to soil erosion on formerly afforested land, reducing it's productivity land further degrading the natural vegetative cover. To slow the rate of erosion, soil conservation measures are needed on an estimated 175 million has of agricultural, forest and other lands in India. This area represents 53% of the total inland territory of the country. Any part of the country falls in catchment area of some river valley project or the other.

Eroded soil from the catchment of an impounded river is carried into the reservoir by run-off water where it is deposited as Sediment, which reduces its capacity and useful life. Initial surveys have revealed that the SSP reservoir rim is generally stable land unlikely to yield high levels of sediment. All the erosion products from catchment of a reservoir do not reach it. Productive life of a reservoir is estimated based on loss of its capacity due to such deposition. Notwithstanding the provision of loss of capacity in the economic analysis of a project, GOI issued a directive in June 1992 that, for the SSP, the Project would bear the costs of the treatment of all critically degraded Sub-watersheds draining directly into the reservoir. Critically Degraded watersheds were those, which The All India Soil and Land Use Survey Organization (AISLUSO) have classified as either "Very High" or "High" priority sub-watersheds in SSP catchment. The project would also be responsible for the treatment of those areas of the catchment, which would be directly damaged by the project activities.

In addition, plans are to be prepared by the States for the treatment of the balance of the critically degraded watersheds but the cost for such treatment will be met from respective land use department and in a timeframe to be determined. In India, there are many ongoing activities for CAT under watershed development programmes. These projects are controlled and coordinated by the MOA, for agricultural lands, and the MOEF for forest lands. When the SSP authorities applied for clearance from the MOEF in 1983, a preliminary survey of the state of the soil in the catchment was requested and in response, a rapid reconnaissance was undertaken, the results of which were submitted in 1985. The Committee reviewed proposals for CAT submitted by the three States, and

Prioritisation of Sub-watersheds

Category	No. of Sub-watersheds	Area (ha)	% of Total Area
Very high	123	278.309	11.4
High	159	415.282	17.0
Medium	262	656.456	26.8
Low	313	730.575	29.9
Very Low	171	354.541	14.9
Total	1,028	2,445.163	100

2.2.2 Proposed Measures for CAT

The MOA has carried out catchment treatment work in many areas of India and has developed detailed guidelines for CAT in all kinds of terrain. The States of Gujarat, Maharashtra and Madhya Pradesh have selected treatment regimes for SSP priority areas from these guidelines taking into consideration:

- ☐ The land use of the sub-watershed;
- ☐ The topography;
- ☐ The needs of the local tribal people;
- ☐ The soil type;
- ☐ The vegetative cover;
- ☐ The traditional agricultural methods in the area.

There is considerable variation in the sub-catchment types in the SSP catchment, a variety of measures were, therefore, selected for CAT in the three States. These may be summarised as follows:

Mechanical Measures

These comprise physical barriers to reduce the velocity of run-off of rainwater and to interrupt the erosion cycle by reducing the steepness of slopes, including:

- ☐ Gully plugging;
- ☐ Construction of check dams;
- ☐ Digging contours and V-shaped furrows.

Agronomic Techniques

These involve both specific farming practices and the use of vegetation for the stabilization of soils and the reduction of run-off velocity including:

- ☐ Intensive afforestation;
- ☐ Rehabilitation of degraded forest;
- ☐ Pasture development;
- ☐ Protection of existing tree growth.

- Mapping of the types and quality of soils;
- Reporting on the present status of the study areas;
- Prioritising the sub-watersheds for treatment;
- Recommending treatment methods.

These studies included the following:

- Report of Inter-Departmental Committee on Soil Conservation and Afforestation: (the Dewan Committee Report), 1985 presented the findings and recommendations of an inter-departmental committee set up by the Ministry of Agriculture to:
 - ▢ Report on conditions in the catchment:
 - ▢ Suggest soil conservation and afforestation measures and
 - ▢ Prepare a phased programme of work and financial outlays.
- Report on Prioritisation of Sub-watersheds in Sub-catchments of Narmada Catchment, 1991 presents the results of a three-year study conducted by AISLUSO in accordance with the recommendations of the Dewan Committee. The catchment of Sardar Sarovar was divided into eight sub-catchments and each of these was further sub-divided yielding a total of more than one thousand sub-watersheds. These were then subject to detailed survey to establish the potential for erosion through consideration of such factors as slope, vegetative cover, soil characteristics, surface condition, physiography etc. This information was used to prioritize the sub-watersheds for CAT.

Findings

The outcome of the study by AISLUSO to prioritize sub-watersheds is presented in Table below, which includes all sub-watersheds above the SSP and below the ISP (i.e. the catchment of SSP, Omkareshwar Project and Maheshwar Project). About 28% of the total catchment area prioritized falls into the 'very high' and 'high' categories most susceptible to erosion.

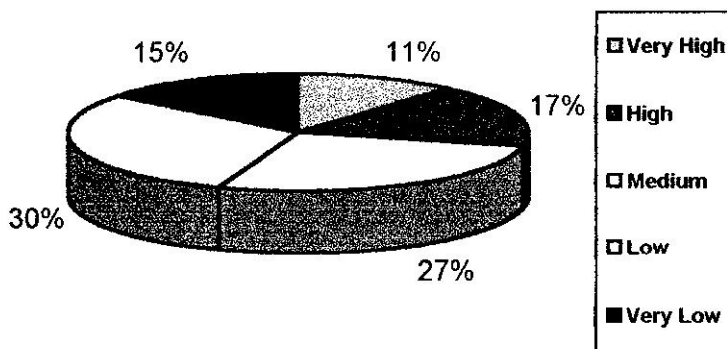


Plate-I

LEGEND

- Photo No.1 : Panoramic view of Narmada Catchment**
- Photo No.2 : Degraded Sub-watershed in Maharashtra**
- Photo No. 3 : Sub-watershed planted up in M.P.**
- Photo No. 4 : Gully plugs**
- Photo No. 5: Run-off management structure in M.P.**
- Photo No. 6 : Plantation works in Gujarat**

PLATE - I



2.3 ACTION PLANS

Project authorities were required to prepare the plans, as *Phase-I* programme, for treating those critically degraded sub-watersheds, which were identified as *directly draining* into the reservoir. The balance sub-watersheds were to be treated in *Phase-II* programme.

Particulars			Madhya Pradesh	Gujarat	Maharashtra	Total
Very High & High	Planned to Treat	Phase-I	125725	29157	24298	179180
		Phase-II	349892		77568	427460

Table 1: Area Statistics of Very High & High Priority Sub-watersheds in the Catchment of Sardar Sarovar Project

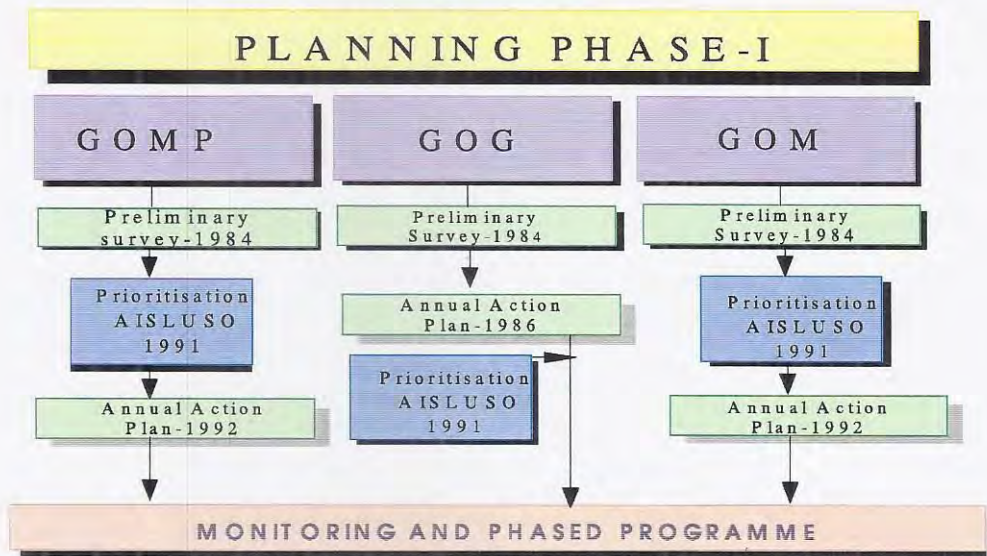


Fig. Flow chart of CAT phase-I planning by Gujarat, Madhya Pradesh and Maharashtra

2.3.1Phase-I: Directly draining sub-watersheds

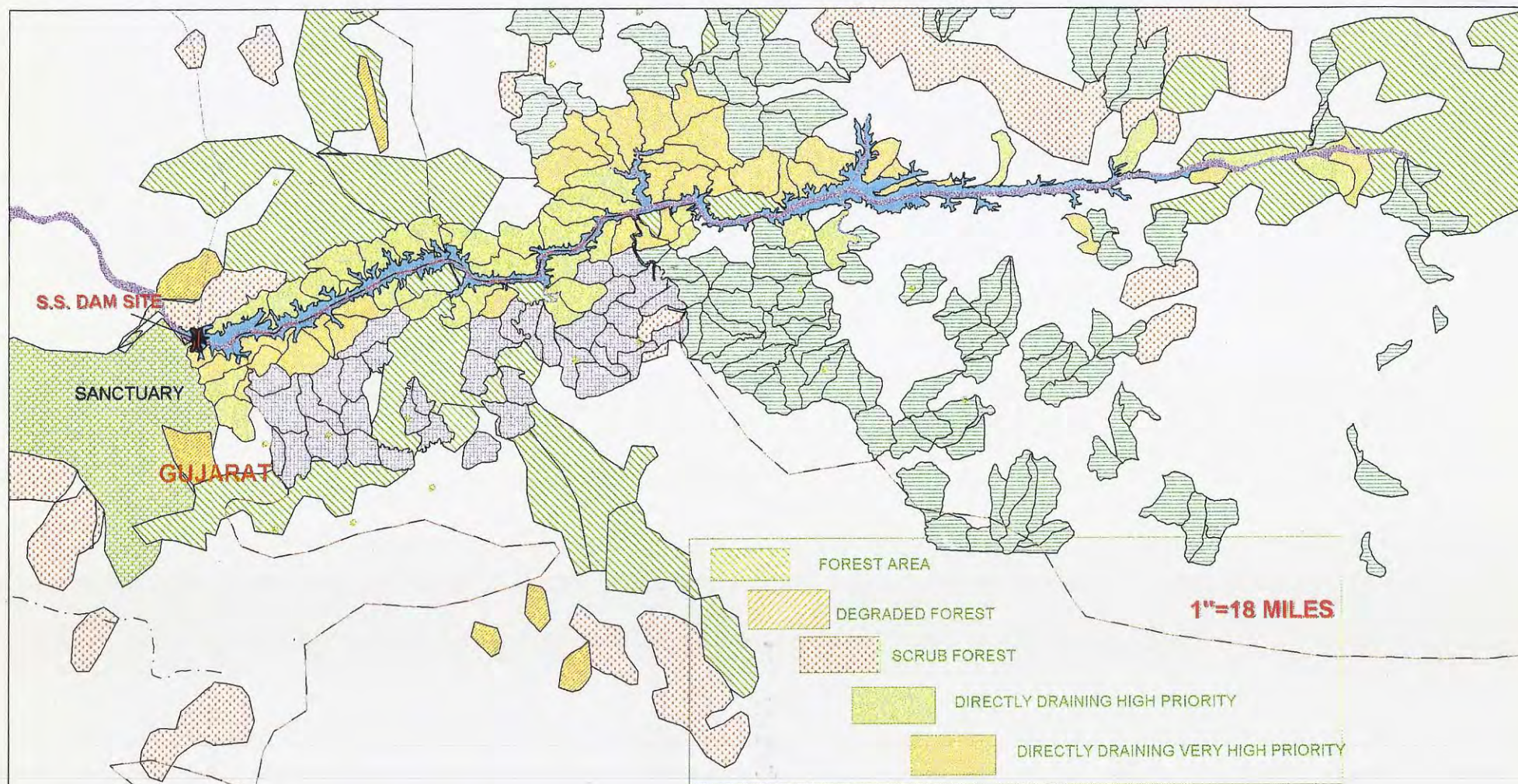
Project authorities have prepared the plans for treating total area of 1,79,180 ha as shown in the table above. This area is required to be treated *pari-passu* with the project works. The project authorities have submitted the Action Plans in varying stages of completeness. These plans contained information related to survey work, management options, monitoring and phased programme of treatment besides provisions for annual budget.

Key components of the Action Plan, which includes timetable, menu, budget etc. received from GOG, GOMP, and GOM, are depicted in Figure below

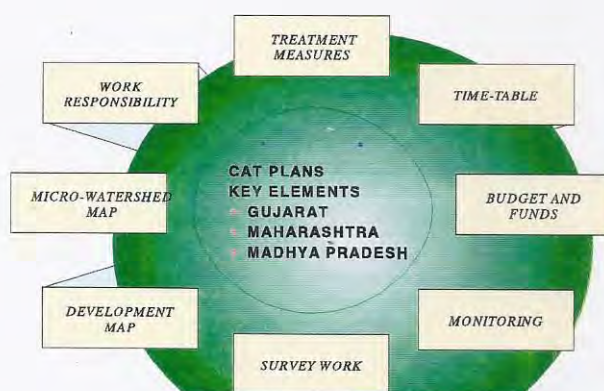
Plate-II

LEGEND

Status of forests in the SSP area of the basin and the Phase-I and Phase-II sub-watersheds under treatment in Madhya Pradesh, Gujarat and Maharashtra.



SARDAR SAROVAR SUBMERGENCE AREA; SOILMOISTURE CONSERVATION WORKS IN THE VICINITY OF THE SUBMERGENCE STATUS OF VEGETATIONAL COVER IN THE SURROUNDING AREAS; FLORA, FAUNA AND CARRYING CAPACITY ASPECTS



Action Plan components.

Principal Elements of Micro-watershed plan

- o Survey work
- o Preparation of detailed map
- o Micro-watershed development map
- o Assignment of responsibility for conducting the work
- o Time table
- o Budget
- o List of species to be planted
- o Proposals for monitoring
- o Proposals for involving local people agricultural land
- o Proposals for involving local people in forestlands

2.3.1.1 Gujarat

GOG accepted the recommendations of the Dewan Committee and decided to treat the entire catchment area without waiting for the prioritisation of the sub-watersheds by AISLUSO. An Action Plan for CAT was included in their Work Plan for Environmental Effects submitted in 1986 for implementation by their Forest Department. This plan was reviewed and up-dated by the Forest Department in the light of the results of a stock mapping survey and thematic mapping work. Thematic mapping was carried out under the guidance of the Indian Space Research Organization using satellite imagery provided by Indian satellite IRS-IA and corroborated with French satellite System Pour Observation de la Terre (SPOT). A revised programme for CAT was developed by dividing the forest within the catchment area into three categories according to the density of tree cover. On areas with good cover only mechanical measures for soil conservation were deemed necessary. More degraded areas will, in addition, be subject to afforestation and the density of planting being determined by the extent of degradation. The treatment work in the forest area was carried out by the Forest Department, GOG. In addition, there are more than 3,000 ha of non-forestland, almost all of it is agricultural land and mainly privately owned. Out of which only 1953 ha area is treatable. The Agricultural Development Corporation, GOG, carried out the treatment work in the agricultural area.

Table below shows the gross area of watershed where treatment was carried out in Gujarat.

Existing Forest Cover	Area Treated (ha)	Treatment Given
Category 1 (canopy cover <0.4)	12,638	Mechanical plus 2,000 plants/ ha.
Category 2 (canopy cover 0.4-0.6)	11,922	Mechanical plus 400 plants/ ha.
Category 3 (canopy cover >0.6)	2,644	Mechanical only.
Non-forest areas	3,025	Mechanical plus pasture/ afforestation.
Total	30,229	

2.3.1.2 Maharashtra

GOM prepared an Action Plan for CAT in forest and non-forest areas based on the available survey reports, which were submitted to MOEF in 1988. Implementation awaited the outcome of survey by AISLUS to priorities the catchments. After publication of the AISLUSO survey results in 1991, GOM submitted revised Action Plans for the treatment of those 'very high' and 'high' priority sub-catchments draining directly into the reservoir. As in Gujarat, catchments were divided into three categories for treatment, although to take account of the specific conditions in Maharashtra, the slope was considered in addition to the percentage forest cover.

2.3.1.3 Madhya Pradesh

A large proportion of the catchment (around 80%) in Madhya Pradesh is privately owned agricultural land. The topography of this area is mainly mild and mature, steep slopes are not common, mechanical and vegetative barriers were to be erected in these areas. The State Government had prepared a detailed plan for treating these areas in 1991-1992. The plan was for 10 years period with treatment of about 10,000 ha of forest areas and 15000 ha of agricultural areas annually. The plan classified forest areas into three groups:

- ≡ Areas having very low existing tree density which will be brought under intensive planting
- ≡ Areas where the density of existing forest is comparatively high which will be treated under a programme of rehabilitation of degraded forests:
- ≡ Forest and non-forest areas unfit for seedling planting which will be developed for pasture.

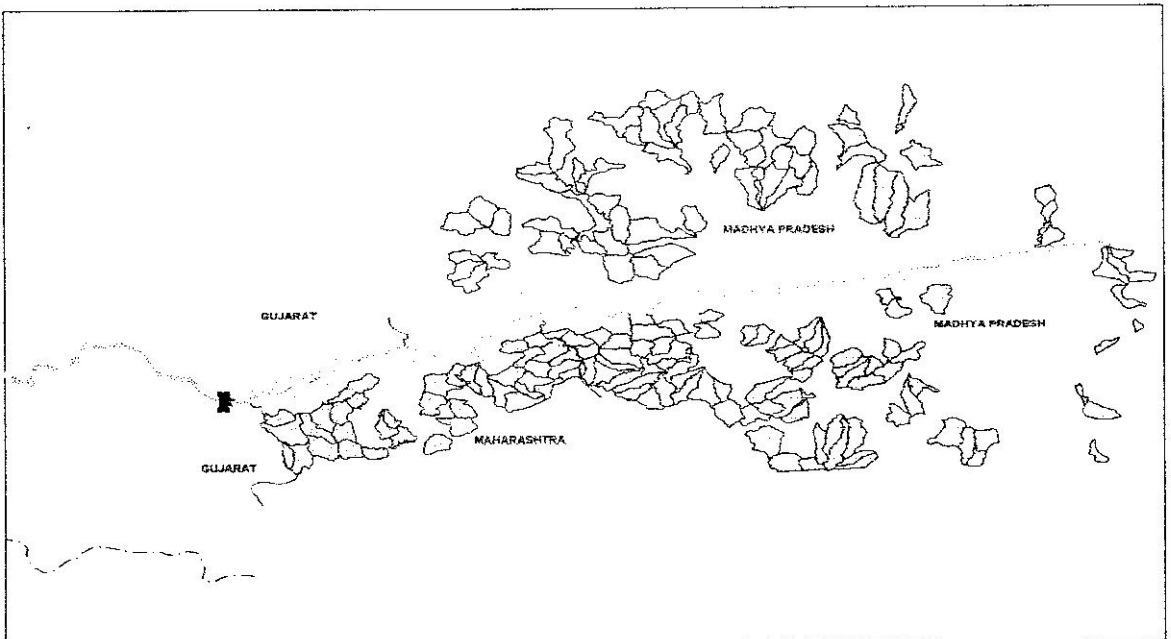
The Action Plan details methods for planting and species to be used. It also notes that the catchment area proposed for treatment is highly degraded.

Most of the area is devoid of ground vegetation with the result that it is not suitable for performing normal soil and water conservation functions. Mechanical measures to prevent erosion were used wherever considered necessary, including:

- Gully checks
- Loose boulder checks
- Stop dams
- Loose boulder traps
- Storage tanks

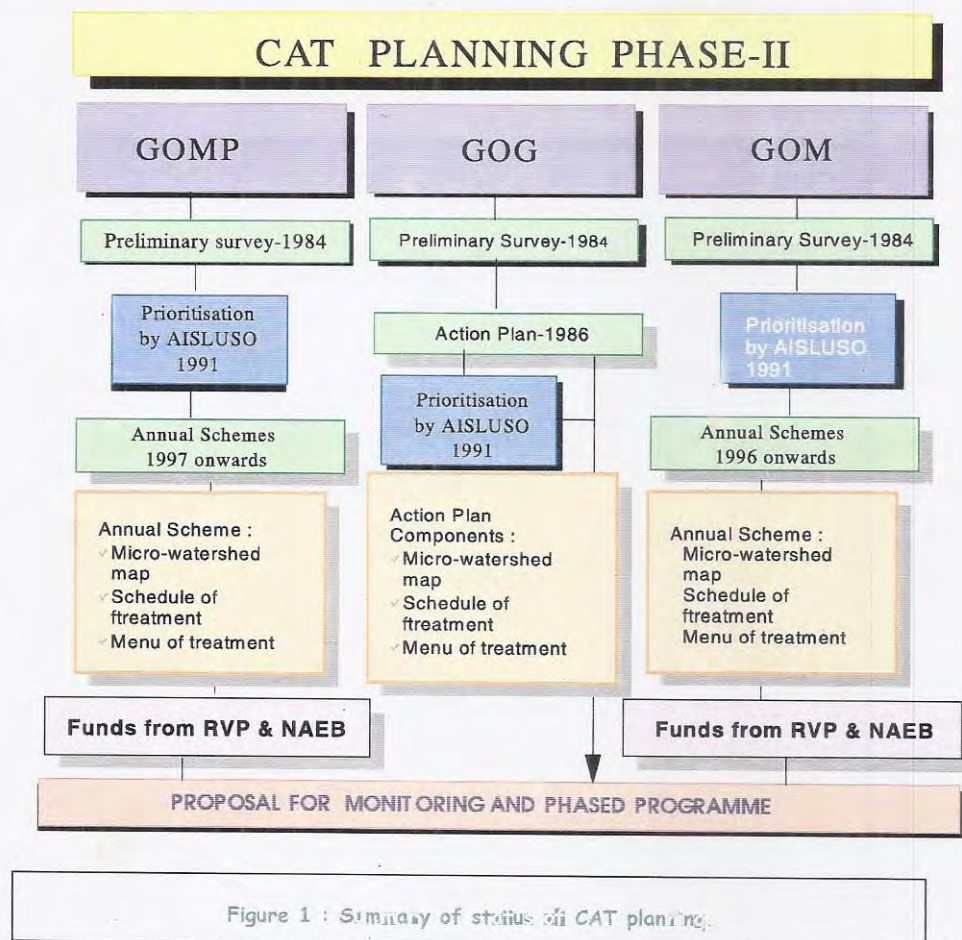
2.3.2 Phase-II: Indirectly Draining Sub-Watersheds:

Project authorities were required to prepare plans for treating balance of the critically degraded sub-watersheds. Planning Commission has agreed for inclusion of Narmada River catchment for treatment under its programme of River Valley Project Scheme being operated by the Ministry of Agriculture. MOEF also promise funds from National Afforestation and Eco-Development Board. The plans are being prepared in a phased manner in accordance with the guidelines of the funding agencies. The MOA under its RVP scheme, and NAEB have approved some of these plans.



Map showing indirectly draining sub-watershed (Phase-II) within the Catchment of the SSP

The planning process is summarised in the figure below :

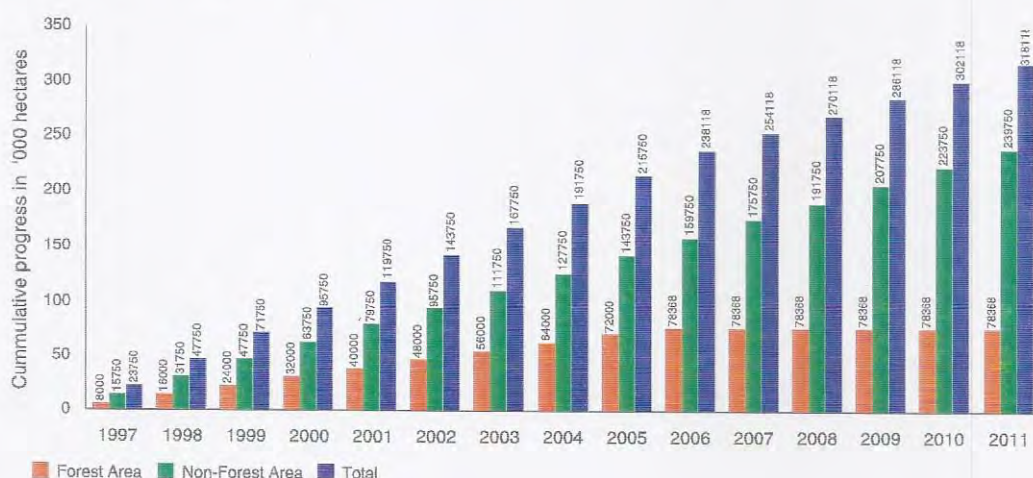


2.3.2.1 Madhya Pradesh:

Catchment area of Sardar Sarovar Project below Narmada Sagar in Madhya Pradesh is 5,44,505 ha. This area includes the freely draining area attributable to Jobat, Man, Maheshwar, and Omkareshwar Projects also as per the details given in the table below. After subtracting such areas, the gross area of critically degraded sub-watersheds is 4,75,617 ha. Out of this, Government of Madhya Pradesh has prepared plans for treating 1,25,725 ha area, as Phase-I already described above, under directly draining category at the cost of the project. Therefore, the gross area for which plans are required to be submitted for Phase-II programme is 3,49,892 ha.

Total Area of Freely Draining Critically Degraded Sub-watersheds			5,44,505 ha
Project	Phase-I (Directly Draining)	Phase-II (Balance Area)	Total Area
Jobat			28,211
Man			12,720
Maheshwar			13,209
Omkareshwar			14,748
SSP	1,25,725	3,49,892	4,75,617
		Total:	5,44,505

Project authorities have prepared schedule for treating the 3,49,892 ha of catchment spread over 139 sub-watersheds by the end of year 2011. which is given in Bar Chart indicating that GOMP would treat about 20,000 – 25,000 ha area per year. However, annual micro-watershed plans are prepared by the state government and got approved by MOA under its RVP schemes according to the availability of budget.



2.3.2.2 Maharashtra

Government of Maharashtra have prepared a macro-watershed plan for 77,568 ha in Phase-II of CAT works, out of total 80,881 ha in 35 sub-watersheds. Apart from this, separate micro-watersheds plans are prepared for forestland and non-forestland. Micro-watershed plans for forestland in all 35 watersheds have been submitted, which covers 42,867 ha area.

2.4 IMPLEMENTATION

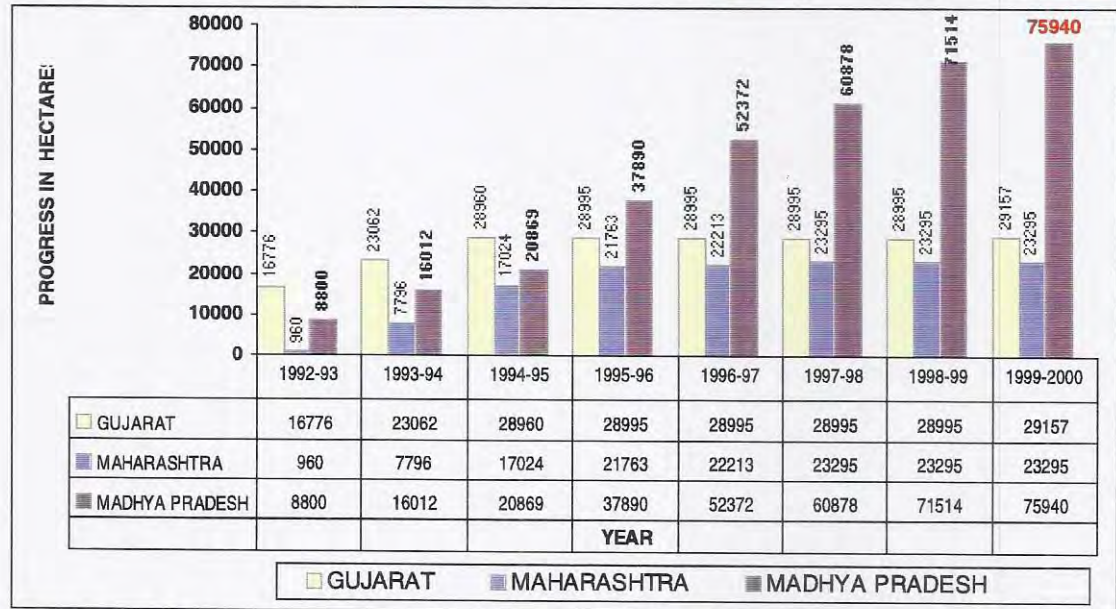
2.4.1 Phase-I: Directly Draining Sub-Watersheds:

Project authorities had planned for treating 1,79,180 ha area in about 10 years time. Government of Gujarat started the treatment works w.e.f. monsoon of 1990 whereas Government of Maharashtra and Government of Madhya Pradesh could start the work in the year 1992. The progress of treatment work is detailed in the table and the bar chart drawn below:

Area under treatment 1,79,180 ha **Progress** 1,28,230 ha **Balance** 50,788 ha

Year wise progress of CAT Works

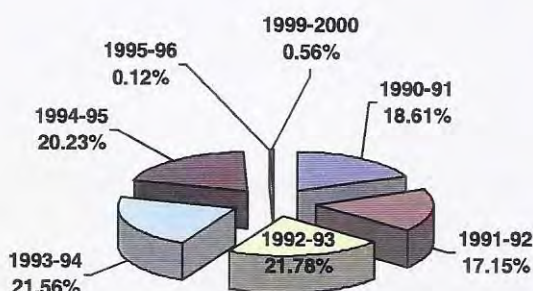
YEAR	GOG			GOM			GOMP		
TARGETS	F A 27204	N FA 1953	TOTAL 29157	FA 21122	N FA 3176	TOTAL 24298	F A 51930	N FA 73795	TOTAL 125725
1990-91	4,528	898	5,426	0	0	0	0	0	00
1991-92	4,770	230	5,000	0	0	0	0	0	0
1992-93	6,014	336	6,350	960	0	960	0	8,800	8,800
1993-94	6,000	286	6,286	6,514	322	6,836	966	6,246	7,212
1994-95	5,730	168	5,898	6,542	2,686	9,228	4,263	594	4,857
1995-96	0	35	35	4,735	4	4,739	N/A	N/A	17,021
1996-97	0	0	0	450	0	450	N/A	N/A	14,482
1997-98	0	0	0	1082	0	1082	N/A	N/A	8,506
1998-99	0	0	0	0	0	0	N/A	N/A	10,636
99-2000	162	0	162	0	0	0	N/A	N/A	4426
Total	27,204	1,953	29,157	20,283	3,012	23,295	N/A	N/A	75940



Bar Chart-1: Cumulative progress of the CAT works in the States of Madhya Pradesh, Gujarat and Maharashtra

2.4.1.1 Gujarat

As the Catchment area of Sardar Sarovar was little in Gujarat, GOG accepted the recommendations of Dewan Committee and commenced the work of treating entire catchment area in the year 1990. By the end of 1994 forest area of 27,042 ha and non-forest area of 1,953 ha were treated. Treatment work was completed by 1995-96. Graphic presentation of the progress is given in the *chart*.



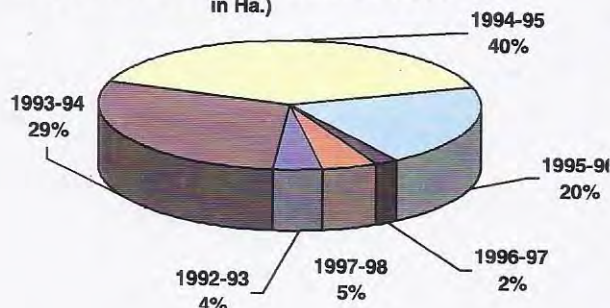
Progress of CAT Phase I in Gujarat (Area in Ha.)

The plan envisaged completion of the programme in a five-year period commencing 1989, however, the treatment works were completed by the end of March 1996.

2.4.1.2 Maharashtra:

Treatment works in Maharashtra could commence in the year 1992. By the end of March, 1998 forest area of 20,283.47 ha and non-forest area 3,011.86 ha were treated. Graphic profile of the progress is given in *chart*.

Progress of CAT Phase I in Maharashtra (Area in Ha.)

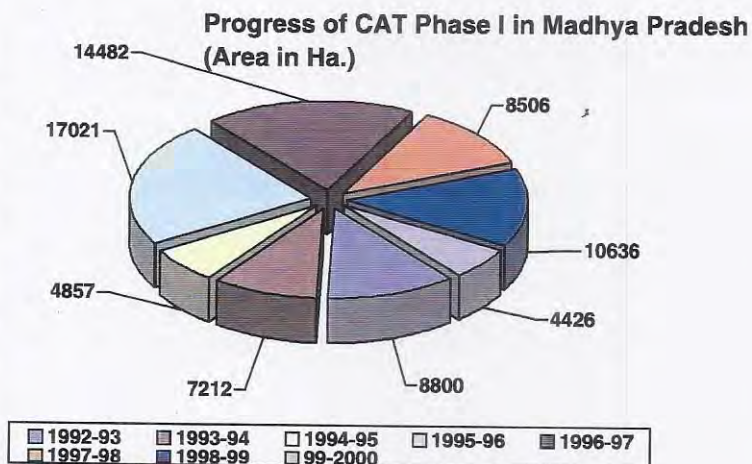


Maharashtra could finalise its Action Plan when the results of the AISLUS survey became available. GOM prepared detailed Action Plans separately for agricultural and forest areas, which were submitted in 1992. However, the work has a delayed start due to agitation by those opposed to the project. Besides as, in Maharashtra, a substantial part of the CAT area is in fact is

designated forest, which has been encroached and used for agriculture by local people. These people reluctantly allowed local forestry officers onto 'their' land as they feared that, if CAT works were carried out on the land occupied by them they might lose their holding and claim for regularization. Nevertheless, work commenced during the year 1993 in the areas free from dispute and was completed for all the areas by March 1997.

2.4.1.3 Madhya Pradesh

Treatment works in Madhya Pradesh could commence after submission of the revised work plan in 1992. 75,940 hectare of land including both, forest and non-forest areas was treated-up by the end of March 2000. Progress is depicted in chart.



Madhya Pradesh submitted a detailed Action Plan for Catchment Area Treatment in 1991 and its implementation started simultaneously. However, the targets could not be met due to failure of the monsoon and a revised plan was prepared. Work is proceeding according to the re-revised schedule by the end of March, 2000, 75940 ha of land was treated. The entire programme is scheduled to be completed by March 2002.

2.4.2 Phase-II: Indirectly Draining Sub-Watersheds:

2.4.2.1 Maharashtra

Ministry of Agriculture, GOI has approved 13 micro-watershed schemes covering an area of 15,656 ha. and GOM has completed the treatment over an area of 7,854 ha by the end of March 2000.

2.4.2.2 Madhya Pradesh

Project authorities have submitted schemes covering 30,881 ha of the catchment to RVP schemes, of which 23,211 ha area was proposed to be treated at a cost of Rs.1,062.67 lacs. GOMP has completed the treatment over an area of 9,973 ha by the end of March 2000.

2.4.3 Assessment of the Success of Implementation:

The long-term success of implementation of CAT measures depends on the cooperation and involvement of local residents and local interest groups. This is achieved through consultations between the implementing agency and the District Land Improvement Committee. Before any CAT work can be undertaken, the implementing agency presents a proposal to the Committee giving such details as:

- Area and location of the sub-watershed:
- Physical and soil characteristics:
- Likely benefits of CAT work:
- Present land-use details:
- CAT treatment menus based on survey results.

The Committee must approve these proposals before CAT work could commence. In addition, where the land is privately owned, as is all agricultural land, the owner must give consent. If the owner has objections the Committee will consider them and negotiate on his behalf with the implementing agency. Where CAT is to take place on encroached forestland, however, there is no requirement for consultations with farmers, (although work can obviously take place if participation and cooperation of local people is obtained).

Overall responsibility for the monitoring and quality control of CAT work belongs to the NCA. The arrangements for monitoring are similar to those for CAF. Although, because large amount of agricultural land is contained in CAT areas in Madhya Pradesh, the Chief Agricultural Officer of the state will also have a duty to oversee implementation. In summary five officers along with the NCA officers are involved in the monitoring and production of reports for the Chairman of the Environment Sub-Group of the NCA. These are:

- In Gujarat, the Chief Conservator of Forests of the SSNNL and the Secretary (Environment & Rehabilitation) GOG
- In Maharashtra, the Chief Conservator of Forests (the Nodal Officer)
- In Madhya Pradesh, the Member (Environment and Forests) of the NVDA and the Director, Catchment Area Treatment of NVDA.

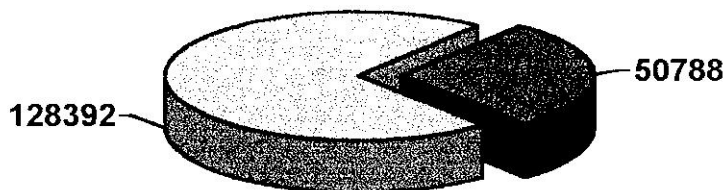
2.5 SUMMARY OF WORK TO BE DONE

Balance Targets for Phase-I

Against the planned target of 179,180 ha of CAT works for the SSP as a whole, an area of 1,28,392 ha was treated up by the end of March 2000. It is proposed that the balance area as shown in chart and detailed in the table given below should be treated by March 2002.

+

□ Progress upto March, 2000 ■ Work remaining



ITEMS	GUJARAT			MAHARASHTRA			MADHYA PRADESH		
	F.A.	N.F.A.	TOTAL	F.A.	N.F.A.	TOTAL	F.A.	N.F.A.	TOTAL
TARGET	27204	1953	29157	21122	3176	24298	51930	73795	125725
WORK DONE	27204	1953	29157	20283	3012	23295	N/A	N/A	75940
Balance	0	0	0	839	164	1003	N/A	N/A	49785

Phase-II

Action Plans for the treatment of other high priority sub-watersheds were also prepared and submitted by the Govts. of MADHYA PRADESH and Maharashtra. Later these plans were redrafted according to the guidelines of the funding agencies like National Afforestation and Eco-Development Board, RVP Schemes of the Planning Commission. Submission of these plans, approval by the funding agencies and implementation by the concerned States is well underway. Institutional structures are in place and functioning for the monitoring and quality control of implementation. It remains to be ensured that State Governments submit annual programme for treating Phase-II areas and frame schemes on year-to-year basis to the funding agencies in time, according to the availability resources and manpower.

3. COMPENSATORY AFFORESTATION

3.1 THE ISSUE

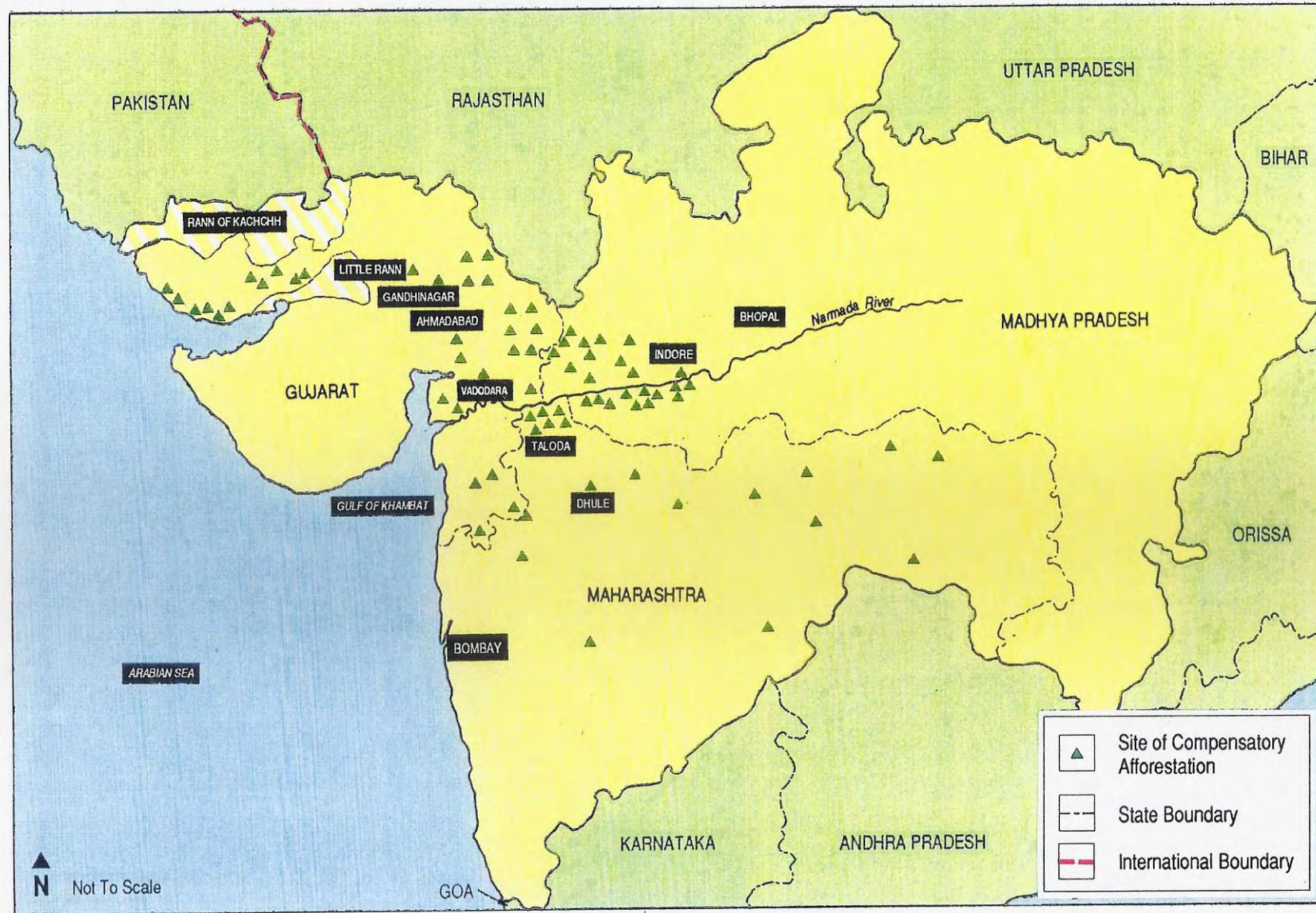
3.1.1 Context

The forests of India provide fuel and timber for the people and habitat for a diverse fauna. This resource is increasingly threatened in modern times, due to exploitation by the fast growing rural population and to a lesser extent, by the pressures of development in several socio-economic sectors.

To preserve and enhance its forest resources, GOI has taken a number of measures for extensive and intensive afforestation programmes within and outside its forest areas. It has also framed policies for forest protection, including measures designed to enable the participation of the local population in forest management. In addition, to ease the pressure of development on forests, the Forest Conservation Act (1980) places restriction on the transfer of land designated as forest for development without prior clearance from MOEF. MOEF considers the cases for diversion of forestland on merit within the provisions of the Forest Conservation Act. Clearance if granted, is subject to the condition that Compensatory Afforestation (CAF) be undertaken on an area of land equivalent to the area of forest submerged. The usual requirement is that for every hectare of designated forest taken, one hectare of non-forestland should be afforested and declared as forest or, if suitable non-forestland is not available within the entire State, two hectare of degraded forest should be reforested.

Approval for the diversion of forestland for the SSP was granted by the MOEF in 1987, 1990 and in 1993 (including for R&R works) but 11 conditions were attached relating to the planning and conduct of CAF and other measures to protect the existing forest. Principal amongst these were the following stipulations

- For every hectare of forestland submerged or diverted for construction of the project there should be Compensatory Afforestation on one hectare of non-forestland plus reforestation on two hectare of degraded forest.
- For the 4,200 ha of forestland in Maharashtra, which is to be used for R&R, an equal area of non-forestland or double the area of degraded forestland should be planted.
- The governments of the three states involved should prepare plans detailing their proposals for Compensatory Afforestation and submit these to the MOEF before work in the forest area is due to commence.
- The project should supply firewood to its construction workers, at its own cost, to prevent them from having to meet their fuel needs from the surrounding forests.



3.1.2 Forest Loss

Forestland taken up by the SSP is follows:

A total of 13,386 ha of land designated as forest in Gujarat, Maharashtra and Madhya Pradesh will be submerged by the reservoir in Gujarat about 357 ha of designated forest will be required for the construction of the dam and the delivery and drainage system. 4200 ha of the Taloda forest in Maharashtra is diverted for the Resettlement and Rehabilitation of people displaced by the project .

3.2 IMPACTS AND MANAGEMENT

3.2.1 Studies and Findings

Studies

There have been a number of studies in three States aimed at assessing the extent and significance of the loss of forestlands attributable to the SSP.

- Sardar Sarovar (Narmada) Project Development Plan, Volume II prepared by the Narmada Planning Group (NPG) in 1983 contained a chapter on the various environmental aspects of the SSP. Details of land use and forest cover derived from aerial photography were included.
- Studies on Ecology and Environment by MS University of Baroda (MSU) in 1983, used satellite photography, statistical sampling techniques, and an extensive programme of field work to determine the density, species composition and productivity of forests in the submergence area of Gujarat.
- Sardar Sarovar Project: Preparation of Environmental Work Plan by the Forests Department of Maharashtra in 1988 was a survey listing all-important flora in the submergence area of Maharashtra.
- Eco-Environmental and Wildlife Management Studies on the Sardar Sarovar Submergence Area in Gujarat reported on work done between November 1989 and May 1992 by MSU. This provided more detailed reports on the status of the forests in the submergence area and environs of Gujarat.
- Impact Assessment of Madhya Pradesh Land to be submerged under Sardar Sarovar Project and Adjoining Ecosystems. The study was conducted by the State Forest Research Institute (SFRI) in Jabalpur. A detailed analysis of the growing stock and species composition of forest to be submerged besides survey of some of the socio-economic parameters was conducted. This report was submitted during 1994.

- Status of Flora and Fauna in and around Sardar Sarovar Project, Maharashtra by the University of Pune was submitted during 1997. It has used satellite imagery and GIS techniques coupled with an extensive programme of fieldwork to report on the density and species composition of forest area in Maharashtra.

Findings

The MSU studies demonstrated that the forests in the submergence area of Gujarat are of low density and quality. Although they could be classified as dry deciduous teak forest and must once have supported a rich fauna but pressure from human activities and soil erosion has reduced these areas to low productivity, highly degraded forest.

In Maharashtra the forest areas in the submergence zone are contiguous with those of Gujarat on the south side of the Narmada and are in the same poor condition. Reports by the University of Pune and field visit's by NCA officials suggest that overexploitation, encroachment by people for agriculture and consequent erosion has reduced much of the area to a highly degraded state. The forests to be used for resettlement in Maharashtra are also heavily degraded so that of the total designated forest area to be diverted in Maharashtra, less than 50% had significant tree cover.

Reports from Madhya Pradesh suggested that the situation is similar there. Fires, over grazing and shifting cultivation have led to degradation of the forest and caused erosion. Study by the SFRI indicated that the SSP submergence areas in Madhya Pradesh were very highly degraded and in only a small patch of 2,732 ha of very poor quality forest most of which was hacked, pollarded and damaged, was to be submerged by the SSP reservoir. Ground flora such as grasses, herbs and shrubs were altogether absent in some areas, and under-stocked, small and bushy in others. In the absence of vegetation cover and due to scarcity of water holes and the lack of fodder, the area harbours little or no wildlife of value.

3.2.2 PROPOSED MANAGEMENT MEASURES:

The SSP will compensate for forestlands taken by the projects with CAF as specified by the MOEF. This involves a programme of tree planting in the three states of both non-forest and degraded forest areas as shown in Table and illustrated below.

Areas for Compensatory Afforestation

	Area of Forest taken by SSP	Area of Degraded Forest to be Replanted	Area of Non- Forestland to be Afforested	Total Area for CAF
	Ha	Ha	Ha	Ha
Gujarat	4,523	9,300	4,650	13,950
Maharashtra*	9,188	12,980	9,190	22,170
Madhya Pradesh	2,732	6,547	2,190	8,737
Total	16,443	28,827	16,030	44,857

3.3 ACTION PLANS

In compliance with the conditions set by the MOEF, each State had prepared an Action Plan for the CAF of areas within its boundaries.

The project made arrangements to supply firewood to its construction workers, at its own cost, to prevent them from having to meet their fuel needs from the surrounding forests. Following documents were submitted :

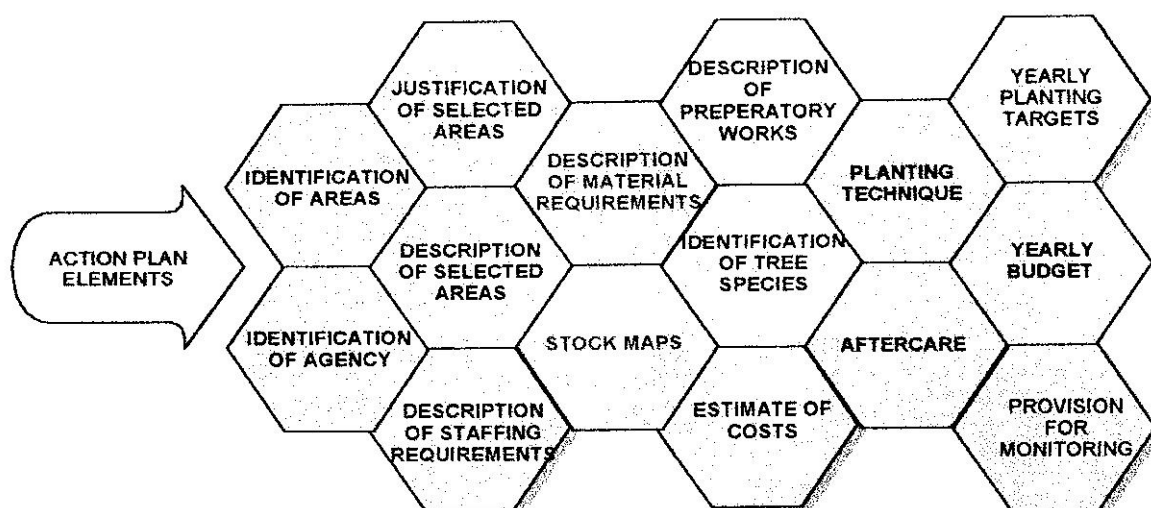
- Government of Gujarat Work Plan for Management of Environmental Effects, Section on Forests and Wildlife: The Compensatory Afforestation Plan for the Rann of Kachchh .
- Project for Afforestation in Sardar Sarovar Project Impact Areas due to Diversion of Forestlands for Sardar Sarovar Project (GOG).
- Compensatory Afforestation Scheme in lieu of Sardar Sarovar Project in Dhule District, Maharashtra State.
- Government of Madhya Pradesh Forest Department Action Plan of Compensatory Afforestation for Sardar Sarovar multi-purpose river valley project .

Contents of the final plans are depicted below :

3.3.1 Action Plan Elements

- Identification of areas for CAF
- Description of selected areas
- Justification of selection of areas
- Identification of responsible agency
- Description of staffing requirements
- Description of material requirements
- Estimate of costs
- Identification of tree species
- Description of preparatory work needed
- Description of planting techniques

- Provision for aftercare
- Yearly planting target
- Yearly budget
- Provision made for monitoring implementation
- Involvement of the local population



The three States have provided land, as far as possible within the immediate vicinity of the project affected areas. In Gujarat, however, there was insufficient suitable non-forestland available owing to the large areas set aside for catchment treatment and other project related work. For this reason, land away from the catchment of the Narmada was selected for plantation including areas within the Rann of Kachchh – an arid area to the north west of the dam site. The feasibility of CAF in these areas was carefully studied before being approved by the Forest Department, GOG.

The very constrained schedule of CAF implementation at first precluded land direct involvement of local communities. None of the original CAF plans contained provision for involvement of local people. But to ensure success of the planting programme, the project authorities have made arrangements to protect the new planting for three to seven years, depending on tree species. The interests of local people, however, have been considered as far as possible and, in particular, provision has been made to reforest degraded forest areas rotationally to avoid the need to close off large areas of forest, which are to be used for grazing animals.

Efforts are now underway to enlist the support of the local population in a participatory management approach, through formation of a Forest Protection Committee at the village level with full representation of the various groupings within the village community. The Committee assisted the Forest Department in :

- Selection of tree species to be planted:
- Policing and enforcing forest protection measures:
- Sharing of the intermediate and final yields of the forest.

The areas treated under the CAF programme are being declared designated forest under the Forest Act of 1927 and will ultimately become the responsibility of the State forest departments. The CAF associated with the SSP is a small part of the total reforestation work being undertaken by these departments, who are managing vast forest resources. They have in the process of the work acquired valuable experience, which will of advantage in ensuring the success of CAF for the SSP.

An area of 13,386 ha was diverted by MOEF vide it's order of 1987. It was stipulated in this order that plantations shall be carried out in equal non-forestland in addition to the plantations on degraded forestland double in extent of the area diverted. Thus for every ha of the area diverted three ha of plantations were to be carried out by the project authorities. In addition to the area diverted by the MOEF in 1987, an area of 357 ha was diverted by GOG earlier. State Govts. have prepared the plans for plantations on 17,528 ha which included plantations over 4,200 ha of non-forestland in lieu of the land released for R&R works in Maharashtra besides reforestation of 28,830 ha. Statewise details of the total area taken for SSP and the planning in lieu thereof are given in the chart on the following pages.

In Maharashtra State 4,200 ha forestland was released for R&R works in two phases 2700 ha in 1990 and 1500 ha in 1993 in Taloda Taluka. Further 1500 ha was released during 1993 in the same taluka. State Government was required to carry out plantations on equal non-forestland. Detailed programme and progress of plantations is given in the table below

Table. Compensatory Afforestation against 4200 ha forestland released for R&R works in Maharashtra vide MOEF order dated 1990 (2700 ha) and 1993 (1500 ha).

Year	Land released	Progress 1993-94	Progress 1994-95	Progress 1995-96	Progress 1996-97	Progress 1997-98	Cumulative Progress	Balance Target
1990	2,700.00	2,192.37	311.00	184.50	0.00	0.00	2,687.87	12.13
1993	1,500.00	0.00	0.00	896.00	0.00	0.00	896.00	604.00
TOTAL	4,200.00	2,192.37	311.00	1,080.50	0.00	0.00	3,583.87	616.13

Chart : Showing forest areas taken for SSP. This includes 357 ha taken for SSP in Gujarat prior to formal clearance under FCA, 1980 besides the area diverted for R&R works in Maharashtra and targets for afforestation/reforestation

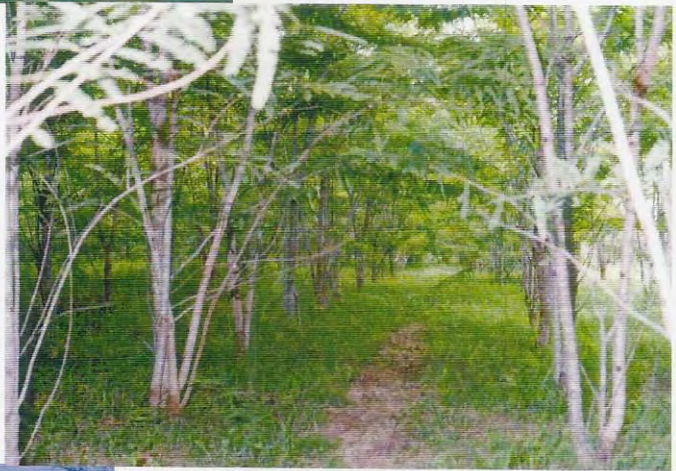
PLATE - IV

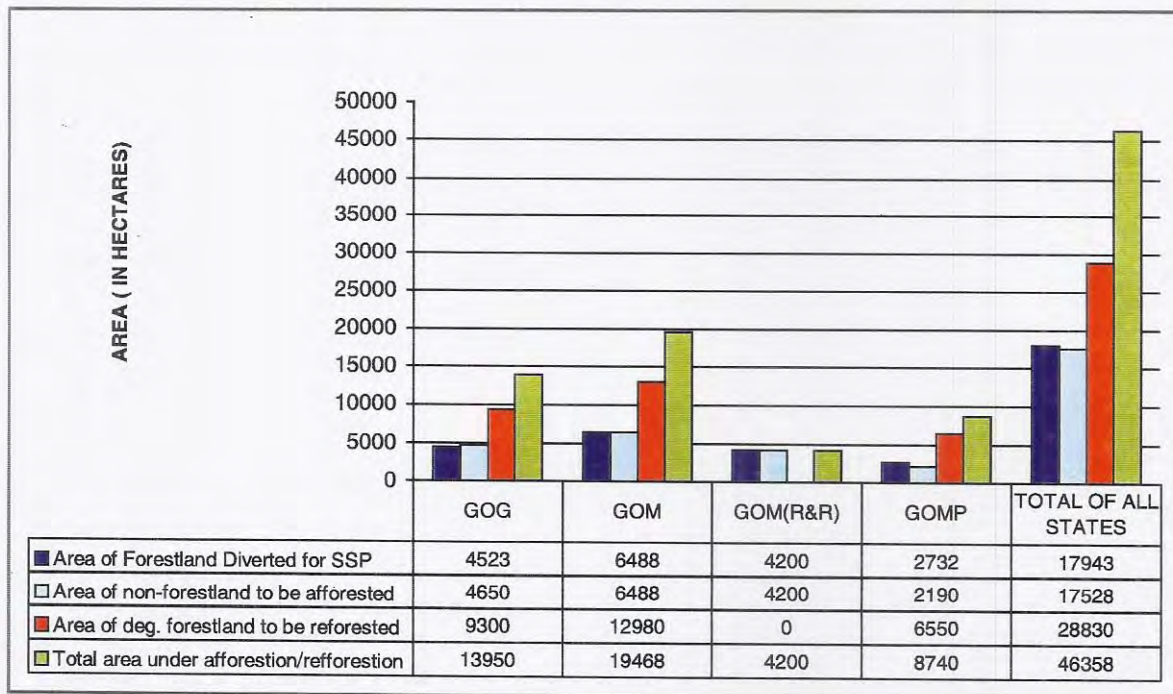
LEGEND

Compensatory Plantations

Photo No.1 & 2 :	Compensatory plantations in M.P.
Photo No. 3 :	Compensatory plantations in Kutchch region of Gujarat
Photo No. 4 :	Canal bank plantations in Gujarat

PLATE - IV





3.4 IMPLEMENTATION

3.4.1 Gujarat

GOG have completed compensatory plantation in 4650 ha of non-forest areas and 9300 ha in degraded forest areas against the submergence of 4523 ha forestland in Gujarat. Area afforested (i.e. non-forest area) has already been declared as forest under (Section-4) of Forest Conservation Act, 1980. The villagewise area transferred for compensatory plantation work in Gujarat is given in following table :

Sl.No.	Name of Village	Taluka	Area in ha
1.	Chandrani	Anjar	150
2.	Dhamadka		270
3.	Godhra	Mandvi	301
4.	Jakhau	Abdasa	251
5.	Bhachau	Bhachau	800
6.	Shikarpur		978
7.	Shivlakha		750
8.	Vandhia		600
9.	Manaba	Rapar	550
Total			4650

In all the three States, tree species are planted keeping in view the agro-climate conditions along with ensuring utility from the point of view of forage, fuel wood, food, medicines, minor forest products like gum and honey and also shade. This has been done to enlarge the biological diversity of the plantations.

- *Prosopis juliflora*
- *Acacia tortolis*
- *Azadirachta indica*
- *Acacia nilotica*
- *Salvadora oleoides*
- *Pithecelobium dulce*
- *Salvadora persica*
- *Acacia Senegal*
- *Ziziphus mauritiana*
- *Tamarindus indica*
- *Commiphora mukul*
- *Albizia lebbek*
- *Cordia dichotoma*
- *Jatropha curcus*
- *Phoenix dactylifera*
- *Coradia rothii*
- *Thespesia populnea*

Table-: Showing detailed progress of CAF, against the target area of 42,158 ha. in lieu of 13,386 ha. diverted for submergence of SSP vide MOEF order dated December, 1987. (Area in ha)

Monsoon year	GUJARAT		MAHARASHTRA		MADHYA PRADESH	
	Degraded forest	Non-forest	Degraded forest	Non-forest	Degraded forest	Non-forest
90-91	-	2,150.00	-	-	132.00	716.00
91-92	2,834.00	350.00	8,383.00	-	1,200.00	373.00
92-93	2,450.00	847.00	4,552.00	2,276.00	2,400.00	-
93-94	2,500.00	460.00	20.00	1,156.00	2,215.00	-
94-95	1,516.00	843.00	-	2,894.00	1189 *	-
95-96	Completed	Completed	Completed	NIL	NIL	NIL

96-97		-	-	NIL	NIL	NIL
97-98	-	-	-	NIL	208 *	
98-99					277 *	
99-2000					26	
Sub-total	9,300.00	4,650.00	12,955.00	6,326.00		
Total	13,950.00		19,281.00		8,736.00	

* Area classification, not reported.

In addition to the above following additional plantations have been taken up by the Government of Gujarat.

3.4.1.1 Additional Plantation Activities in Gujarat

(a) Plantation along Canal Banks

The total potential of canal bank plantations is estimated to be 5,300 ha. A project report prepared for this purpose by Gujarat Forest Dept. is under scrutiny by SSNNL. The plantation programme was launched from the year 1990-91. Plantations on 1,870 ha have already been established till monsoon of 1999.

(b) Dam Vicinity Plantation (240 ha)

The plantation in total area 551 ha. In the vicinity of dam have been completed by the forest department as well as project authorities. Project authorities are maintaining this.

(c) Ravine Land Afforestation (200 ha)

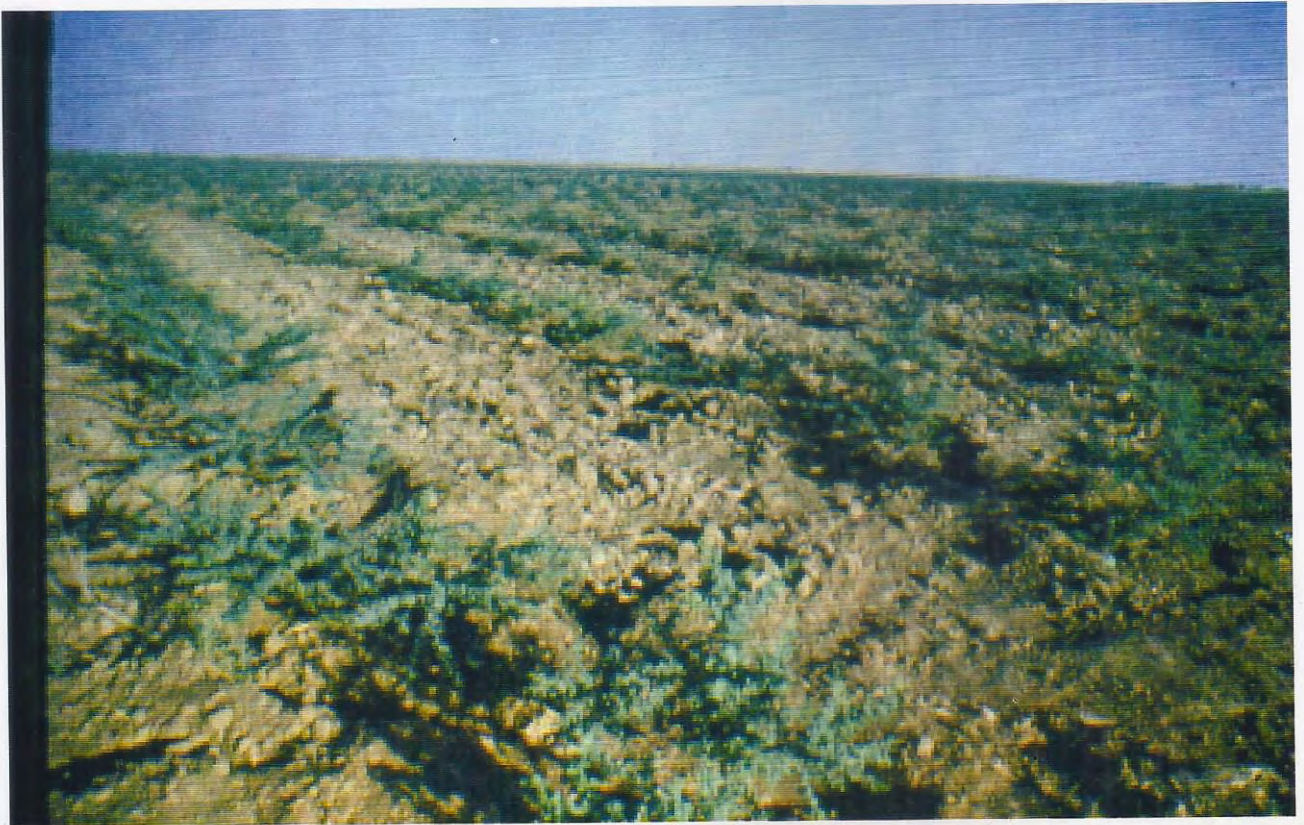
On the left bank of river Sabarmati an area of 200 ha in two villages i.e. Ratanpur (120 ha) and Phirojpur (80 ha) was taken up for model plantation. Entire work has now been completed.

An area of 311 ha had been planted in the project area and the work is completed.

PLATE - V



Compensatory plantations, two years old, in Runn of Kachch *Photo of 1993*



3.4.2 Maharashtra

Maharashtra has completed compensatory afforestation works over an area of 19,468 ha in lieu of 6,488 ha of forestland diverted for submergence of SSP and another 4200 ha of non-forestland was also planted against the release of 4200 ha of forestland for R&R works in Taloda Taluka as per stipulations of MOEF, GOI.

3.4.3 Madhya Pradesh

Madhya Pradesh has completed compensatory afforestation works over an area of 8,740 ha in lieu of 2,732 ha of forestland diverted for SSP as per stipulations of MOEF, GOI.

3.4.4 Assessment of the Success of Implementation

Under the Forest Conservation Act (1980) the GOI was required to appoint an agency to monitor the implementation of the provisions of the Act. Five regional offices have been established for this purpose around India. The office of the Regional Chief Conservator of Forests at Bhopal is responsible for monitoring CAF for the SSP on behalf of the MOEF. In addition, each State forestry department is required to make it's own monitoring arrangements. At the state level, CAF for the SSP is being monitored by the following:

- ⇒ In Gujarat, the Chief Conservator of Forests of GOG and the Secretary (Environment & Rehabilitation) of Sardar Sarovar Narmada Nigam Limited (SSNNL).
- ⇒ In Maharashtra, the Chief Conservator of Forests, who is designated as 'nodal officer' for project works.
- ⇒ In Madhya Pradesh, the Member (Environment & Forests) of the NVDA.

The Chairman of the Environmental Sub-group of the NCA receives quarterly reports, therefore from several sources including

- ⇒ Member for the Environment of the NCA:
- ⇒ Regional office of the MOEF:
- ⇒ Members for the Environment of the State Governments.

In addition, the Chairman has also constituted Committee of the Environmental Sub-group for field visits to the areas of SSP. Progress is reviewed at meetings of the Environmental Sub-Group and reported in the minutes together with any directives, which have been issued.

3.5 SUMMARY OF WORK TO BE DONE

The detailed background work necessary to assess the impact of loss of forest resources owing to the SSP was carried out in the three States in which forest losses will occur. In accordance with the conditions laid down by the MOEF, comprehensive action plans were prepared for the areas afforested. In accordance in the stipulations of the MOEF under the Forest Conservation Act (1980) the States have completed CAF on 46,358 ha of land for 17,943 ha of designated forest released for submergence and resettlement. The entire programme of CAF was monitored and quality assured independently by three organisations whose findings were coordinated by the Chairman of the Environmental Sub-Committee of the NCA.

Now the areas afforested / reforested are required to be declared as forestland and are to be placed with the State Forest Departments. Environment Sub-group has suggested certain studies to assess the development of new ecosystem in the previously un-wooded environment or in the degraded forest environment. This work is only a small part of a massive programme of reforestation, which is underway throughout India. The institutional structures put in place to control this larger enterprise will also serve to assure the success of the SSP CAF work, when aftercare obligations have been met and control is handed over to the forest departments of the three States.

To ensure the long-term success of the programme, State governments have framed policies to secure the cooperation of the local communities in a participatory management approach to the newly afforested and reforested areas.

4. FLORA , FAUNA AND CARRYING CAPACITY

4.1 THE TERRESTRIAL ECOLOGY

4.1.1 The Issue

4.1.1.1 Context

India is one of the 12 mega-diversity countries of the World. Biological diversity is significant in the forests of eastern Himalayas & the moist deciduous forests of the Western Ghats. Narmada river basin represents an important highway for the plant & animal species. Like the whole countryside, the areas to be submerged by the SSP were once upon a time, a part of large ecosystem supporting a diverse range of plant and animal life. These included plants and fungi, invertebrate life, birds and reptiles, small mammals and larger animals such as tigers, bears, panthers, deer etc.

Fresh waters support many species of plant, fish & invertebrates that are endemic to river basins. Their habitat makes them vulnerable to changes in water regime and pollution. Many populations of these species are important source of genetic material used to improve domestic strain used in aquaculture & agriculture. This genetic diversity should therefore be maintained to be of great use to the society when needed.

Although much of the forest is now degraded, there may still be valuable plant and animal resources which are worth conserving and, where practicable, enhancing as part of the environmental management of the projects. Wildlife is protected in India by the Wildlife Protection Act (1972), which contains schedules listing rare, endangered and threatened species requiring special protection.

The guidelines of the MOEF require that when environmental clearance for large projects such as the SSP is sought, surveys of the terrestrial ecology are conducted so that the flora and fauna present can be assessed, listed species can be detected, if present, and appropriate conservation measures are devised. Based on such studies, the MOEF issued clearance for the SSP in 1987. A condition of this clearance, as far as it relates specifically to the terrestrial ecosystem, was that detailed studies of flora and fauna would be carried out. MOEF through their letter No. 3/87/80/HCT/ENV-5 dated 4.2.1988 have laid down the framework to be followed by all the four states to facilitate basic environmental data collection for preparation of needed action plans with particular reference to Flora. The focus was on rare & endangered species, gene pool reserve where as for faunal aspects the focus was on rare & endangered species, migratory species migration route, breeding habitat, sanctuary national parks.

The issues identified with respect to submergence area were identification of endangered species, rare & habitat sufficiency. Accordingly, the rehabilitation of flora fauna action plans were expected to cover the Surveys of flora & fauna in the region going to be affected due to implementation of the SSP with reference to the following

- 1) Gene pool, if any, likely to be affected.
- 2) Details of wildlife habitat in the region
- 3) Measures proposed to rehabilitate endangered species of flora fauna, if any.
- 4) Assessment of the carrying capacity of the neighbouring areas wherein the wildlife would dispose if the scheme were implemented.
- 5) Plan for rehabilitation of endangered flora & fauna.

4.1.1.2 Source of Impact on Terrestrial Ecosystems

Several aspects of the SSP have potential to cause adverse effects on the terrestrial ecology of areas upstream of the dam, principal amongst these are:

- ⇒ The submergence of forestland,
- ⇒ And the resettlement of people in new areas

The SSP also has considerable potential to have beneficial effects on ecological resources, owing to:

- ⇒ The creation of new and regenerated forest habitat:
- ⇒ The establishment and improvement of wildlife sanctuaries:
- ⇒ The greater availability of fresh water for irrigated forestry or for wildlife.

4.1.2 IMPACT AND MANAGEMENT

4.1.2.1 Studies and Findings

Studies

There have been extensive studies/surveys of the flora and fauna in all the project affected areas of the States of Gujarat, Maharashtra and Madhya Pradesh carried out by the identified institutions/agencies. In general, the aim of these surveys has been to establish the composition and status of the terrestrial ecological resources. This information is being used as a basis to develop mitigation measures and management strategies. Important survey work included the following

TITLE OF THE STUDY / REPORT	YEAR OF COMPLETION	AGENCY
The Environmental Impact Study	1983	Maharaja Sayaji University, Vadodara
Preliminary Report on First Botanical Exploration and Plant Collection from Narmada Valley	1986	Botanical Survey of India
Narmada Basin Water Development Plan: Development of Fisheries	1987	Narmada Planning Agency, GOMP.
Rapid Reconnaissance Survey of Limnological Aspects Part I, II and III	1987	Bhopal, Vikram and Rani Durgavati Universities for GOMP.
Report on the Survey of the Narmada Sagar Area.	1988	Zoological Survey of India
Note on Sardar Sarovar Project - Preparation of Environmental Work Plan for Forest and Wildlife	1988	State Forest Department, GOM.,
People's Involvement in Wildlife Management	1991	VIKSAT
Narmada River Basin Development Project: Fisheries Component.	1991	GOPA, German Consultants to the World Bank.,
Sociological Survey of the Fishing Families of the Narmada River	1991	Central Inland Capture Fisheries Research Institute, Barrackpore.
Aquatic Fauna (Fish) Studies in Indira Sagar Submergence Area.	1991	Friends of Nature Society
Eco-Environmental and Wildlife Management Studies in the Sardar Sarovar Area in Gujarat	1992	Maharaja Sayaji University, Vadodara
Wildlife Management Studies in the Submergence and Catchment Area of Narmada Project: With Special Reference to Shoolpaneshwar Wildlife Sanctuary.	1992	Sardar Sarovar Narmada Nigam Ltd., GOG
Studies on Fish Conservation in Narmada Sagar, Sardar Sarovar and it's Downstream	1993	Central inland Capture Fisheries Research Institute, Barrackpore.
Status of Flora and Fauna in and Around Sardar Sarovar Project, Maharashtra	1994	University of Pune
Impact Assessment of Madhya Pradesh Land to be Submerged Under Sardar Sarovar Project and Adjoining Ecosystems.	1994	State Forest Research Institute (SFRI) Jabalpur
Pre-and Post-Impoundment Limnological Studies of Narmada Basin.	1994	Bhopal, Vikram and Rani Durgavati Universities for GOMP.
Ecology and Fisheries of the Narmada Estuarine System with Special Reference to Proposed Impoundment (Sardar Sarovar Dam)	Contd.	Central Inland Capture Fisheries Research Institute, Barrackpore..

The key reports pertaining to upstream terrestrial environment and command area, which have been helpful for developing management plan, are described in following paragraphs.

4.1.2.1.1 Upstream Terrestrial Environment

- ⇒ The Environmental Impact Study of 1983 prepared by MSU, Baroda. This study included a botanical survey of the forest submergence areas in Gujarat. Lists of tree species and medicinal plants were compiled and recommendations for further, more detailed, work were made.
- ⇒ Preliminary Report on First Botanical Exploration and Plant Collection from Narmada Valley by the Botanical Survey of India in 1986. It reported on field survey work carried out in the different phyto-geographical zones of the Narmada Basin. More than 700 specimens were collected for laboratory study and a detailed species list of the flora was prepared. The areas investigated were located within the Narmada Sagar Complex (NSC), outside the submergence area of the SSP but within the same ecological zone.
- ⇒ Report on the survey of the Narmada Sagar Area by Zoological Survey of India, 1988. It reported on a two-week field survey undertaken by a group of zoologists with expertise in five different animal groups in the submergence area of the Narmada Sagar Project (NSP) in Madhya Pradesh. A list was compiled of animal species which were either found to be present or had been reliably reported in the area.
- ⇒ Note on Sardar Sarovar Project – Preparation of Environmental Work Plan for Forest and Wildlife by the State Forest Department, GOM, 1988. This short note lists the main flora and fauna present in the submergence area of Maharashtra and comments on their frequency of occurrence in the State.
- ⇒ Status of Flora and Fauna in and around Sardar Sarovar Project, Maharashtra is a study by the University of Pune. The report, lists species of plants found in the submergence areas and reports on such aspects as the species abundance, density, frequency of occurrence etc. Report on the Faunal Studies, lists the animal species identified in the same areas with the aid of field visit's and interviews with the local population. The School of Environmental Sciences, Pune completed their study in the submergence area by the end of 1993. The final report was, however, submitted during 1997.
- ⇒ Eco-Environmental and Wildlife Management Studies in the Sardar Sarovar Area in Gujarat, 1992, by MSU reports on extremely thorough and comprehensive surveys of flora and fauna in the State of Gujarat.

The surveys had the aim of assessing the present status and composition of flora and fauna in the submergence area and environs and noting the presence of any rare or endangered species. More than 70 field trips spending more than 2,000 staff days over a period of two and a half years were used to collect data in accordance with a rigorous statistical sampling regime.

- Impact Assessment of Madhya Pradesh Land to be submerged under Sardar Sarovar Project and Adjoining Ecosystems is study, which began in September, 1990 and for which quarterly reports were submitted from-time-to-time. The study was conducted by the State Forest Research Institute (SFRI) in Jabalpur and financed by NVDA, the final report was available at the end of March 1994. Botanical Surveys have been conducted, species lists have been compiled and the condition and utility to the local population of the flora are being assessed.

4.1.2.1.2 Command Area in Gujarat

Biodiversity has played a vital role in enabling agriculture to develop to it's current productive state. Genetic variation has allowed plant breeders to select desirable characteristics and manipulate plant characters & productivity.

Though large part of SSP command is semi-arid & have fewer species than moist forestland, it may harbor species potentially valuable genetic resources having developed advance physical & biological defense against the harsh Environment. Detailed inventories have been directed to investigate the flora & fauna of the vast command of the SSP

TITLE OF THE STUDY / REPORT	YEAR OF COMPLETION	AGENCY
1. Study on Flora and Fauna of the Command Area of Sardar Sarovar (Narmada) Project Lying in Saurashtra and Kachchh Area (EIA studies).	Saurashtra University, Rajkot.	January 1996
2. 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.	November 1995
3. Study on Flora and Fauna of the Command Area of SS(N) Project: Lying Between Sabarmati River and Rajasthan Border, EIA Studies.	Gujarat University, Ahmedabad.	March, 1998
4. Ecological Study of Wild Ass Sanctuary and Surrounding Area Using Remote Sensing Technology for EIA.	GEER Foundation, Gandhinagar.	March 1998
5. Environmental Impact Assessment of Nal Sarovar Bird Sanctuary.	GEER Foundation	March, 1998

6. Environmental Impact Assessment of Black Buck National Park located at Velavadar in the command area of SSP.	Gujarat. Ecological Education & Research Foundation (GEER Foundation) Gandhinagar	December 1993
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Findings

Final studies/surveys of the terrestrial flora and fauna were conducted to identifying rare or endangered species for devising appropriate conservation measures. Detailed studies of flora and fauna in the submergence zone of Gujarat, Maharashtra and Madhya Pradesh have concluded that no valuable flora or fauna will be threatened by the SSP.

Creation of a reservoir in the present water deficit terrestrial ecology is going to significantly modify the moisture regime. The river & reservoir bank areas, which remain dry on high lands, will be most benefited both in the upstream and downstream by the changed moisture regime as well as greater water availability round the year. The impoundment of water will provide new scope for revitalization and rebuilding of a better and more productive eco-system. The project offers a promising opportunity for recreating healthier forests.

An opportunity for environmental improvement provided by the SSP is the creation or enhancement of areas of wildlife sanctuaries in all three States. The function of these sanctuaries will be to provide habitats for fauna following submergence and to encourage development of a diverse wildlife. Some of the new finds have been reported from the areas of Shoolpaneshwar sanctuary & the forests of Narmada Sagar Complex areas like Hodgson's frogmouth bird was never reported from this region, before. This bird is found in dry bamboo brakes of the Dadiapada area in Gujarat (part of Shoolpaneshwar Sanctuary).

Gujarat

Eco-Environmental and Wildlife Management Studies in the Sardar Sarovar Area in Gujarat, 1992 Maharaja Sayaji University, Vadodara

The study area was about 20 km. on each side of Sardar Sarovar in Gujarat & extended Shoolpaneshwar sanctuary encompassing about 1599 sq.km. area. The study concentrates upon ecology & environmental aspects of the submergence & catchment area and essentially was an extension of the earlier bench-mark study conducted during 1983 by the same institute which highlighted the positive & negative aspects of the Sardar Sarovar Project for it's upstream, downstream & command area.

The thrust areas of the study were:

- a) The biological inventory mainly concerned with the rare & endangered plant & animal species and attempt at their in-situ & ex-situ conservation & propagation.
- b) The biomass studies to highlight distribution of productive systems as an aid to salvage & monitor the existing wildlife.
- c) Restoration & enhancement of eco-system following trends of the newly evolving field of "Restoration ecology".

The survey work in Gujarat by Maharaja Sayajirao University (MSU) confirmed that much of the submergence area and surrounding catchment has all the characteristics of a highly degraded ecosystem. In particular, the north bank of the proposed reservoir had very little vegetative cover apart from a few isolated patches of forest. On the south bank there were some areas of fairly good forest cover however, located within the area designated was the Shoolpaneshwar Wildlife Sanctuary. These were somewhat degraded, but the presence of small numbers of indicator species of teak forest (*Dillenia pentagyna* and *Careya arborea* for example) showed that the area was once good forest and had the potential to recover. The study group noticed no endemic, rare or endangered species.

The study of animal life also showed a marked difference between the degraded north bank and the comparatively diverse fauna of the Shoolpaneshwar Sanctuary. The north bank was devoid of wildlife. South of the river, however, particularly within the original boundaries of the Shoolpaneshwar Wildlife Sanctuary, there was diverse fauna. Overall, 539 species of animals were identified including 173 species of birds and 28 mammals. The presence of notable species like Heartspotted Woodpecker (*Hemicircus canenze*), the Rusty spotted Cat (*Felis rubiginosa*) and the Barking Deer (*Muntiacus muntjak*) etc. suggested desirability of considering this Sanctuary as priority conservation area.

Key Recommendations

The studies suggested enhancement plans and management strategies for eco-system of the area spread to 20 km on each side of the Sardar Sarovar in Gujarat and also the existed Shoolpaneshwar sanctuary in the vicinity of Sardar Sarovar and Karjan reservoir and measures for sanctuary improvement were suggested. The study covered Shoolpaneshwar Wildlife Sanctuary on the left bank, right bank catchment area of Sardar Sarovar and besides right bank extended area beyond the basin boundaries. Recommendations were also made for management of aquatic ecosystem and management strategies for the study areas were suggested by the study group.

The above findings were presented before a group of experts of GOG / NCA who accepted the findings with following recommendations:

PLATE - VI

LEGEND

Flora, Fauna & Carrying Capacity studies

- Fig. 1 :** Dam site before inundation
- Fig. 2 :** Leopard in Shoolpaneshwar Sanctuary
- Fig. 3:** *Sterculia urens*, multi-purpose tree from sanctuary area
- Fig. 4 & 6 :** Hogson Frogmouth bird, a rare find from Shoolpaneshwar Sanctuary
- Fig. 5 :** Rusty spotted cat from Shoolpaneshwar Sanctuary
- Fig. 7, 8 & 9 :** Pressure on forests
- Fig. 10 :** Women going for fishing in the river
- Fig. 11 :** Reservoir stretch
- Fig. 12 & 13 :** Estuary showing mangrove trees Near Aliabet island

1. The group observed that any endangered or threatened endemic plant or animal species were not present in the study area, however, a few plant species like yellow variant of Palas *Butea monosperma* and *Radernaschera*, *xylcorpa* which were rare in distribution, were noticed.
2. The Group suggested measures for controlling aquatic weeds, which though were not found in the Sardar Sarovar areas but were noticed close to the dam site. The study group expected a positive threat of invasion by these species once the lake is formed. Study group suggested measures to control undesirable species like *Eichhornia* and *Pistia*.
3. The Group stressed the need for catchment area treatment to control soil erosion by stabilization of the slopes and enhancement of the ecosystem. It recommended the vegetative measures as inexpensive and efficient measures for CAT works besides bamboo, grass, herbs, shrubs, and trees, which can be propagated vegetatively.

The study report also included a section on management strategies and Action Plan for the enhancement of ecosystem of the Sardar Sarovar environment.

Madhya Pradesh

Studies of the Narmada basin catalogued a very rich and diverse flora and fauna but no rare or endangered plant species were identified. These studies were undertaken as part of the preparatory work for the Indira Sagar Project and so concentrated on the submergence area of the dam. Nevertheless, the study areas were in the same ecological zone as the submergence area of the SSP in Madhya Pradesh and, therefore, the same species of flora and fauna was expected to be endemic in the two areas, unless the natural biota has been disturbed by anthropogenic activity.

The study entitled "*Impact assessment of Madhya Pradesh lands to be submerged under Sardar Sarovar Project and adjoining ecosystem : flora, fauna and other listed components*" was conducted by the State Forest Research Institute, Jabalpur, Madhya Pradesh. The MOU for the study was signed in June 1990 and study was submitted in 1994. The object of the study was to suggest compensatory conservation measures with particular reference to the floral & faunal status. Main focus of attention was to investigate into the impacts of the project on the flora & fauna within the impact area of SSP falling in the state of Madhya Pradesh.

Report of the SFRI indicated that the SSP submergence areas in Madhya Pradesh were very highly degraded. Moreover, in Madhya Pradesh, only a small patch of 2,732 ha of very poor quality forest most of which was hacked, pollarded

and damaged, was to be submerged by the SSP reservoir, Ground flora such as grasses, herbs and shrubs were altogether absent in some areas, and understocked, small and bushy in others. In the absence of vegetation cover, and with the scarcity of water holes and the lack of fodder, the area harbours little or no wildlife of value.

The study identified that the submergence (impact) areas were mainly falling in the three districts namely Dhar, Jhabua and Khargone. It indicated that the forests in the impact area were highly under stocked and their distribution by girth class very erratic the condition of impact area was not conducive to support good wildlife and as such it was not considered desirable to provide corridors for migration of wild animals as escape route during progressive filling of the reservoir. However, a plan for felling the forest being submerged was prepared.

The key recommendations / findings were:

1. To reestablish indigenous forest ecosystem and local diversity besides catchment protection work.
2. Production of fodder through agroforestry or silvi-pastoral system through management of village wastelands and production of bamboo through agro forestry.
3. Using state-of-art technology for devising the management plans for the forests under study area with special reference to protection from fire and stringent control of grazing in the development area.
4. Intensive campaign for forestry-cum-environment awareness, people's participation backed by development legislation.
5. To cater the increased requirement / demand of timber, fuel-wood etc. intensive social forestry programme shall be undertaken.
6. Introduction of quick growing exotics in interest of soil stabilization and meeting the requirement of people in short time.
7. Proposal for creating two sanctuaries namely Mathwad (34659 sq. km.) in Jhabua district and Bokrata (3559 sq. km.) in Khargone district to provide habitat for the wildlife.
8. 60 islands which will be found in the reservoir varying in extent from 1 ha to 75 ha should be left undisturbed for study of the process of natural succession and to provide refuge to bird life in the area.

Maharashtra

The submergence area of Maharashtra is highly degraded forest, which has been subject to over-exploitation and encroachment for agriculture. The submergence areas are contiguous with those on the south bank of the Narmada in Gujarat and the survey has been carried out earlier by the Forest Department and more detailed work undertaken by the University of Pune. Plant life included only commonly occurring species and animal life was not abundant but there is still a wide diversity of invertebrates, reptiles and birds. Larger mammals have almost disappeared from the area although some traces of large cats were found.

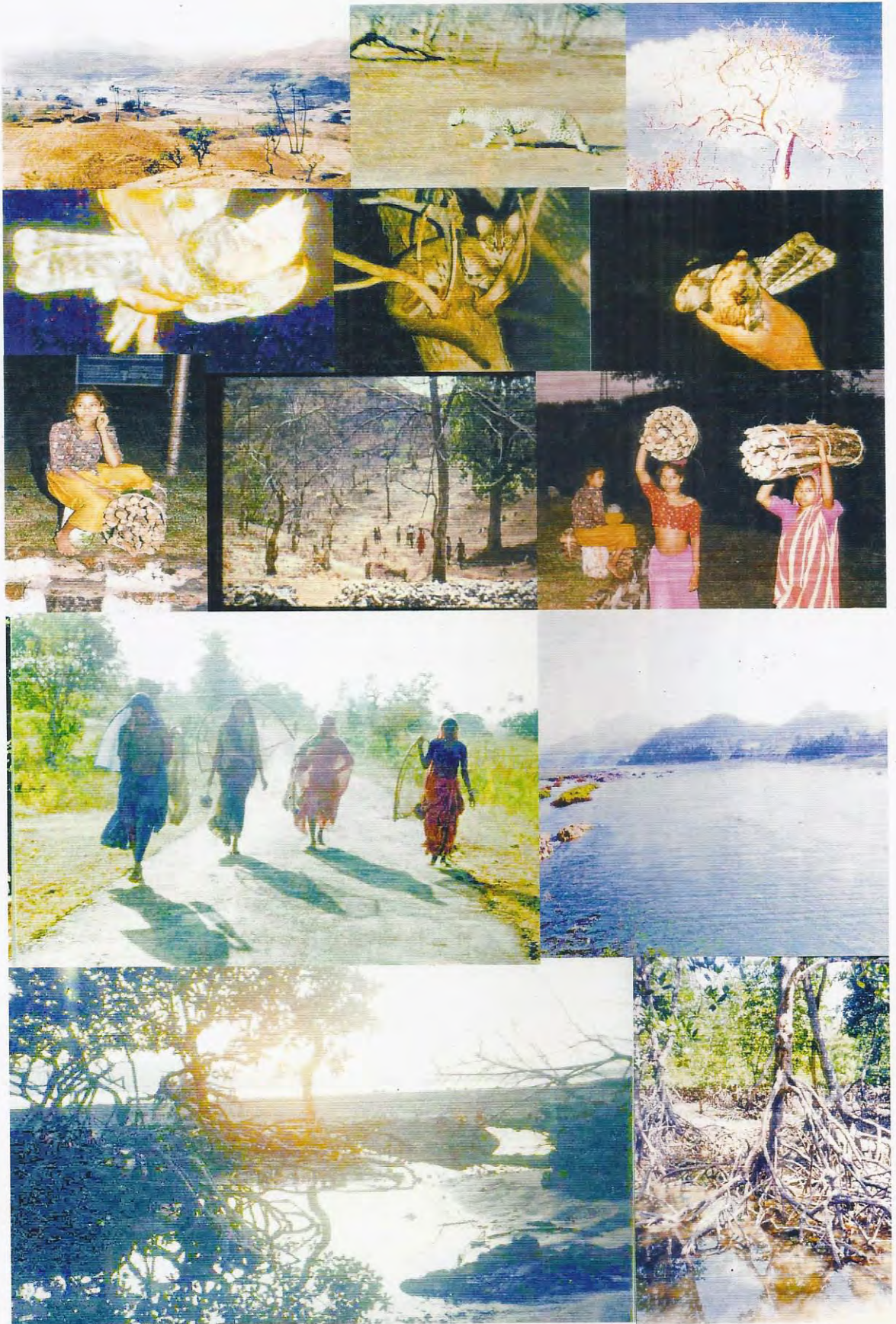
The study entitled "*Status of Flora and Fauna in and around Sardar Sarovar Project: Maharashtra*" was conducted by School of Environmental Sciences, University of Pune at the instance of Department of Environment, Government of Maharashtra. the key objectives of the study were :

- ☐ Survey of the plant and animal wealth
- ☐ Estimation of value of existing forests.
- ☐ Identification & Assessment of submergence area & biological elements that would be lost in submergence.

The study was conducted for a period of 18 months (1992-1994). The area covered roughly 70 Km long and 20 Km wide belts along the southern bank of Narmada River in Maharashtra. The survey was carried out in the submergence and catchment areas of Sardar Sarovar Project. The study was based on remote sensing data of 1990 for vegetation & land cover identification. Aerial photographs of the areas on 1: 60000 scale were used. Ground truth checking was done on a few points. The study included Land-use pattern of study area, soil characteristics, water resources which included ground water potential & its quality. No reference of carrying capacity of wildlife has been made in the study, but carrying capacity of seeds was discussed. The methodology used was as follows:

- ☐ The satellite images (1:50,000) and aerial photographs (1:60,000) were used to analyse a number of observable spectral elements such as brightness, colour, texture, space such as relief, shadow, shape, location and association and temporal nature in order to combine these elements into distinctive pathways whose limit's serve to determine land use and cover types.
- ☐ The frequency, abundance & density of the vegetation in the study area, and faunal studies were carried out at more than 35 localities using quadrants of different sizes, line and belt transect methods.
- ☐ Soil analysis was carried out for the samples collected from submergence and catchment areas.

PLATE - VI



- ☐ Survey was done to identify ground water potential and the area was classified into different types, depending upon ground water potential.

The area under study was hilly, undulating with precipitous slopes. It was rugged with very narrow 'V' shaped valleys that hardly showed any development of floodplain. The foothill zones, however, showed very narrow alluvial patches. The hills and plateau had very thin (less than 10 cm) reddish-brown soil cover. The soil profile was ill developed and poorly defined. The organic content of soil was low in the uppermost horizon because of poor vegetative cover. The clay content of these soils was very low and they had very poor fertility. On the other hand, narrow patches of land on valley floors had thicker (20-60 cm) grayish-black to brownish-black soils that were well defined with well-developed profiles. The upper-most organic horizon was rich in clay and was relatively more fertile.

The ecological studies carried out at more than 35 localities revealed that the density of forest was in the range of 0.1 to maximum of 0.6 at Pimpalkuntha in the catchment area of Sardar Sarovar Project. The minimum cover of canopy on the basis of 0.1 to 1.0 scale indicated poor vegetation cover in the region as a whole with some patches of good vegetation in the areas in inaccessible zone. In the submergence zone, the canopy cover was found to vary between from 0.1 to 0.2. The submergence villages such as Manibeli, Chimankhedi, Dhankhedi, Bhusha, Bilgaon bear poor vegetal cover

In all 511 plant species were listed in the area. The plant inventory thus prepared revealed that none of the species were endemic, rare and endangered. Phytosociology, shifting agriculture, herbaceous flora, biomass and carrying capacity studies were included. The carrying capacity studies revealed that the soil cover in the study area is much degraded, eroded & poor.

Studies on animal resources including insect, reptiles & mammalian fauna, besides phytoplankton & zooplanktons were carried out. In all 90 insect species were identified by the study group. For studying wildlife indirect methods were used, overall 263 species belonging to class Aves & 12 each of Mammals & Reptiles were noticed.

Key Recommendations and Findings

To minimize the loss of biomass and life, including wildlife, anticipated due to submergence because of filling the reservoir, following measures were recommended

1. Management of corridors for shifting of wildlife, several corridors, passing through moderate to good >0.3 vegetation cover was suggested.
2. Seed bank status of soils of low-lying (e.g. valley bottoms) areas were good, therefore, it was suggested that surface soils from such areas be used to develop vegetation (natural) in degraded areas.

3. Tree species with high diversity in the region (e.g. *Buchanania lanzan*) should be conserved on large scale, in the form of multi-region seed banks. Some of these seeds from each variety should be planted in iso-climate regions, with care, if such regions fall in degraded areas.
4. Small storages of run-off water, was suggested with adoption of local methods of soil conservation suiting to the different types of terrain found in the study area.
5. Considering the good vegetative growth along the crevices and slopes, it was suggested to develop microhabitats on difficult terrain by making use of the identified species with a view to form a pioneer stages of secondary succession on distributed habitats. This was expected to help to consolidate the substratum and pave the way for further regeneration on steep slopes and areas with poor soil cover.
6. To aim at improvement of carrying capacity of the region, efforts should be made to encourage conservation of soil on slopes and crests and restore adequate soil cover on undulating grounds, through deposition of soil, restoration of degraded lands, formation and retention of plant cover and eventually improvement of water potential.

4.1.2.2 Proposed Management/Mitigation Measures

1. Intensification of surveys and cataloging of biological resources in different part of the Narmada basin including the island ecosystems. This includes information on distribution pattern of particular species/population/communities and the status of ethno biologically important groups.
2. Conservation of biodiversity through a network of protected areas including National Parks Sanctuaries with including the lower vertebrate, invertebrate and micro-flora contributing to the healthy maintenance of ecosystems are being developed for NSP areas in MADHYA PRADESH and Shoolpaneshwar, Nalsarovar, Wild Ass Sanctuary & Black Buck sanctuary in Gujarat.
3. There is an extensive programme of CAF associated with the SSP as well as tree planting in command area and tree / grass planting as part of CAT programme, conservation of micro-fauna and micro-flora. This shall help in reclamation of wastelands and revival of biological potential of the land is being taken up in plantation areas developed in Rann of Kutch in Gujarat.
4. Since no endemic or endangered plant species are endemic in the submergence areas of the SSP and since areas in Gujarat and Maharashtra are contiguous with far larger areas which will be preserved

and, in some cases enhanced by the projects, there need be no further measures to preserve flora or to increase carrying capacity.

5. The results of the baseline survey, described above, suggest that a key mitigation measure for the SSP will be the preservation and enhancement of the Shoolpaneshwar Wildlife Sanctuary including the participation of local people in the sanctuary's management. To assist and inform the development of the wildlife management strategy and to facilitate the preparation of Action Plans, however, several more studies were undertaken which examined the available options. These included:

- Workshop on Approaches to Integrated Wildlife Management in Gujarat: A Report, by the SSNNL, October 1990. This reported the outcome of discussions of an event organised by the Wildlife section of the Gujarat Department of Forests in conjunction with the SSNNL. The 90 participants included representatives from the World Wide Fund for Nature, MSU and other organisations. Papers presented discussed the various approaches to the management of wildlife reserves as well as specific issues relating to the wildlife of the SSP area.
- People's Involvement in Wildlife Management, by VIKSAT in 1991 This report was prepared for the World Bank and looked at local people's use of forests and attitudes towards wildlife in conjunction with the aims and objectives of the Shoolpaneshwar Sanctuary. It suggested several approaches for the development of the sanctuary including the proposal that tribal people be allowed to remain within it's confines and that they should be involved in it's management
- Wildlife Management Studies in the Submergence and Catchment Areas of Narmada Project: With Special Reference to Shoolpaneshwar Wildlife Sanctuary, by the SSNNL, 1992 studies the distribution and status of flora and fauna in the submergence areas of Gujarat and went on to suggest management measures for the Wildlife Sanctuary which are described below

Fauna of the submergence areas will be conserved by:

- Creating new wildlife sanctuaries or extending existing ones;
- Encouraging migration to the surrounding forest areas;
- Providing escape routes from the submergence area;
- Enhancing the carrying capacity of the surrounding areas.

The proposals of the three States for the conservation of wildlife are as follows: .

Gujarat

Shoolpaneshwar Sanctuary Management Action Plan is based on strategies which combine land use, and ecosystem classification to develop management zones for the Sanctuary, and which induce a small but sustained movement of humans from relatively well forested areas to less forested areas and from less forested areas to outside the Sanctuary. The movement is to be voluntary and well assisted by agencies set up for the purpose. As more and more areas of the Sanctuary are made available, the ecosystem restoration can proceed. Under this scheme, it is expected that it will take between two and five years to relieve the biotic pressure on the Sanctuary and about 10 years to nearly eliminate it. However, a proper legal framework for initiating the plan and achieving full goals is necessary, therefore, the legal strategy was considered.

The area of the Shoolpaneshwar Wildlife Sanctuary has been enlarged to 607 sq.km almost four times it's original size. The northern boundary now extends to the shore of the reservoir providing access to the waterfront for the animals. Work has been undertaken to improve the habitat in the sanctuary. These improvement activities are now complete. The proposed sanctuary developments in Gujarat are illustrated below.

The management strategies and action plans outlined indicated that development and environmental progress were not necessarily against each other. It was the wrong kind of development that created environmental damage through neglect or through harmful policies.

In order to protect damaged ecosystems and to restore their health, it is necessary to undertake development programmes in rural areas, that regard natural watershed and all the communities in it as a unit, improve hydrological regime of the unit, institute rational land use planning, undertake reseedling programmes, and induce each unit of the state to solve it's own problems rather than transfer it's biotic load to other unit. Equally important steps are those of putting these areas on strong cash economy, training the manpower for necessary industrial skills and establishing interactive relationships among different unit's of the state. Availability of trained work force from these regions is likely to prove a boon to further economic development of the state. In it's absence, either plans will be seriously flawed or the state and in it's absence, either plans will be seriously flawed or the state will have to import trained people from outside while leaving it's other citizens in poverty. An independent monitoring and evaluating infrastructure is an absolute necessity for successful execution of these strategies and Action Plans.

Maharashtra

Animals will be able to migrate from the submergence area of Maharashtra to a contiguous area of the Shoolpaneshwar Wildlife Sanctuary in Gujarat and to the surrounding forest in Maharashtra. As only a small number of

animals reside in the affected area and large scale planting have been carried out under CAT programme to increase the carrying capacity of impact zone forests in Maharashtra.

Madhya Pradesh

The study by the SFRI had recommended the creation of wildlife sanctuaries in Madhya Pradesh. In addition, they have prepared a plan for felling the forests, which provides corridors for whatever little wildlife remains in the submergence areas.

4.1.2.2.1 Conservation in SSP Command

The SSP will also provide an opportunity to enhance nature conservation outside the immediate catchment area of the Narmada. In particular, three wildlife sanctuaries located in the Command area of the Project will benefit from the increased freshwater availability resulting from the project and there are plans by the GOG to expand these. They comprise:

- Nal Sarovar, a freshwater lake which is a site for 120-150 species of migratory birds,.
- Wild Ass Sanctuary in the Rann of Kutch.
- Black Buck Sanctuary at Velvadar.
- Great Indian Bustard Sanctuary in Kutch.

4.1.3 ACTION PLANS

4.1.3.1 Sardar Sarovar adjoining areas

To ensure that the wildlife conservation measures outlined above are implemented effectively, Action Plans were needed as follows:

- Migratory corridors were not needed, however, felling plans for tree felling from the submergence areas in Maharashtra and Madhya Pradesh.
- Action Plan for development of Shoolpaneshwar sanctuary.
- Plans for increasing the carrying capacity of forest areas receiving wildlife from adjoining submergence areas, for the areas in Maharashtra and Madhya Pradesh.

Gujarat

Shoolpaneshwar Sanctuary (Action Plan)

This was prepared by the SSNNL in 1992 and includes details of construction work to be carried out, a timetable and a cost estimate based on the

recommendations of the SSNNL study described above. The Forest Department, GOG is responsible for implementing the plan. Improvement of carrying capacity has already taken place in Shoolpaneshwar and is an inevitable consequence of the CAT and plantation programmes taking place in areas adjoining the dam in Gujarat.

This plan seeks to convert all such EIA studies ,undertaken in the past by M.S. University, Baroda, Dr Sanat Chavan and others ,into concrete action plan for the management of the Sanctuary.

Shoolpaneshwar Wildlife Sanctuary encompasses an area of 607.708 sq.km. in Bharuch district, Gujarat state. It is in the Rajpipla (East) Forest Division, dominated by the Rajpipla hills.

The Forest of the area is rich in pockets with varying degree of biotic interference. The honey combing effect of large number of forest villages over the forest is quite significant in bringing about the present status of the forest. Good forests are restricted to hills and hill slopes while flat areas have largely been covered with habitation or cultivation.

The forests of Shoolpaneshwar eco-system can be classified into five basic forest types (1)Teak Forest (2) Southern Moist Mixed Deciduous Forest (3) Dry Deciduous Scrub (4) Dry Bamboo Breaks (5) Evergreen to Moist Deciduous, much of which is in retrogression stage that reflects heavy influence of biotic pressure and forestry operations.

Due to shrinking habitat, habitat deterioration, hunting and biotic pressure, the wildlife is highly compressed, threatened and its carrying capacity reduced. Four horned Antelope, Barking Deer, Sloth Bear are in good number, while Rusty spotted cat leopard cat, Giant squirrel, Primates and Sambar, all are and threatened. Tiger, Chital and Wild Dogs are on the verge of disappearance from the area.

Shoolpaneshwar sanctuary supports good diversity of avian life these include common birds like king-fishers, parakeets etc. game bird like jungle fowl, peafowl, partridges, quails etc. and migratory birds like wagtail, harriers etc. Today, the sight the jungle fowl, Red spur Fowl, Grey Jungle Fowl, Rain Quail and Bustard Quail are rare, indicating their endangered status. Raptor population has also declined in the last two decades. During 1990-92, wildlife study Group identified 198 species of Birds, out of which 10 were new records for this area.

Limiting Factors and Threats:

Some limiting factors and threats evident in the development of Shoolpaneshwar sanctuary area are:

- i) The presence of 38000 villagers in 104 villages in the sanctuary areas. The population density has increased very fast from 20 persons/sq.km in 1961 to 42 persons/sq.km. in 1981.
- ii) Dependence of economy on agriculture and large-scale cattle grazing.
- iii) Direct dependence of tribals on forests such as fuel wood for energy needs bamboo & timber for household work, hunting of animals and birds for food and fishing in streams and use of other minor forest products.
- iv) Indirect dependence of forest for example, clearing forest for agriculture, cattle which graze on forest and illegal trade of wildlife.
- v) Shoolpaneshwar Sanctuary is under tremendous pressure of overgrazing. About 26,672 cattle in the sanctuary (1981 census) have deteriorated the forest cover.

Overall, the forest cover, the wildlife presence along with the naturalness of the wilderness has deteriorated due to intense biotic pressure on the sanctuary and other external factors like forest fires and forestry operations.

Restoration plan:

The primary objective of the restoration plan is to halt the degradation of Shoolpaneshwar wild life sanctuary, reestablish viable stock of the endangered wildlife species, conserve them as gene pools and channelize it's benefit's for the socio economic upliftment of the forest tribals. About all, the objective is also to safeguard the catchment area of Sardar Sarovar and Karjan reservoirs.

To ensure the above objectives and long-term sustenance of ecosystem of the Shoolpaneshwar sanctuary people's participation in wildlife conservation forms the core philosophy without which any action plan would be a failure. The Action Plan is based on the following principles:

- (a) These forests, which are the last of the best forests in the state should be developed, conserved and managed in accordance with the ecological principles of land use.
- (b) Optimum utilization of forests in a sustainable manner for the maximum benefit of the local population.
- (c) The tribal must be given the opportunity for full social development in terms of the modern world and in accordance with the principles of human rights without adversely affecting the forests and its wildlife.

A step down outline has been envisaged as part of restoration plan, which includes the following:

1. Maintaining the existing habitat and its wildlife, it was strongly felt that as bamboo (forest) breaks in the sanctuary area are inhabited by some unique animal and bird species. These areas should be preserved at any cost.
2. Habitat protection and management so that the quality of habitat is maintained only if needed, restored, through continuous monitoring.
3. Species measures for wildlife conservations and management.
4. Nature education and awareness programme for the public and information on maintenance efforts.
5. Core and buffer area planning in Shoolpaneshwar sanctuary. Buffer zone here should be compact. In addition, micro cores are also identified to protect the existing honeycombed habitat and meet with immediate management of habitat.
6. Corridors migration routes of receiving areas have been planned to facilitate genetic exchange and movement of animals, both ways.
7. Carrying capacity has been estimated for most of the major wild animals of the sanctuary. In future, if biotic pressures are reduced and status of Central core portion improved, carrying capacity of sanctuary area can be increased.
8. An important measures succeed is the captive breeding programme for reproduction of wildlife which has either disappeared the recent past or is on the point of disappearance.
9. Eco-development of village coming in the sanctuary area is the most important policy enunciated in the action plan for sustainable development of Shoolpaneshwar sanctuary vital for reducing the pressure on the wildlife pockets.
10. Tourism development is suggested in the Buffer zone to promote interest and awareness in wildlife conservation.

The plantation of fuel wood, timber, minor forest produce, bamboos and fruit species is recommended in degraded forest areas and in cultivated fields of tribals as well as for migration purposes and animal corridors. SMC works like check dams, gully plugging and development of vantalavadi is also suggested.

The Eco-development programme includes development of water facilities, SMC in human habitations, construction of school buildings, provision of mobile store, mobile medical unit's, upgrading livestock and veterinary facilities etc and nature education and awareness programme for local villagers.

Protection measures like wireless networks will go long with wildlife management and research programme, habitat improvement, captive breeding, research stations, bird ringing etc.

Tourism measures envisaged include development of orientation centre, bird observation huts, publicity aid and other measures for attracting tourists.

A detailed break up of each programme and its financial implications for a five-year period is given in the Restoration Plan.

The implementing agency will be mostly the Forest Department. It will network with other Government and Non-Government agencies in order to implement the various programmes suggested in the Restoration Plan.

It is hoped that the action plan suggested by the Expert Group will provide the necessary guidelines for the sanctuary management that will ensure sustainable development of the Shoolpaneshwar Sanctuary.

Maharashtra

The study by Pune University included a felling plan for the submergence areas of Maharashtra prepared for the Forest Department, which is responsible for the felling.

Madhya Pradesh

Scheme for Clear-felling the Forest Areas to be submerged in Sardar Sarovar Project, by the SFRI 1993. This presents a plan for felling the trees in the submergence area of Madhya Pradesh. The plan takes account of the need to leave corridors for the migration of wildlife but notes that due to the heavily degraded nature of the forest in the submergence area, animals appear already to have moved deeper into the forest. The State Government has decided not to declare any more areas as protected even though recommended by the SFRI. This is in accordance with the recommendations of the expert (peer) group constituted by NCA and has been agreed to wildlife board constituted by Government of Madhya Pradesh.

4.1.3.2 Command Area in Gujarat

Protection and sustainable use of plant and animal genetic resources through appropriate laws and practices is proposed in the command area. Action

Plans for development of sanctuaries / National Parks in the vast command of SSP of have been prepared by the project authorities,

- + Nal Sarovar Bird Sanctuary, a freshwater lake which is a site for 120-150 species of migratory birds.
- + Black Buck National Park at Velvadar.

The study relating to Wild Ass Sanctuary in the Rann of Katchch has been completed and the Project Authorities will prepare action plan for its management. It is emphasized here that siphon type structures may be most appropriate so that the canal crossing the narrow neck of the sanctuary may not bifurcate LRK and GRK so that movement of wild asses between LRK to GRK is not affected.

4.1.4 IMPLEMENTATION

4.1.4.1 Implementation of Action Plans

4.1.4.1.1 Gujarat

The detailed study on flora and fauna identified important flora, i.e. plants which although were not endangered or rare in the sub-continent as a whole but occurred infrequently in Gujarat. Specimens of these were collected and were preserved in the University's nurseries. From Rajpipla (East) Forest Division and Environment Cell of SSNNL, some species found in left bank catchment of Shoolpaneshwar Sanctuary, are being raised in nurseries and planted in the blanks of Sanctuary and also along the Narmada Main Canal. These species are very scarece in the Sanctuary area. which are :

1. Azanza lampas
2. Radarmachera xylocarpa
3. Carya arborea
4. Casearea tomentosa
5. Stereospermum sp.
6. Oroxylum indicum.
7. Bambusa arundinaea (Katas Bamboo)
8. Cochlospermum religiosum
9. Buchanania lanzan.

Initial improvements to the habitats of the Shoolpaneshwar Wildlife Sanctuary were completed by the end of 1992. There is also provision for five years of maintenance. The sanctuary presently is managed by the Forest Department as per the approved management plan. Details of the works carried out are presented below.

Improvement works in Shoolpaneshwar Sanctuary, during the year 1998-99.

Sl.No.	Work component	Physical progress
I.	Protection to the sanctuary	
	Fencing	Proposed
	Watch Tower Maintenance	3 No.
	Fire Lines	100 Km.
	Vaccination to the cattle	Proposed
	Stone wall fencing	10262 m.
	Fire post	15 No.
	Fire watchers	35 No.
II.	Habitat Improvement & facilities for wildlife.	
	Supply of water for wildlife	L.S.
	Supply of fodder	Proposed
	Bird observation hut	Proposed
	SMC works (Barricades)	2 No.
	Creation of habitat (Check Dam)	1 No.
	Construction of small ponds	2 No.
	Removal of unwanted species	Proposed
	Advance work of plantations	35 Ha.
	Fodder plantation for wildlife	22 Ha.
	Nala Bunding	2113 Cu. Mt.
III.	Eco development	
	Trench works	
	To provide no conventional energy (Solar light)	6 Villages
	Digging of tube well and Providing hand pumps (3 nos.)	1 No.
	Installation of hand pump	1 No.
IV.	Nature education camp for the population in & around the Sanctuary	Proposed
V.	Wildlife training for the Sanctuary staff	Proposed
VI.	Compensation for the injuries caused by wildlife	04
VII.	Wildlife week celebration	

4.1.4.1.2 Madhya Pradesh and Maharashtra

In view of the GOI policy is that no felling within submergence areas be undertaken more than six months before filling of the reservoir, the felling of trees in the submergence zone of SSP in Maharashtra and Madhya Pradesh shall be carried out at an appropriate time. Plans are already in place.

4.1.4.2 Status of Flora , Fauna And Wildlife Management

Management strategies for all the sanctuaries in the SSP programme are under implementation. Status of environmental management strategy for the terrestrial flora and fauna is presented in the Table below.

	Gujarat	Maharashtra	Madhya Pradesh
• Preliminary Surveys	Complete	Complete	Complete
• In-depth Studies	Complete, Final reports available.	Completed, Final report available	Complete Final reports available.
• Development of Management Options	Complete for Shoolpaneshwar sanctuary.	Plan under review as per the recommendations of the peer group which met during June 2000 and reviewed the implementation of the Integrated Management Plan.	Plan under review as per the recommendations of the peer group which met during June 2000 and reviewed the implementation of the Integrated Management Plan.
Action Plans :			
• Migratory corridors	Not needed	Not needed	Plan ready
• Sanctuary development	Shoolpaneshwar sanctuary Management Plan prepared	Not needed.	Not needed.
• Wildlife conservation measures in adjoining forest(s)	Plans available. Massive afforestation in catchment of SSP.	Under review.	Under review.
• Implementation	Shoolpaneshwar Sanctuary Plan under implementation. CAT work (increasing carrying capacity) completed.	Under review. CAF & CAT nearly completed.	Under review. Substantial CAT works in the catchment completed.

4.1.5 SUMMARY OF WORK TO BE DONE

Baseline studies and analysis of management/mitigation options to conserve terrestrial flora and fauna have been completed for areas affected by the SSP. These studies have indicated the condition of wildlife in the project-affected areas of Maharashtra. A programme for the improvement of Shoolpaneshwar Wildlife Sanctuary is almost complete, but development of the plans in Madhya Pradesh is under review.

4.2 The Aquatic Environment

4.2.1 The Issue

4.2.1.1 Context

Narmada river valley hitherto free flowing, will get converted into large, medium, and small spreads of water exerting profound impact on the riverine ecosystem including its estuarine extent. The impoundment of the Narmada by the SSP will convert a stretch of river between the dam site and the upper limit's of the reservoir, from a comparatively shallow, free-flowing river into a narrow lake about 2 km in wide and of about 210 km long with depth of about 120 meters at the dam site.

In addition, whereas previously 90% of the annual flow occurred during the monsoon period, the dam will regulate the rate of discharge and a substantial amount of water will be retained throughout the year. Consequently, there will be considerable changes in the aquatic environment.

A condition of the environmental clearance given to the SSP by the MOEF was that flora and fauna be surveyed from a conservation point of view. Which included the following

1. **Flora** : Rare and endangered species, gene-pool reserve.
2. **Fauna**: Rare and endangered species, migratory species, migration route, breeding habitat, sanctuary, national park.

Accordingly, the rehabilitation of Flora and Fauna Action Plans cover the following:

- Survey of flora and fauna in the region going to be affected due to implementation of the scheme;
- Gene-pool, if any, likely to be affected;
- Details of wildlife habitats in the region;
- Measures proposed to rehabilitate endangered species of flora and fauna, if any;
- Assessment of the carrying capacity of the neighbouring areas wherein the wildlife would disperse if the scheme is implemented;
- Plan for rehabilitation of endangered Flora and Fauna.

The Environment Sub-group of the Narmada Control Authority subsequently discussed the issues.

The result of studies on the effects of the SSP on the aquatic environment upstream of the dam and the proposed actions to manage these are described in this chapter.

4.2.1.2 Sources of Impact

The impoundment of a river effects it's physical characteristics such as the depth, water quality, sediment carried and therefore the nature of the ecological niches it provides. The dam itself constitutes a physical barrier to the movement of fish. Impacts of the SSP can therefore be expected to include changes in the composition of the aquatic flora and fauna within the reservoir, downstream and in the estuary. Impacts may also be felled in the deep sea as hilsa fish is an anadromus fish.

Three kinds of impacts are of greatest potential significance upstream of the reservoir it's downstream and in the estuary:

- There may be physico-chemical changes in the benthic environment or the water column and consequent impact on the food chain leading to effects on important fish species
- There may be a loss of breeding grounds with adverse impacts on commercial fisheries.
- Fish catches may decline for those who fish in the deep sea.

4.2.2 IMPACT AND MANAGEMENT

4.2.2.1 Studies and Findings

Studies

In India, the overall conservation and development of fisheries is the responsibility of the Ministry of Agriculture (MOA) which directs the efforts of the State Ministries of fisheries. Amongst the benefit's of the SSP which these agencies are keen to exploit is the potential for increased fish catches in the reservoir. A number of studies have been carried out to establish a baseline and help to predict future conditions for aquatic life behind the Sardar Sarovar dam. Many of these studies predated the planning of the SSP but have provided a useful basis for further work and have been reviewed and synthesised by the Central Inland Capture Fisheries Research Institute (CICFRI).

In addition to these early studies, studies undertaken as part of SSP planning include the following.

Gujarat

- + Environmental Impact Analysis, in the Sardar Sarovar (Narmada) Project Studies on Ecology and Environment by Department of Botany, MS University of Vadodara (July 1983).

The Environmental Impact Study of 1983 prepared by MSU catalogued the flora along the riverbanks and examined the planktonic flora and fauna. Data on fish catches was also examined and some preliminary conclusions about the potential for increased fish yields were reached, although further in-depth studies of likely conditions in the deeper parts of the reservoir were recommended.

The report covers issues such as forestry, fishery, zoology, soils, land use, aquatic vegetation, health profile etc. Various experts did primary data generation by visiting the sites during February-July, 1982. On flora, fauna and forest, the report brings out that less hardy species had already disappeared and the hardier ones like teak, Khakhro, Timru and Gugal (all local names) are surviving. Natural regeneration of these species is almost absent. The floristic composition of the forest on the right and left banks of the river is different especially near the dam site. The difference in vegetation is due to slope/gradient and the thickness of soil layer. The density of trees on slopes is low, more so on the right bank than on the left bank. During the survey conducted, the undergrowth was not observed.

The conclusions and recommendations brings out that agriculture would markedly benefited by the project. It has advised avoidance of heavy inputs of pesticides and fertilisers in crop fields in the neighbour-hood of the dam to avoid contamination of the river and canal waters. The fisheries in the upstream by get a boost by development of inland fisheries but the fishing in the downstream stretch might face a set back particularly in the later stages of operation of dam. Suitable measures will, therefore, have to be adopted for development of breeding of Hilsa which is important fish of Narmada river. The report has suggested development of wildlife/bird sanctuaries in the vicinity of the project.

- + Sardar Sarovar (Narmada) Project Development Plan Vol.II Chapter-11 - Environmental Aspects - May 1983.

This Plan analyses the effect of reservoir creation on upstream and downstream areas of the dam. On flora and fauna, the report covers the composition of forest type (dry deciduous), type of slopes, fauna noticed in the area, inland fisheries etc. On fisheries, the report observed that the main groups of major fishes were Carps, Catla, Labio, Catfish, Hilsa and Prawns. It was envisaged that biology of fishing pattern would change from riverine to lake model on formation of the reservoir, which would help a different physical chemical composition of water. The changes may be positive for some species while these may be negative for others. One of the negative impact of the dam in

the downstream would be on migration of Hilsa and giant Indian prawn upstream of the Narmada estuary for breeding. The dam, therefore, will affect the process of breeding and the total fish catch on the downstream of dam including deep sea.

- ✦ Sardar Sarovar Project - Work Plan for Environmental Effects (Sector-Fish and Fisheries) - February 1986.

This Work Plan covered the following 3 stages:

- Investigative studies to assess the impact on fish and fisheries and suggesting mitigative measures.
- Development of fisheries in Sardar Sarovar Area.
- Development of fisheries in four ponds between Sardar Sarovar and Mahi Dam.

In the investigation stage, the thrust was to assess present state of fishing in respect of Hilsa, Prawn, correlation of catch to discharge in different seasons and change in discharge over years, and to identify breeding ground for commercially important species of fish. It was also decided to evaluate probable loss of fish downstream and probable benefit by developing fisheries. For development of fisheries in Sardar Sarovar area, proposed activities were, hydro-biological surveys, jungle clearance in the area to be submerged, stocking of fish seed etc. Training of fishermen was also a component of the work plan.

Maharashtra

Note on SSP - Preparation of Environmental Work Plan for Fisheries Development in Maharashtra, 1987.

This note covered the reservoir details, survey of river basin, deforestation of reservoir basin, fish seed hatchery, stocking, training, management etc. The proposed work plan included location of suitable land for construction of fish seed hatchery, collection of information regarding fishermen who were desirous to take up fisheries as vocation, location of breeding ground before impoundment etc. The work relating to survey of fish fauna of Narmada river was undertaken by Fisheries Survey Division, GOI. It was observed from the survey carried out during the period from 1958-59 to 1969-70 that this river system harbors Indian major carps to an extent of 60 percent. The other local species include *Punties sorana*, *Mystus singhala*, *Wallago attu*, *Notopterus* and *Chana*. It further emphasises that since existence of major carps was established it was essential to supplement the stock of major carps by restoring to stocking of these species in the form of fingerlings for steady fish production from the reservoir. It was estimated that considering the fisheries potential, active work force of about 2000 fishermen will be essential for harvesting the fisheries potential. Families from

affected villages were to be engaged in this activity. Training and management also formed part of the work plan.

Madhya Pradesh

Aquatic Fauna (Fish) Studies in Indira Sagar Submergence Area, prepared by the Friends of Nature Society in 1991 on behalf of the NVDA.

These studies were carried out for the Indira Sagar (Narmada Sagar) Dam. However, due to similarities in the limnological environment, comparisons can be drawn with the SSP. The status of the present fauna was assessed, the changes, which could be expected after impoundment, were predicted and the ecology of more than twenty of the most important fish species was described.

Narmada Basin Water Development Plan for Development of Fisheries by Narmada Planning Agency, GOMP, 1984.

This was a desk study for synthesis of the earlier Limnological and fisheries studies and development of proposal for fisheries management within the reservoir. The report gave detail description of physio-chemical characteristics and the biota in the upstream environment together with an analysis of fish catch statistics, potential impacts of impoundment and a plan for future fisheries development.

Rapid Reconnaissance Survey of limnological Aspects Part I, II and III. 1984 undertaken by the University of Bhopal, Vikram and Rani Durgavati for GOMP.

The stretch of the river within Madhya Pradesh was divided into three zones, east, central and west, of which the western zone abuts the SSP area. The physico-chemical and biological status of each zone was assessed by means of samples taken on several occasions at a number of sites in each of the three zones. This rapid survey provided background information for the setting up of a more detailed study, described below.

Report on rapid Pre-impoundment Limnological Survey of Narmada river for Water Quality and Aquatic Aspects under Narmada Planning Agency - By Department of Limnology, Bhopal University - 1984-85. for the areas in Madhya Pradesh.

The objective of undertaking this study was to decide the work plan on limnological and water quality monitoring studies of western regions of Narmada River. It dealt with the eutrophication analysis of benthic fauna of the sandy basin of the river. It covered rapid survey of the western zone of Narmada River. Detailed sampling of the physico-chemical features, plankton, benthos and periphytonic organisms along with details of aquatic macrophytes were made.

Particle analyses of the sediment samples from different locations were studied. Water samples were collected and analysed from different locations along the Narmada. Study included Morphometry, Physical Kinetics in the river belt, Physico-chemical characteristics, Biological characteristics such as Biomass, Plankton, Periphyton, Benthic etc., Productivity study, Energy Budget, Seasonal Impact Study, Fresh Water Resources Utilization and Fisheries potential were also studied. The report concluded that establishment of reservoir eco-system would help in economic upliftment of this area by providing power, irrigation facilities, increasing food output and fisheries development, opening vast potentials of employment in agriculture power generation, industry and fisheries. This would help to develop a thriving reservoir ecosystem with continued fish yield and preservation of the delicate, niches throughout the extent of the fresh water resource.

The report compared the findings from the impounded reservoirs on the main stream of the Narmada to that of reservoirs like Sardar Sarovar and Indira Sagar proposed to be impounded. The results showed that Bargi reservoir was ecologically healthy because it contained low BOD, chlorides, nitrate, phosphate and algal biomass and a higher concentration of dissolved oxygen. All the reservoirs including Bargi reservoirs did not show any thermal stratification. This might be mainly due to wind action, convective overturn and circulation. These lakes were newly constructed and their ecology was to be developed by succession and establishment of different communities. Narmada River was found to be on very sound ecological health and was considered the least polluted west flowing Indian river. Study made the assessment and recommendations based on the data collected and suggested a long term monitoring. Corrective measures for checking degradation of environment of the river were also discussed. Report also dealt on fisheries in the river Narmada.

The report contained details of limnological investigations in free-flowing regions of the Narmada and in some of the impoundments already completed. Analysis of around 20 physico-chemical parameters was carried out monthly, for two years. In conjunction with this, sampling was undertaken to identify and assess the abundance of large plants and of the planktonic and benthic biota. The Report included detailed analyses of the water samples collected and recommended that the water management measures should be planned and a continuous monitoring and modeling of the lake ecosystem. To prevent silting eutrophication and deterioration in water quality, afforestation in the catchment was suggested in the report. It was pointed out that deterioration in the water quality would otherwise may affect flora and fauna including certain species of fishes. It recommended measures to prevent eutrophication.

Other key studies

Sociological Survey of the Fishing Families of the Narmada River, by CICFRI, 1991.

This report recorded the results of an investigation into the socio-economic status of the fishing communities of the Narmada basin. Over 8,000 families in 453 fishing villages were interviewed with the aid of a structured questionnaire and the results analysed to provide information on the income, secondary occupations, demography, fishing methods, culture, access to social services etc. of the fishing families. The report also recommended strategies for fisheries development

Narmada River Basin Development Project: Fisheries Component, 1991, GOPA

The German consultants to the World Bank, GOPA, studied the potential for fisheries development in:

- The catchment area of the Narmada River;
- The Command Area of the SSP;
- The estuary of the Narmada River.

The report focused on the logistic and costing of fisheries development in the Narmada basin but also provided a summary of the environmental conditions in the SSP reservoir and made recommendations for further studies.

Studies on Fish Conservation in Narmada Sagar, Sardar Sarovar and it's Downstream is a desk review sponsored by the NCA and undertaken by CICFRI during 1994.

The review was commissioned in October 1992 to summarize the existing baseline information on the fisheries of the Narmada basin, investigate potential adverse impacts on the aquatic environment and to recommend strategies for the conservation of important fish species. CICFRI considered over 140 articles of published research on fisheries in the Narmada, in the Indian sub-continent and in impoundments around the world. They also consulted 30 scientists and administrators familiar with the Fisheries aspects of the SSP. The Terms of Reference (TOR) for Fisheries Conservation Studies were

- Listing of all important fishery species found in the river system, which may be categorised, as rare, endangered or threatened.
- Suggest methodologies, research the endangered Fish Fauna,
- Predict the effect of impoundment on estuarine environment of the river keeping in view of the stipulations of Narmada Water Tribunal Award.

The study is a desk review of studies carried out on aquatic life in Narmada River. The emphasis in the report was on identification of endangered, vulnerable and rare species and their conservation through in-situ and ex-situ measures.

The recommendations of the study in the form of Action Plan were contained in the report. The Action Plan had suggested measures to be implemented during pre-impoundment and post-impoundment stage. The Pre-impoundment suggestions included

- Tree felling plan prior to submergence. This would enable smooth execution of exploitation programme.
- Action Plan for Post Impoundment Stage covers stocking norms, multi species stockings based on eco-oriented approach, observation of closed season for allowing possible natural recruitment.

The study covered the Narmada river system and the consequences and impoundment; it enlisted important fish fauna and categorized them under rare endangered or threatened categories. It deliberated on impact of varied land use pattern, fisheries scenario consequent to human intervention, fisheries scenario of Narmada river in space and time besides detailed work out on threatened fish fauna of Narmada river system with reference to Narmada Sagar, Sardar Sarovar and it's downstream. The report also gave detailed description of the rehabilitation, methodologies for endangered fish fauna including artificial propagation. The report described in detail the possible impact of impoundment on estuary at 10th, 30th, 45th year of development.

Mitigation for formation of hydro-sulphuric sludge was described. Management methodology and action plans were suggested. The report stated that as per IUCN Red data book of 1988 does not contain any fish species from India. It also stated that Zoological Survey of India has also not published any list pertaining to threatened fishes of India. However, the study proposed eight species of fishes for consideration as vulnerable from the Narmada River. In other words, there was no threat to the gene pool of the fishes. As these fishes are wide in their geographic distribution. Study suggested rehabilitation programme for fishes through in-situ and ex-situ conservation.

Ecology and Fisheries of the Narmada Estuarine System with Special Reference to Proposed Impoundment (Sardar Sarovar Dam), is an ongoing study begun in 1988 by CIFICRI.

This comprises five sub-projects, as follows:

- + Monitoring of ecological parameters:
- + Assessment of fishery resources
- + Biological investigations and stock evaluation studies
- + Artificial breeding and rearing of Hilsa;
- + Identification of point pollution sources and monitoring of discharges.

The study has been extended to develop models of estuary water quality under different scenario. In addition, pre-impoundment investigations for developing rational management practices are also being undertaken by CIFICRI.

4.2.2.2 Management strategies

Following SSP dam attaining a height of 85 m, excluding humps, the process of initial submergence has been triggered. With accomplishment of stipulated height of the SSP dam, the major consequences of the impoundment will be manifested as follows:

Upstream environment

None of the aquatic fauna of the Narmada is listed as rare or threatened in the "Red Data List" of the International Union for the Conservation of Nature and Natural Resources (IUCN). Nonetheless, CICFRI compiled a list of eight species, which is suggested, could be considered 'vulnerable' in the Narmada Basin though they are present elsewhere in India in abundance. These comprise three species of Mahaseer (*Tor tor*, *Tor putitora*, and *T.khudree*), important food and game fish upstream of the dam site, and one species each of *Rita rita*, *Rita pavementata* *Labeo fimbriatus* and *Notopterus chitala*. Experience of Indian impoundments has shown that all these species can adapt to the conditions in reservoirs and will thrive there. The CICFRI review also presented findings on the artificial hatching and rearing of key fish species. The report concluded that, if appropriate management practices are adopted, there would be no threat to important fauna. The earlier CICFRI report and the report by GOPA recommended specific mitigation measures and CICFRI has also stressed the need for training of fishermen in techniques appropriate to the changed fishing conditions in the reservoir.

Habitat management is an intricate issue since this involves 'Stock Enhancement' with compatible, fast growing and eco-friendly fish species to colonize all the vacant ecological niches came into existence as a result of 'Trophic Burst' on one hand and on the other, device prescription of exploitation based on Maximum Sustainable Yield (MSY) criteria involving adjustment of Catch Per Unit Effort (CPUE). Other important aspects of efficient habitat management encompass, observation of closed season, fishing holidays and gear selectivity.

Stock Enhancement

Stocking of the reservoir is a very vital aspect and in the present context, this has to play dual role of optimising fish yield and conserve the endemic fauna. Further, the subjective purpose of stocking gets more pronounced in case of reservoirs with feeble or no natural recruitment of fishes strategic importance due to a spectrum of factors including disruption of pristine floodplains acting as breeding and initial nursery grounds.

With regard to stocking in the Sardar Sarovar reservoir, multi-species stocking based on the eco-oriented approach and considering the prevailing status of the endemic fish fauna, will have to be resorted to. The essence of stocking with the view to plant the vacant, shared and unshared ecological niches has great relevance to the trophic burst stage and if these niches are not filled up with compatible and eco-friendly fish species, these will get occupied by the minor fishes having higher proliferation rate due to their being prolific breeder. The ultimate scenario which unfolds, remain associated with the dominance of trash fishes leading to low fish yield. This scenario is succeeded by dominance of Catfishes due to abundant forage food but with low yield owing to catfishes foraging at higher consumer level.

For taking decision for the fish species to be stocked in the reservoir, the main pathways for conversion of primary energy into harvestable material need to be established. There are two main pathways, viz. Grazing and Detritus for conversion of primary energy into fish flesh. The extent of contribution of these pathways in the total energy package will decide the spectrum of fish species suitable for stocking in the reservoir. For Sardar Sarovar, similar exercise will have to be taken up for reaching the species combination for optimising the fish yield.

In Sardar Sarovar, Indian major carps, which are fast growing and quite compatible to the endemic fauna of the Narmada River System will be the indispensable major stocking component under multi-species stocking programme. Central Inland Capture Fisheries Research Institute, Barrackpore under its prestigious scientific programme captioned "Exploratory Survey of River Narmada in relation to fisheries and environment" have studied a host of sites over River Narmada, coming under proposed submergence of Sardar Sarovar and this study has indicated the excellence of phytoplankton over zooplankton (Table 4). With the view to utilise the abundant food items (Table 4 & 5), inclusion of herbivores and omnivores in greater numbers is justified. *Catla catla*, *Labeo rohita*, *L. firmbratus*, *L. calbasu*, *Cirrhinus mrigala*, *Tor tor*, *T. khudree*, *T. putitora* may be considered as the most suitable stocking species. Striking a viable prey - predator ratio will also have to be considered for sustained production and taking care of conservational aspects of Sardar Sarovar reservoir. Swingle (1950) has referred a F/C ratio varying from 3 to 6 for the culture system. A lower ratio may be maintained because of competition by the forage fish species with other economical fish species in the reservoir.

Decision regarding number of fingerlings to be stocked is very vital and depends upon the potential of the biotope, which can be calculated by trophodynamic models. The computation of stocking rate may be conveniently reached by utilising the formula proposed by Huet (1900), which is presented as below:

$$\text{Stocking rate (Nos. of late fingerlings Per ha)} = \frac{\text{Total production expected in kg.}}{\text{Average individual growth in kg}} + \text{Loss}$$

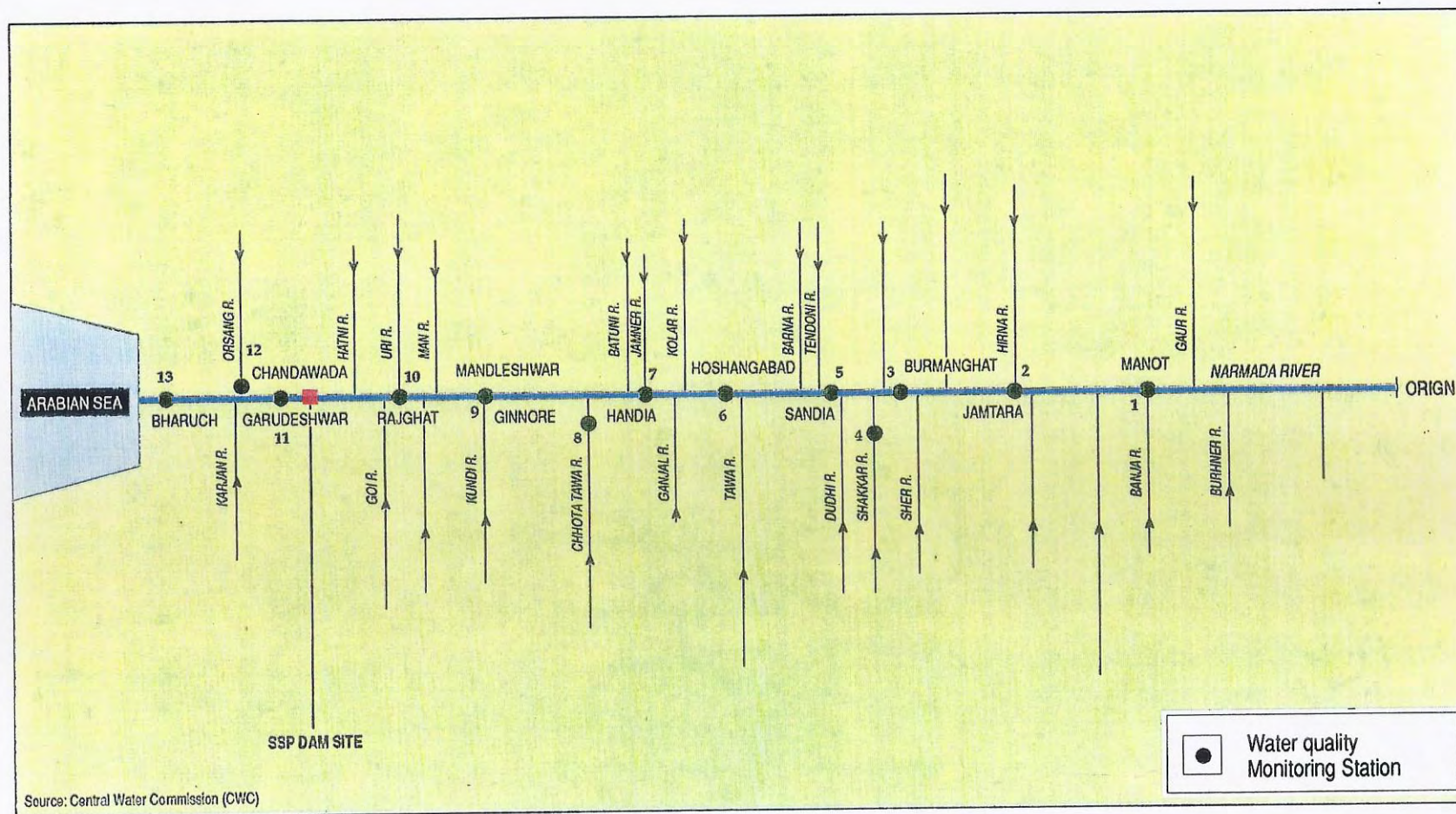
Since at present, the potential of the consequent reservoir is not known, an adhoc stocking rate of 300 Nos. of fingerlings (100 mm size) per ha is suggested. Based on a number of studies undertaken by a host of agencies including CICFRI, Barrackpore, the Narmada river has high abundance of predatory fishes; and crocodiles will have added contribution, a loss allowance of 25% is considered reasonable. The Sardar Sarovar reservoir has average area (FRL + DST /2) of 23,131 ha, so the total number of fingerlings required is computed to be 8.674 million during the trophic burst stage. As soon as the potential of the reservoir is calculated, the precise figure would be utilised.

Rationale for exploitation and other considerations

The prescription of exploitable quota for Sardar Sarovar reservoir will be based on maximum sustainable yield criteria since this has great relevance to realising sustained fish yield and conservation. More precisely, this encompasses maintaining the fishing effort to the optimum level following assessment of fish stock by catch per unit effort, which is a very sensitive tool for deciding the exploitable quota.

Mesh regulation of the gear and observance of closed season will further add towards the judicious management of fishery of the Sardar Sarovar reservoir for optimum returns. A total ban on commercial fishing for at least three years is recommended so as to assess the stock and success of the planted fish species by experimental fishing. This will also lead to development of prospective Breeders. Negative methods of exploitation like dynamiting and use of certain pesticides like Demicron, Thiodiaton etc should be discouraged. Moreover, the conservation of catchment area, rational use of agricultural inputs like fertilizers, pesticides etc. and blanket ban on the release of untreated effluents into the reservoir should be considered under an integrated approach towards fisheries development in Sardar Sarovar Reservoir.

Timber and other physical obstruction clearance is an important exercise towards scientific management of reservoirs and this should be achieved well before the submergence since the cost of post-impoundment clearance is several times higher than that at pre-impoundment. The areas having gentle sloping shore should be considered for clearance up to 5 m depth from economic and utilitarian point of view. This issue of timber clearance has special significance in respect of Sardar Sarovar reservoir because of its high depth 120.68 m, and being sheltered between Vindhyas and Satpura hill ranges acting as natural barrier. Deep reservoirs are prone to thermocline formation particularly during the summer months.



Deep pools may play crucial role in conservation of fish fauna particularly during the months of lean flow and the period of heavy draw down exposing considerable area of the reservoir. These should be declared as fish sanctuaries.

Macrophytic infestation in Sardar Sarovar reservoir is not likely to take place in view of high water fluctuation which is detrimental to the floating macrophytes acting as nutrient sink. These also create hindrance in exploitation operations and cause shadowing, leading to decline in prime production.

Key measures to manage effects of the SSP on the upstream aquatic environment focus on the preservation of valuable fish species and proper management of fisheries in the reservoir. Protection of valuable fish fauna will, to some extent, be dependent on maintaining acceptable water quality upstream of the dam. In order to monitor water quality, the NVDA, CWC, CPCB and CICFRI have already commissioned a series of water quality monitoring stations along the Narmada River. Figure given below indicates the location of these stations.

Downstream environment

Due to changes in the fluvial nature and confined fresh water drainage at the downstream, severe oceanic intrusions further towards river is anticipated. This will cause enhancement in salinity regime, pollution intensity and conditions deleterious to the system. The biotic communities will make comprehensive shift towards predominantly of oceanic origin. Anadromous fishery represented by *Tenualosa ilisha* forming the prime fishery of the estuary will be drastically impacted. The fresh water giant prawn *Macrobrachium rosenbergii* will also be affected.

The downstream of the SSP dam is expected to experience serious repercussions due to containment of fresh water availability. Commensurate with the pace of completion of the upstream projects, the fresh water crunch will lead development of progressive stress conditions involving morpho-edaphic and hydrographic aberrations.

Anthropogenic interference in the form of industrial, agricultural domestic effluents will inflict its own toll and adversely affect the hydro-biological process of the system. This is more relevant and pronounced for the estuarine extent which is surrounded by a large network of industries discharge their wastes. The dilution and flushing process of wastes will be further impacted by the severe curtailment in fresh water discharge particularly during the period of lean inflow months.

With the anticipated changes in the land-use patterns owing to better power and irrigation facilities, point and non-point source of pollution hazards will further

aggravate, and the fishing gears and crafts in vogue may become obsolete and invite modification.

Sardar Sarovar Project (SSP) dam is being commissioned on the mainstream, 5.6 km. upstream of Village Navagam under Taluka Nandod District Narmada of Gujarat State and this dam has attained a height of 85 m. As such, this has triggered the initial process of submergence involving comprehensive changes in upstream as well as downstream of the SSP dam. The construction sluices of SSP dam at EL 18 m were plugged in February, 1994 which temporarily meddled with the normal state of fresh water availability at the downstream. Commensurate with the pace of progress of the SSP dam and other upstream projects, the fresh water availability at the downstream will be constrained which has been precisely documented in the Narmada Water Dispute Tribunal (NWDT) award. As per this award, the fresh water availability from the dam at the downstream will decline from 19612 M.cum at 10th year from the commencement of construction to 5353 M.cum at 30th year while no fresh water discharge will be available at 45th year. As such, the downstream environment will experience increasing stressed condition in relation to the fresh water availability. Moreover, the lower estuarine extent is surrounded on both the banks by a host of townships and large industrial networks bringing in composite effluents. The SSP reservoir will function with subdued capacity till the Narmada Sagar Project (NSP) reservoir is completed since the earlier has to receive water from the later on periodic basis. Under the above mentioned eventualities, the Narmada river basin is bound to undergo comprehensive morpho-ecological aberrations and a host of biotic components of the ecosystem may succumb to the pressure exerted by the emerging scenario and lead to biodiversity shift.

4.2.3 ACTION PLANS

The three State Governments have submitted Action Plans on fisheries as follows:

The Narmada Basin Water Development Plan: The Development of Fisheries, 1984.

This comprehensive plan for GOMP addressed the development of fisheries in the NSP, Omkareshwar, Maheshwar and SSP areas. Phasing and programming with respect of pre and post-impoundment, clearance of the forests, training of fishermen, cooperation societies and post impoundment management were proposed.

Environmental Work Plan: Sector Fish and Fisheries, GOG, 1986.

Revised and updated from time to time. Latest updating was carried out during 1997. The initial work plan submitted in 1986, included the establishment of fish hatcheries and fish farms, training of fishermen, establishing primary cooperatives, and establishing primary cooperatives, and establishing an Inter-State Fisheries Board. In addition, it included proposals for conducting hydro biological studies, studies on the morphology of the river, investigations into the physical and chemical characteristics of the water and soil, and studies on flora, fauna, fish yield, plankton, and productivity in the reservoir.

The latest work plan submitted in 1997 was in four volumes containing details of general background and environmental studies in volume-I, Volume-II contained plans for fisheries development in the main reservoir. Volume-III contained plan for fisheries development and estuarine areas and volume-IV contained the proposal for fisheries development in irrigated command area of the Sardar Sarovar Project.

In Volume – I the information on impoundment impacts on fisheries, compensatory measures planned which included scientific management of the impoundment through eco-oriented approach. Information on a biotic and biotic components resources, fish seeds, reservoir production, fishing culture in ponds, fishing rights, community, implements, institutions and state development plans was given. Objectives of fisheries management in the reservoir, costs estimates were detailed. In volume – II details about the project proposals it's impacts, development strategies, concept of the plan including hatchery and rearing ponds, stocking of fingerlings, fisheries infrastructures, training and extension services, apex organization and societies, management and enforcement, benefit's, cost estimates etc. were discussed in the details. In the Volume-III impacts on the estuary, development concepts and strategies, hilsa hatchery, prawn hatchery, polyculture bonds, brackish water ponds, environmental enhancement, management plan, cost estimates and project benefit's were given in details. In volume-IV development strategies, project details, pond culture, aqua culture in reclaimed, waterlogged areas, borrow pit culture in canals, pilot scheme for carp culture , cost estimates and project benefit's, were discussed in details.

Environmental Work Plan for Fisheries Development in Maharashtra, 1987.

Revised and updated from time to time. Latest updating was carried out during 1992. The initial work plan submitted in 1987 included proposals for the felling in the reservoir submergence zone, fish seed, hatcheries, stocking fishing, manpower requirements, and training and management through the Inter-State Board. Projections of funding requirements were also included.

Subsequently, the state Government revised their plans to address further issues as they arose. The revised plan for GOM included proposals for the fishing population to be resettled on the periphery of the reservoir or in R&R sites

in Maharashtra. In addition, the establishment of low-cost hatcheries and irrigation tanks, the development of pen cage culture fisheries, and intensive fish farming were proposed.

Detailed plans for fisheries development and exploitation were presented in the CICFRI and GOPA reports described above and have been accepted by the project authorities. The main elements are as follows:

- selective stocking of the reservoir with a combination of indigenous fish species.
- research into and instigation of pilot projects for the artificial propagation of important species;
- setting up of an Interstate Fisheries Development Board (IFDB) to control and monitor fisheries exploitation and to coordinate research and development;
- monitoring of potential pollution sources;
- training and/or rehabilitation of fishermen;
- completion of studies to predict the post-impoundment condition of the reservoir

4.2.4 IMPLEMENTATION

On-going Fisheries Activities in the Sardar Sarovar

Some fisheries development activities are already going in the Sardar Sarovar from the year 1992 onwards. From 1993-94, these programmes received the financial support from the Sardar Sarovar Project. These activities are:

- Seed Stocking in the Sardar Sarovar
- Development of Rearing space for Fish Seed Production
- Mangrove Plantation Programme.

Till the March, 2000 State Fisheries Department and other Fisheries Development Agencies have stocked 382.35 lacs fingerlings / yearlings in the main reservoir as well as dykes of the Sardar Sarovar.

There is a provision to create rearing space for seed rearing in the Sardar Sarovar and the funds have been provided by the SSP.

The total amount for the rearing ponds is at present Rs. 64.36 lakh. The site selected for the rearing ponds initially in the reservoir premises was found to be unsuitable on account of higher water permeability of the soil. Hence, another site has been located in the village of Timbi (Nanded Taluk) of Bharuch district, in the Survey No. 303. The soil samples have been sent for analysis to decide the suitability.

In order to avoid any possibility of the formation of hydro-sulphuric sludge after the inundation of forests, all three state governments have prepared work plans for the clear-felling of the forest areas due to be submerged. In Gujarat, reservoir bowl is already cleared of all vegetative growth. Execution of felling in Madhya Pradesh and Maharashtra, will be carried-out *pari-passu* with the commencement of impoundment.

CICFRI have also commissioned to monitor the whole of the estuary and their study has been extended to examine pollution and to undertake Modeling studies in the downstream environment.

Interstate Fisheries Development Board

The creation of an Interstate Fisheries Development Board (IFDB) has been suggested by the NCA and agreed, in principal, by the governments of Gujarat and Maharashtra and Madhya Pradesh which will be an autonomous organisation. The IFDB will have the responsibility for the detailed planning of fisheries development, conservation and management in Sardar Sarovar including training and rehabilitation of fishermen. The Organisation will be constituted in accordance with the agreement amongst the party-States and is expected to be set up and fully functioning prior to complete reservoir filling

In the meantime, an expert group has been set up under the chairmanship of Joint Secretary (Fisheries), Department of Agriculture & Cooperation, Ministry of Agriculture, Government of India. This group was constituted by the NCA on the advise of the ESG to address conservation aspects during and after filling of the reservoir. The issue of adequacy of studies, preparation of action plan, it's implementation etc. are under review of this Group. This group has further constituted a working group to prepare detailed guidelines, to address the issue of fisheries development in large reservoirs, small reservoirs, rivulets, and command area. The guidelines are under draft stage.

Status of Aquatic Fauna Plans

	Government of Gujarat	Government of Maharashtra	Government of Madhya Pradesh
Preliminary surveys work plan	Yes	Yes	Yes
Updating of detailed surveys/studies of fish fauna	Yes	-	Yes
Updated Action plans	Yes	Submitted in 1997	Submitted in 1997
Implementation			
1. Plan for clear felling	Completed	Yes, to synchronise with submergence about 734.00 ha. felled.	Yes, to synchronise with submergence work commenced.

2. Establishment of IFDB for future R&D Management	Agreed	Agreed	Agreed.
3. Expert group to lay down guidelines for Conservation & Development	Yes, agreed by the State and constituted by the NCA. Five meetings held, guidelines are on the anvil.	As per column No.2	As per column No.2

4.2.5 SUMMARY OF WORK TO BE DONE

Survey work has identified the ecologically and commercially important aquatic fauna, and provided information on the likely water quality in the reservoir. Detailed recommendations have been made concerning the development and exploitation of fisheries in the reservoir. A coordinating body for fisheries development will be institutionalized as IFBD. The implementation of the recommendations contained in the plans will be the responsibility of the IFDB, till such time ,NCA /expert group shall coordinate the activities for fisheries development and conservation

A Socio- economic survey of fishing families for the entire basin has already been completed. A contingency plan for the rehabilitation of families fishing in the deep sea and living in the coastal areas of Gujarat has been promised by the Government of Gujarat at the time when impact shall be felt upon full development upstream of the SSP, stage envisioned by the NWDT Award after 45 years from the date of the Award. However, the current developments indicate that to achieve Stage-III shall be ambitious and is unlikely in the time frame given by the NWDTA.

4.3 The Estuary and the Marine Environment

4.3.1 The Issue

4.3.1.1 Context

There are two river tributaries downstream of the reservoir, the Orsang and the Karjan and there is a major Irrigation dam on the latter. Some Irrigation water is also supplied from outside the catchment area. At the head of the estuary lies the town of Bharuch, which has a diminishing role as a port due to the larger size of modern vessels. Commerce and industry continue to flourish, however, and industrial development of both river banks is increasing. In addition exploration for oil and gas is proceeding and it is anticipated that the reserves will be developed for a proposed thermal power station on the north bank of the Narmada river.

There are few remaining areas of natural habitat, which have not been degraded by human activity. This situation will be exacerbated when planned industrial and urban development proceeds. The estuary is used for fishing, however, where several hundred fishermen exploit Hilsa and Prawn fisheries. Hilsa is also fished in the bays of the coast of Gujarat.

This Chapter briefly examined the potential effects of the SSP on the downstream environment by reporting on completed and ongoing studies. The material presented here is summarised from the larger and more detailed study undertaken by the NPG.

4.3.1.2 Sources of Impact on the Downstream Environment

The major sources of potential impact on the estuary and marine environment downstream of the SSP are as follows:

- + Hydrological changes which may lead to low flow regimes which will reduce the probability of flooding but will increase salinity Intrusion downstream and effect aquatic biota.
- + Attenuation of monsoon peak flows, which may influence fish migrations. Increased pollution, when low flow changes concentration of pollutants discharged into the river. Also, as agrochemical use increases in the Command Area, return flows may increase their concentration downstream.
- + Changes in patterns of erosion and sedimentation may affect river morphology and the sea at the head of the estuary.
- + Effects on fisheries may have socio-economic implications for fisherman and their families.

- + Increased availability of water will bring health benefits but changes in patterns of flow may promote the breeding of disease vectors.

4.3.2 IMPACT AND MANAGEMENT

4.3.2.1 Studies and Findings

Studies

There have been a number of studies carried out on the downstream environment. These have been assessed and synthesized in the Wallingford report.

CICFRI has conducted a socio-economic survey of the fishing communities of the Narmada basin, which includes areas downstream of the dam site.

The Sardar Sarovar (Narmada) Project: Studies on Ecology and Environment. This 6-month study was carried out by MSU in 1983. Likely downstream impacts are described and mitigation measures to address them are outlined..

An approach paper on environmental Impact assessment for the river downstream of the Sardar Sarovar dam was prepared by SSNNL in 1992. This considered the likely hydrological changes and the impacts which would arise from these.

CICFRI has conducted studies in the estuary since 1988. These studies have included qualitative and quantitative assessments of the estuarine behavior, the ecology of the estuary, fisheries and an assessment of water quality and pollution.

The Central Water Commission, the Gujarat Pollution Control Board and the National Institute of Oceanography have collected water quality data.

A number of studies have re-evaluated the data found within these reports and contributed views on the likely downstream impacts.

Central Water and Power Research Station (CWPRS) has carried out a series of numerical model studies to allow greater prediction of hydrological, morphological and water quality changes in the lower river and estuary.

In addition, several studies on fisheries, agricultural run-off etc. which may impact the estuary and the marine environment have been commissioned in the Command Area.

Findings

The potential changes downstream of the SSP and studies to address them are considered in the Wallingford report, which summarises the main findings as follows.

It is likely the increased concentrations of pollutants will result in the lower river and estuary, mainly as a result of increased urbanisation, industrialisation and reduced flows.

The studies also suggest the slight probability that salinisation of groundwater may occur during state III, due to reduced river flows. Recharge from irrigation is likely to counteract this however. Freshwater intakes near Jhanor may be affected in the short term by saline intrusion during closure of the construction sluices and the concreting of the stilling basin apron. Impacts of a longer-term nature may also arise when releases from SSP are zero.

It is highly probable that *hilsa* and *giant freshwater prawn* will decline after stage II of the project.

There is a possibility that malarial vector populations will increase after stage II of the project if more areas in which they can breed are allowed to develop.

Few impacts on terrestrial ecology are anticipated. The remaining mangroves are severely degraded and there are unlikely to be biodiversity impacts.

Significant effects on marine fisheries are unlikely and certainly no effects can occur until after Phase I of the project.

It is not envisaged that no major adverse impacts will arise due to changes in channel morphology.

4.3.2.2 Proposed Management Measures :

Much work has been done to collect background information on the fisheries, the socio-economic conditions of fisherman of the estuary, and to prepare places for retraining fishermen. In addition, work is being undertaken:

- To study channel and estuary morphology and salinity modeling in the estuary;
- To study flood routing and risk;
- To assess impacts on downstream aquatic ecosystem;
- To assess impacts to river bank ecology;
- On artificial rearing of commercially, important, estuarine fish species.

The report prepared by H.R. Wallingford also lists a series of monitoring and management actions to be undertaken over different time horizons. Many of the effects on the downstream environment will occur only after substantial volumes of fresh water are diverted for irrigation in stage II of the project. Key actions in the short and medium term however, are:

- ◆ The devising of a plan of action to prevent the short-term loss of flow during the period when the initial filling of the reservoir occurs.
- ◆ The extension of ongoing research into flood wave propagation to investigate the nature of flow surges, which may result when one, or more turbines are switched on.

CWPRS studies indicated that Narmada might be regarded as a well-mixed estuary even after the post dam situation. For fresh water discharge of 45 cumecs salinity intrusion limit was found to be 72 Km only.

On-going studies provided detailed information on:

- fish behavior and fish ecology in the river and estuary, to provide data for predictive modeling Impacts on fisheries;
- regular monitoring of water quality in relation to river discharge and tidal conditions at the freshwater Intakes near Jhanor;
- downstream flood risk at all stages of upstream development;
- flood plan land use zonation to limit encroachment onto newly exposed areas which may be susceptible to flooding under the new hydrological regime.

In the medium to long-term, a priority action is to assess the effects that the SSP will have on the estuary in its several phases of development and under the most likely operating conditions. A single integrated study to address the following issues is to be compiled.

The likely future patterns of discharge from the SSP and the effects this will have on water quality, river and estuary morphology, aquatic biology and, in particular, fish ecology.

The costs and benefit's of providing guaranteed compensatory flows at various levels of discharge.

Policy options to safeguard or replace the freshwater supplies currently drawn from the intakes near Jhanor.

Examination of management options for the limitation and control of effluent from proposed industrial developments along the estuary.

4.3.3 CONCLUSION

The study so far identifies the following as the major potential downstream impacts of the SSP.

Studies done by CWPRS indicated that Narmada estuary is a well-mixed estuary even after the post dam situations for a maximum release of about 3000 cumecs of water. The effect of post dam release of 88 cumecs would be to push back the salinity ingress to be confined within 40 Km from the river mouth.

- ◆ Effects on fish stocks and related fisheries.
- ◆ Water quality changes affecting freshwater intakes and the ecology of the estuary.
- ◆ Possible effects on human health and flood risk.

Recommendations are made for actions for mitigation and monitoring, and much of the work is already in progress under the auspices of the NPG, SSNNL and NCA.

4.4. The Mangrove Areas

4.4.1 The Issue

4.4.1.1 Context

Mangrove forests occupy tropical coastlines and estuaries wherever there is a supply of freshwater entering the marine environment. They inhibit erosion by stabilising riverbanks and coastline, provide habitat for a diverse fauna and can be a valuable source of fuel-wood. Their disappearance from many locations due to human activities is a matter of global concern.

The total area of mangrove forest in India has been estimated at 424,400 ha. Mangrove forest was once present on the island of Alia bet , downstream of the SSP but has been severely over-cut and has largely disappeared. The environmental clearance issued by the MOEF stipulated no specific conditions with regard to the mangrove forest but required a general commitment to investigate possible significant environmental effects and take appropriate environmental safeguard measures. This chapter focuses on the possible effects of the SSP on the remaining areas of mangrove forest and on the potential of the forest to be regenerated.

4.4.1.2 Source of Effect on the Mangrove Forest

The SSP could affect the mangrove areas downstream of the dam in two ways, as follows:

- + Reduced sediment loading in the water released from the reservoir may lead to reduced Island building and some scouring of the islands;
- + Reduced flow of freshwater in years with less than average rainfall could increase the salinity around the islands beyond the tolerance of the mangroves.

4.4.2 IMPACT AND MANAGEMENT

4.4.2.1 Studies and Findings

Studies

Two reports are available to the project authorities to establish the current status of the mangroves in Narmada estuary.

The State of the Forest Report 1991 by the Forest Survey of India reports on the forest cover of the country based on the Interpretation of *Landsat* images for 1987-1989. The forest areas in each state are identified with mangrove forest

areas separately distinguished. The data obtained from the satellite images is supplemented by the results of ground surveys in some instances.

The Narmada Basin Development Project Staff Appraisal Report prepared for the World Bank, 1991, reports on the findings of a mission to the Narmada Basin Development Project areas. Part of this document comments on the existing condition of mangroves in the Narmada estuary and proposes a pilot project to establish mangroves in the area.

Findings

The current condition of the mangrove forest in the Narmada estuary is poor. The comparison of recent satellite images with the older data of the survey of India shows that the size and shape of Alia bet has changed markedly. The area has increased due to silt deposition and low flow has affected the mangroves.

No significant areas of mangrove exist at the moment, and damage to mangroves is unlikely to result from the SSP, yet the responsibility of the SSP authorities is to ensure that, as far as is practicable, aspects of the operations of the project which might affect the re-establishment of the mangrove areas are foreseen in advance and minimised.

4.4.3 ACTION PLAN

The measures for mangrove reforestation in the Narmada estuary are part of the proposed Narmada Basin Development Project. Although these measures may not be carried out, an outline plan and detailed cost summary were prepared for the World Bank by GOPA consultants.

Due to the degraded state of the mangrove areas on Alia bet, it is thought that SSP will have no significant adverse impacts. At some stage in the future, however, the rehabilitation of the mangroves may come under consideration once again as a measure to enhance the breeding ground of fish in the estuary. The preparation of an Action Plan for mangrove areas would then be appropriate however there is no immediate need to constitute such a plan.

4.4.4 IMPLEMENTATION

The proposed scheme to re-establish mangrove forest in the Narmada estuary is an environmental enhancement measure which may be assisted by the regulation of freshwater flows provided by the SSP but is not in response to any adverse impact of the projects. The implementation of this scheme is, therefore, independent of the progress of SSP mitigation measures and outside the responsibility of the project authorities.

4.4.5 SUMMARY OF WORK TO BE DONE

Aspects of the SSP may affect the areas of the Narmada estuary, which in the past have supported a substantial expanse of mangrove forest. The mangroves have reduced to a small fraction of it's original area due principally to human influence but plans are being developed to reestablish mangrove in small areas. Effects of the changed freshwater flow and sediment load after completion of the SSP on mangrove areas are expected to be positive. A strategy can be developed to attempt revival of mangroves.

5. COMMAND AREA DEVELOPMENT

5.1 The Issue

5.1.1 Context

The command area of the project is fixed based on the areas included by NWDT for purposes of considering requirement of Narmada water for irrigation in Gujarat. Accordingly, the GCA of the project is 3.43 million hectares of which culturable command is estimated to be 2.12 million hectares. Thus, the command encompasses a very large area of the state of Gujarat and about 75000 ha area in Rajasthan and is characterized by wide diversity in agro-climatic and socio-economic conditions.

More than 50 per cent of the command area has very low reliability of rainfall. 30 of the 62 talukas of the command have been identified as drought prone talukas by the Irrigation Commission (1972). It is estimated that almost three fourths of the command is drought prone areas.

Maximum and minimum temperatures are known to vary in the command area between 40^o C during May to 5^o C during February. The relative humidity is low most of the time, except during the rainy season from July to September. The mean annual rainfall varies between 1000 mm in the south to 400 mm in the north and northwest. Regions in south of the command fall in sub humid zone, but the north and northwestern regions are semi arid the regions of the command according to levels of annual precipitation are classified as follows:

Sl.No.	Mean annual rainfall (mm)	Regions
1.	800-1000	1, 2
2.	700-800	3,4,5,6
3.	600-700	7,8,9,10
4.	400-600	11,12,13

Narmada Main Canal is 458 km. long and will have a design discharge capacity of 1100 cumecs (40,000) cusecs. It will be the largest carrying capacity canal in the world when completed. About 2500 km. long canal Network including Branch Canals involved in canal automation are spread over the wide area of 34 lakh ha, out of which 18 lakh ha will be the culturable command area (CCA). A large part of this area is characterised by unreliable rainfall and is prone to drought. These factors, together with demographic growth, have made it difficult for the local population to grow sufficient agricultural produce to sustain an acceptable standard of living. When SSP irrigation water becomes available, the impact of drought will be greatly reduced. It will also be possible to increase cropping intensities.

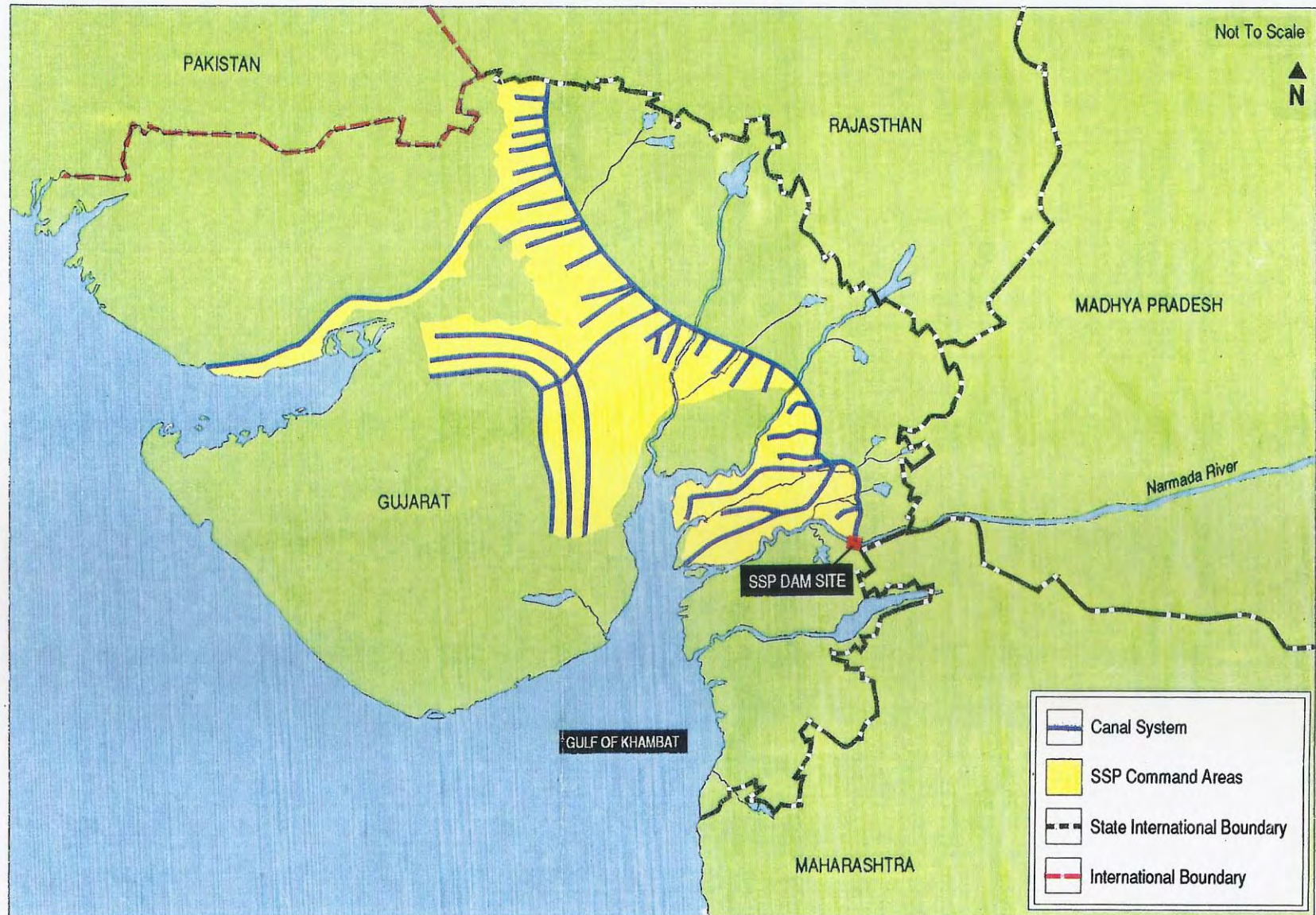
Three fourth of the command is drought prone. However, a very high percentage of the command area is under plough. Soils, ground water and drainage conditions in general are favourable for irrigation and conjunctive use. Some parts of the command present difficulties for normal irrigation but they are also the more drought prone areas of the command.

To safeguard development of irrigation in the vast command, it is important to ensure that the transfer of water to the Command Area does not give rise to the environmental problems, which have been experienced by some water developments in the past. In view of the potentially far-reaching effects of water distribution in the SSP command area, mitigating measures have been determined. The chapter summarises the work completed to date in the Command Area on this aspect.

5.1.2 Sources and Impacts

- » The Narmada Main Canal also known as Navagam Main Canal off-takes from Sardar Sarovar Dam in Gujarat at a full supply level (FSL) of 91.44 m (300 ft.) and traverses through a distance of 458.30 km before entering Rajasthan near village Silu, Tehsil Sanchore, district Jalore. The entire length of NMC is to be lined with M-15 grade controlled concrete.
- » The entire main canal portion in Gujarat is planned to be completed in two phases. Phase - I of the main canal envisages construction up-to Ch. 144.5 km (i.e. upto Mahi river crossing) and the remaining reach from Mahi river crossing up-to Ch. 458.3 km (i.e. upto Gujarat-Rajasthan border) will be covered under Phase - II.
- » In Rajasthan, the Canal runs for a distance of 74 km. The Topography of the area is suitable for a contour canal upto 54.00 km as such in this reach irrigation has been restricted to portion of command on river side only. From Km 54.00 onwards up-to the tail end (km 74.00) the canal has been aligned as a ridge canal to irrigate areas on either side.

The 458 km long Narmada Main Canal (NMC) is designed to carry a maximum discharge of 1133 cumec at a FSL of 91.45m (300 ft) at head regulator. This would taper down to 75 cumec at the tail end at Gujarat-Rajasthan border where the FSL in the canal is fixed at EL 44.96 m (147.5 ft) as mutually agreed to between the two States. Cross regulators with radial gates would be provided in the Canal to control water levels within safe limit's, during normal and emergency operations, to store all water during shut-down and to isolate reaches and river crossing in case of failure. Diversion to the branch canals would be through radial gated turnouts and no other delivery facilities would be provided in the main canal. River crossings where the canal is confined in a structure, would incorporate multiple barrels or channels to allow isolation of individual monolith to facilitate their repairs. Gated weir escapes of



limited capacity would also be provided. There would be 196 structures on the main canal upto km 144 and in all 590 structures upto Gujarat-Rajasthan border at km 458.

There will be 42 branch canals having a total length of 3500 km (including sub-branches) taking off from NMC with discharges reducing from 320 cumec to 3 cumec. The major branches of the system are Miyagam branch (86.66 km), Vadodara branch (115.00 km), Saurashtra branch (104.60 km) and Kachchh branch (329.18 km). The largest branch in capacity is the Saurashtra branch which negotiates a series of falls and lifts generating electricity at falls in the process, which will satisfy a part of the power, needed for the subsequent lifts.

Distribution system will comprise of 7500 Km of distributaries and nearly 30000 km of minors and sub-minors. The aggregate length of the distribution network including field channels will be about 75000 km. The NMC is contour aligned and passes through inhabited areas and cultivated field in the districts of Narmada, Bharuch, Vadodara, Panchmahal, Kheda, Ahmedabad, Gandhinagar, Mahesana and Banaskantha.

Provision of water from the SSP to the Command area will have a great many beneficial effects associated with increased water supply for domestic use (particularly in securing supplies of drinking water to Kachchh and Saurashtra), for industry and for agriculture. Potential effects, which have been studied and considered in the design and environmental management plan for the command area, are discussed below.

1 Agricultural practices and socio-economic changes

To facilitate the change from rain fed to irrigated agriculture, it will be necessary to ensure the provision of adequate training, agricultural extension services and facilitates such as markets and supply of inputs.

2 Drainage, waterlogging and soil salinity

When land is irrigated, provision is made for the drainage of excess water. If drainage is inadequate, waterlogging of the soil can occur which can damage most crops. This can also promote the transport of salts to the surface by capillary action and lead to salinisation of the soil. These effects can reduce agricultural potential.

3 Flora and Fauna

Increased availability of fresh water may positively affect flora and fauna. In particular, availability of water in the wildlife preserves of Gujarat provides an opportunity for enhancement of wildlife habitat. Electricity transmission lines and canals passing through forests in the Command Area is unlikely to exceed 100 ha. according to SSNNL estimates.

4 Fisheries

The volume and quality of return of flows from the irrigated lands through rivers and streams and into the marine environment may have some effect of marine fish. This issue is being dealt with separately.

5 Public Health

The increased availability of fresh water should have beneficial effects on public health within the Command Area. There are, however, potential negative effects, which may result if pools of stagnant water are allowed to develop which mosquitoes can use as breeding grounds.

6 Water Quality

Surface and ground water quality in the command Area may be affected by agricultural run-off, saline groundwater extractions, changes in surface flow regimes, and municipal and industrial discharges. The polluted water may contaminate drinking water supplies or other water uses downstream of the command Area or in another streams whose catchments lie within the Command Area.

5.2 IMPACT AND MANAGEMENT

5.2.1 Studies and Findings

Studies

There have been many background studies on environmental conditions in the Command Area and likely effects of the SSP.

Government of Gujarat have undertaken several studies related to the command area development. Most of these have been completed. Government of Gujarat have formed an expert Multidisciplinary group to coordinate the studies and for drawing up the needed plans. The various studies are listed below:

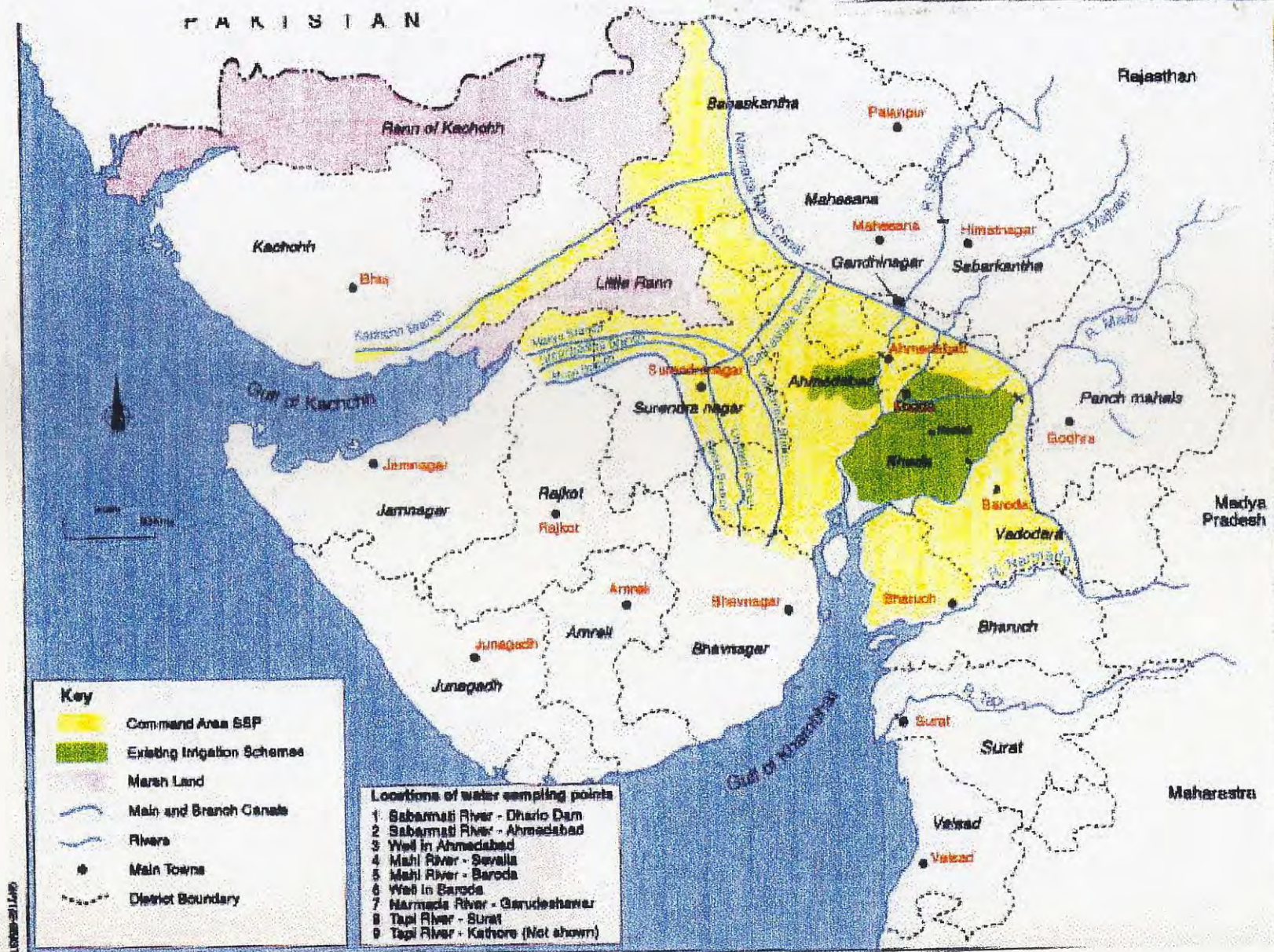
Agricultural Practices and Socio-Economic

- + 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
- + A Study of Settlement Pattern (6 Talukas in the Narmada Command Area of Mahesana Distt. of Gujarat).
- + Department of Geography, Gujarat University, Ahmedabad.1982
- + Regionalisation of Narmada Command, Operations Research Group, Vadodara.1982.

PLATE – IX

LEGEND

SSP command showing administrative district boundaries.



- + Socio-Economic Bench Mark Survey of 62 Talukas (Sub-districts) of Narmada Command Area. Fourteen Different Agencies including Universities Research Institutions etc. 1983
- + Population Projection and Migration Study for Narmada Command Area. Operations Research Group, Vadodara. 1983
- + Consumer Expenditure, Assets and Indebtedness of Rural Households of the Command Area of Sardar Sarovar (Narmada) Project. Directorate of Economics & Statistics, Gandhinagar. 1983
- + State 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
- + Land Use and Cropping Pattern Survey and Mapping of Narmada Command Area Zone 4A & 4B. Department of Geography, M.S. University, Vadodara. 1986
- + Growth of Agro-Processing Industries in Phase-I of the SSP. Gujarat Industrial & Technical Consultancy Organisation Ltd. Gandhinagar. 1990
- + Studies in Water Rates Policy, in 3 parts:
- + Pricing of a Public Utility Survey of Literature. Department of Economics, South Gujarat University, Surat
- + Financial working of Irrigation Projects - A Case of Four Projects in Gujarat. Department of Economics, Sardar Patel University, Vallabh, Vidyanagar.
- + Some Policy Issue for Canal Water Rates in Gujarat. Department of Economics, Sardar Patel University, Vallabh, Vidyanagar. 1992
- + Economic Dimension of the Sardar Sarovar Project. S.P. Institute of Social & Economic Research, Ahmedabad. 1995
- + Wasteland Development Project for Command Area of Narmada Canal (Region 11 and 12). Gujarat State Rural Development Corporation Ltd., Gandhinagar. 1984
- + Cropping Pattern and Waste Demand Study in Narmada Command Area. Operations Research Group, Vadodara. 1987
- + Study on Preparation of a Detailed Integrated Command Area Development Plan for SSP. M/s. Wamana Consultants Pvt. Ltd., Hyderabad. 1994

Drainage, Waterlogging and Salinity

Groundwater Studies

- » Mathematical Modeling of Ground Water System for single layer model- Narmada Mahi-Doab by Operations Research Group, Vadodara. Completed in 1982.

This study was taken up as a preliminary study, to deal with recharges due to rainfall and due to irrigation inputs of varying levels and rise of varying level of pumping. The study provided initial insights for planning for future ground water development on introduction of surface irrigation.

- » Mathematical Modeling of Ground Water System Narmada Mahi Doab. By Operations Research Group, Vadodara. Completed in 1985.

And

- » Additional work of Mathematical Modeling of Ground Water System Single Layer Model-Narmada Mahi-Doab. By Operations Research Group, Vadodara. Completed in 1985.

These detailed modeling studies dealt with recharges due to rainfall and due to irrigation inputs of varying levels and rise of Ground Water over time with varying levels of pumping. Based on these results, the ground water development in command area is visualised in planning of the SAP.

- » Survey and Investigation Work of Ground Water Resources in Narmada Mahi-Doab by Gujarat Water Resources Development Corporation Ltd. Gandhinagar. Completed in 1987.

This study was carried out for determination of hydro geological and hydrological parameters of the aquifers. The study has provided useful information regarding water levels and water quality for conjunctive use and to control the problem of water logging after surface irrigation starts.

- » Mathematical Modeling of Ground Water System for SSP Command between Rivers Shedhi and Sabarmati by Consultancy Engineering Services, New Delhi. Completed in 1993.

And

- » Mathematical Modeling of Ground Water System for SSP Command between Rivers Sabarmati and Banas by Operations Research Group, Vadodara.

And

- » Mathematical Modeling of Ground Water System for SSP Command beyond Banas upto Rajasthan Border by Dalal Consultants, Ahmedabad. Completed in 1993.

These modeling studies dealt with recharge due to rainfall and due to irrigation inputs of varying levels and rise of ground water overtime with varying levels of pumping. The studies provided insights for planning for future ground water development on introduction of surface irrigation.

- » Hydro geological Impact Assessment Study by H.R. Wallingford. Completed in 1995.

This was a review of earlier drainage studies. It has provided information about the revised drainage co-efficient.

- » Survey and Investigation of Ground Water Resources beyond river Mahi upto border of Rajasthan in SSP Command Area.

This study was carried out for determination of hydro-geological and hydrological parameters of the aquifers. The study provides useful information regarding water levels and water quality for conjunctive use and to control the problem of waterlogging after surface irrigation starts.

Drainage Studies

- » Pre-feasibility Level Drainage Study of Narmada Mahi-Doab of SSP Command, by Core Consultants, Ltd., Ahmedabad. Completed in 1982.

This study has been carried out for assessing the drainage requirements of the command area upto Mahi. Drainage co-efficient for each region are worked out and accordingly surface and sub-surface drainage requirements are planned.

- » Pre-feasibility level Drainage Study for SSP Command beyond River Mahi. By Consultancy Engineering Services, New Delhi. Completed in 1993.

This study has been carried out for assessing the drainage requirements of the command area. Drainage co-efficient for each region are worked out and accordingly surface and sub-surface drainage requirements are planned.

Floral and Faunal Studies

- » The Sardar Sarovar Narmada Project Studies on Ecology and Environment by Department of Botany, M.S. University, Vadodara. Completed in 1983.

The objective of the study was to suggest ways and means of achieving optimum utilisation of the Narmada Waters without any appreciable damage to the river ecosystem and to collect the data on various parameters of ecosystem, to assess likely changes and to suggest remedial measures for negative impacts, if any. Based on the findings of the report, work plans for Forest and Wildlife, Public Health and Fish and Fisheries have been prepared for implementation.

- » Study on Flora and fauna of the Command Area of Sardar Sarovar (Narmada) Project lying between the Narmada and Sabarmati Rivers (EIA studies) by Sardar Patel University, Vallabh Vidhyanagar. Completed in November 1995.

The study was taken up to assess the Environmental Impact of the SSP on Flora and Fauna based on experience of Mahi irrigation Project. Based on recommendation of the study, the floral and faunal management plan is to be prepared.

- » Study on Flora and Fauna of the command area of Sardar Sarovar (Narmada) Project lying in Saurashtra and Kachchh Area (EIA) Studies by Saurashtra University, Rajkot. Completed in January 1996.

The study was taken up to assess the Environmental impact of the SSP on Flora and Fauna based on experience of Mahi irrigation Project. Based on recommendations of this study, the floral and faunal management plan is to be prepared.

- » Study on Flora and Fauna of the Command Area of Sardar Sarovar (Narmada) Project lying between Sabarmati and Rajasthan Border (EIA studies) by Gujarat University, Ahmedabad. Completed in March 1998.

The study was taken up to assess the environmental impact of the SSP on flora and fauna based on experience of Mahi Irrigation Project. Based on recommendations of this study, the floral and faunal management plan is to be prepared.

- » EIA on Downstream of Sardar Sarovar Dam upto Gulf of Cambay by M/S H. R. Wallingford. U.K. Completed in April 1995.

This was taken up to evaluate the environmental impacts on the downstream in the initial stage of 25 years of this project. The results of this study will be used for downstream area planning.

- » Ecological study on Wild Ass Sanctuary and surrounding Area Using Remote Sensing Technology for Environmental Impact Assessment by Gujarat Ecological Education and Research Foundation, Gandhinagar. Completed in 1997.

This study was taken up to determine various land use classes by remote sensing to monitor the trend of *prosopis*, salt and grass land in and around the sanctuary. The information of the study report will be utilised for detailed EIA study of the sanctuary.

- » Environmental impact Assessment of Nal Sarovar Bird Sanctuary by Gujarat Ecological Education and Research Foundation, Gandhinagar. Completed in 1998.

The study was taken up to assess the impacts of canal irrigation in and around the Sanctuary area. Based on the recommendations of this study, the Action Plan for Nal Sarovar Bird Sanctuary is to be prepared.

- » Environmental Impact Assessment of Velavadar Black Buck National Park by Gujarat Ecological Education and Research Foundation, Gandhinagar. Completed in 1997.

The study was taken up to assess the various impacts of surface irrigation) and around Sanctuary area. Based on the recommendations of the study, a draft action plan has been prepared and as per the suggestions of experts, the final Action Plan is being prepared.

Fisheries

- » Environmental Impact Assessment Studies on Inland Marine Fisheries relevant to the Command Area of Sardar Sarovar (Narmada) Project, by M.S. University, Vadodara. Completed in 1995.

This study was taken up to assess the impacts of SSP Canal water on fisheries. Based on recommendations of the study, fisheries development programme (an action plan) for Phase-I area has been prepared by the Commissioner of Fisheries.

Health

- » Environmental Impact Assessment (EIA) studies on Water Related Diseases in Sardar Sarovar Project (SSP) Command Area including the Area Down Stream of the SSP Dam by Commissionerate of Health, Medical Services Medical Education, Government Of Gujarat, Gandhinagar. Completed in October, 1995.

The study was taken up to assess the impacts of canal water on water related diseases. Based on recommendation of this study an action plan for health sector for the SSP Command is being prepared.

Water Quality

- GWSSB(1983) Study to determine Municipal and Industrial demand; parallel study on Sabarmati basin by GPCB(1989).
- GPCB Compilation of water quality data for 10 selected rivers in Gujarat under GEMS (WHO Supported) and national MINARS Project; Limited ground water monitoring by GPCB.

Findings

The command area encompasses twelve districts, viz Bharuch, Vadodara, Panchmahals, Kheda, Ahmedabad, Gandhinagar, Mahesana, Bhavnagar, Surendranagar, Rajkot, Banaskantha and Kutch. Total number of the talukas of these districts wholly or partially covered in the command is 62 and about 3344 villages of these talukas are expected to be served by the project for irrigation.

The Canal system would command a gross area of 3.43 M ha. and cultivable area of 2.124 M ha. It is envisaged to irrigate annually 1.792 M ha. with the availability of 9 MAF of surface water from the project. From management point of view, for laying down a set of prescriptions for crop pattern, water allocation and management, conjunctive use etc., the command has been divided into regions based on the following factors:

- (a) Annual rainfall
- (b) Land irrigability class including drainage characteristics
- (c) Ground water quantity and quality in terms of ground water table and salinity of water in the upper aquifers
- (d) Alignment and the command of major branches.

Considering these factors, the command has been divided into 13 regions. The main regions, their names, GCA and CCA are as follows:

Sl.No.	Name of the region	Region No.	GCA	CCA
1.	Sankheda-Savli	1	2531	1619
2.	Sinor-Vadodara	2	2731	1876
3.	Bharuch-Amod	3	1532	849
4.	Vagra-Jambusar	4	1113	368
5.	Mehmedabad-Daskroi	5	2957	1923
6.	Sanand-Kadi	6	1817	1257
7.	Dholka-Dhandhuka	7	4760	2643
8.	Limdi-Botad	8	2940	1826
9.	Halvad-Malia	9	2684	1680
10.	Viramgam-Dasada	10	3446	2421
11.	Sami-Harij	11	1917	1152
12.	Radhanpur-Vav	12	4628	3197
13.	Rapar-Mundra	13	1229	428
	All regions	14	34285	21239

The Soil Survey Manual (IARI 1970) recognises six irrigability classes.

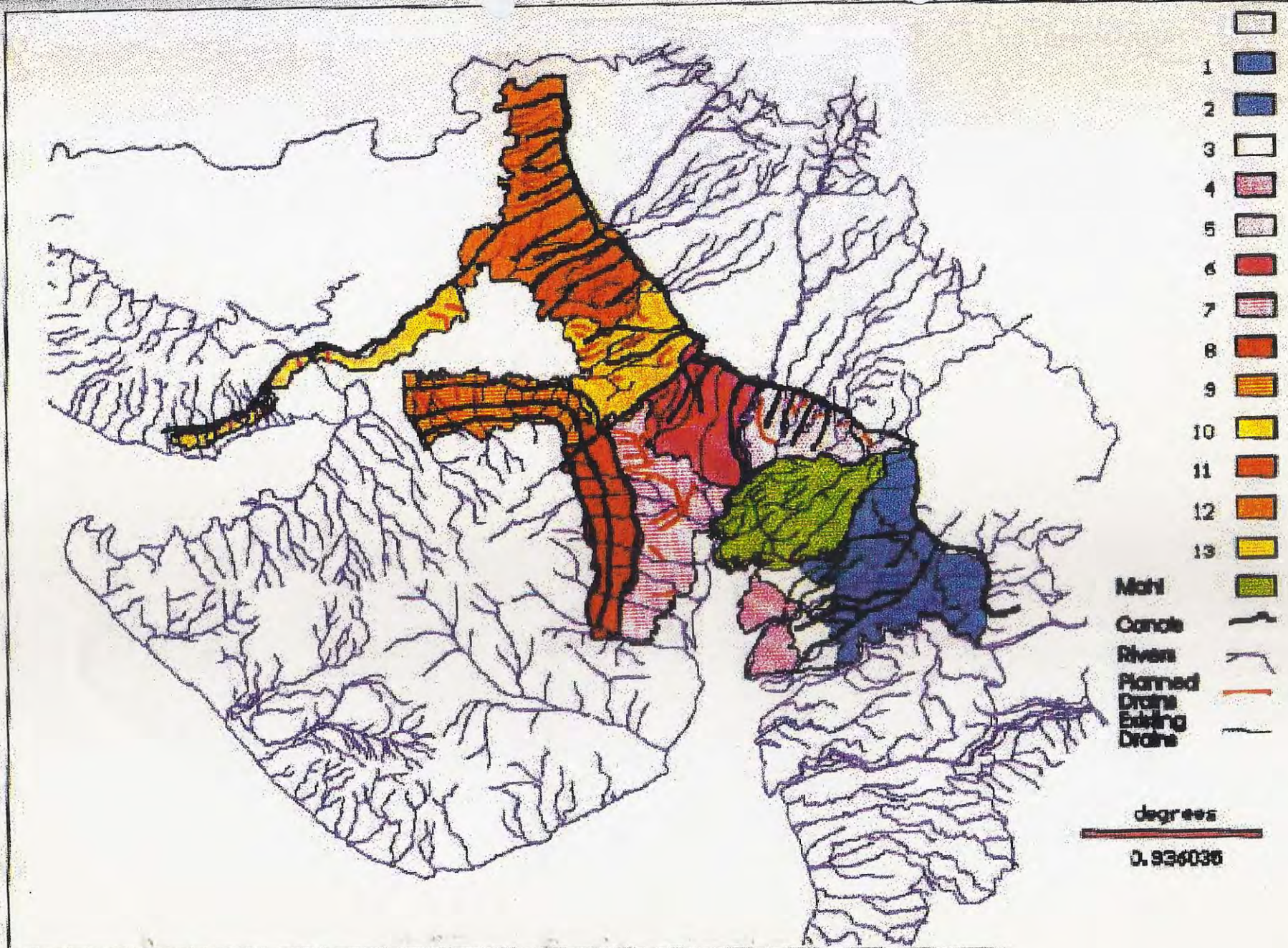
- Class 1 : Lands that have few limitations for sustained use under irrigation.
- Class 2 : Lands that have moderate limitations for sustained use under irrigation.
- Class 3 : Lands that have severe limitations for sustained use under irrigation.
- Class 4 : Lands that are marginal for sustained use under irrigation because of very severe limitations.
- Class 5 : Lands that are temporarily classified as not suitable for sustained use under irrigation pending further investigations.
- Class 6 : Land not suitable for sustained use under irrigation.

PLATE – X

LEGEND

**Regionalisation of the Narmada command into 13
agro-climatic zones.**

Figure 1 Agro-climatic regions of SSP in Gujarat



Surveys were conducted in the command area between 1957 and 1969.. Map showing irrigability classes was prepared based on surveys and presented to the NWDT. On the basis of the available data regarding classification of soil and land irrigability classes, it is found that all regions are good for irrigation except some critical areas in regions 4 and 7 which would require special plans for water use.

Soils

Soils in the State can be grouped into six broad types i.e.

- (i) deep black,
- (ii) medium black,
- (iii) coastal alluvia,
- (iv) alluvial loam,
- (v) alluvial sand and
- (vi) desert sand.

Regions of Narmada-Mahi Doab have primarily alluvial sandy soils. Parts of Regions 2, 3 and 4 upto Mahi river have alluvial sandy soil. Region 4 has also some saline area on the coast. Regions 5 and 6 also have alluvial sandy soils. Region 7 has medium black soils with coastal alluvial soils on the coastal side. Large area of regions 8 and 9 have medium black soils with some parts having coastal alluvial soils. Regions 10, 11 and 12 have coastal alluvial soils

Irrigability of the deep black cotton soils, medium deep soils and sandy soils have all been dealt with from a scientific angle.

(a) Black soil is a loose scientific description. In soil science, clayey soils conventionally difficult to manage are vertisols which have high swelling-shrinking characteristics containing mont morillonites. Sardar Sarovar Project command has only 16 per cent of pure vertisols of GCA (with reference to CCA, the percentage may be around 10 to 12). Another 15 per cent soils in GCA are vertic inceptisols which are less difficult to manage. Large part of the command has inceptisols very suitable even for conventional irrigation. The following table summarises the position.

Soil Types	Regions	Percentage of gross area (rounded up)
(a) Vertisoles (including aridic)	1,2,3,4,7,13	16
(b) Vertic inceptisols (deep)	1,2,3,4,7,10	15
(c) Vertic Inceptisols (medium deep)	1,7,8,9	4

(d) Inceptisol	1,2,5,6,7,8,9,10,11,12	45
(e) Entisols	5,6,8,9,13	8
(f) Others	All regions.	12

(b) World over, there are 271 million ha of vertisols and associated soils spread over almost all continents. In India, these amount to 70.3 million ha (21.4 per cent of geographical area). Large parts of these are irrigated either from groundwater or by surface water and water management practices are by now well defined and documented. Vertisols are being irrigated especially when severe moisture deficiencies during crop cycles bring down their production potentials. Case of Rahad Project of Sudan is highlighted in Chapter 3. Adequate land preparation (borders, ridge and furrows etc.), timings of irrigation, stream sizes to be used for water deliveries to borders and furrows are all factors related to scientific water management land. With these measures, vertisols can be well managed. Maintenance of adequate moisture levels to avoid cracking is practically possible. Most farmers of Gujarat know and practice this.

(c) In highly sandy soils (not exceeding 10 per cent of GCA) also, water management measures comprising adequate stream size, narrow borders, etc. hold the key to efficient water management. The frequency between irrigations has to be smaller compared to clayey soils and delta (depth) per watering limited but in a rapid burst. Farmers in Dailtiwada command of Gujarat are irrigating such soils with very good dividends.

(d) There is a view that black soils should be irrigated by groundwater, but not by canal water. Apart from the question of feasibility of doing all black soil irrigation with available groundwater resources (which are found depleting), it is seen that most farmers irrigate black soil lands by borders or ridge and furrows through water courses and field channels even under tubewell irrigation. These are surface channel systems, similar to those of 8 ha turnouts under Sardar Sarovar Project. Conventional flood irrigation with 60 to 100 ha chaks is totally ruled out under Sardar Sarovar Project and the critics have not perhaps become familiar with Sardar Sarovar Project infrastructure and water management. Under the systems planned, black soil irrigation will be successfully done.

Sardar Sarovar Project systems, thus, are so designed and institutional mechanisms so planned that all soil types can be irrigated. Limited water allowance and volumetric pricing impart a value to canal water. Farmers, at present, grow crops and will be encouraged to grow crop sequences that are consistent with the agro-ecological regimes of the areas. Farmers of Gujarat have been practising canal and tube well irrigation since last 3 to 4 decades in different soils and are also well aware of land preparation needs. Even then, farmer training is an important constituent of command area development programme.

Agricultural development

The command area cuts across taluka and district boundaries and therefore it becomes a little difficult to compile socio-economic statistics from the normally maintained statistical information for talukas and districts. With a view to generating information base for the command and regions of the command, socio-economic benchmark surveys have been conducted for the talukas in the command. For obtaining the estimates of debts, assets and consumption levels, another special survey has been completed. The socio-economic profile presented here is based on these surveys.

The land use pattern in the command is significantly different from that in the State. As compared to the state average, a very high percentage of area in the command is under cultivation (net area sown) and a very low percentage is culturable waste.

Land use pattern in the command area

Sl.No.	Category	Command	State
1.	Net area sown	70.1	50.1
2.	Current and other fallows	7.6	4.7
3.	Culturable waste	3.2	10.6
4.	Other uses	19.1	34.0
Total		100.00	100.00

Average size of holding in the command is 5.3 ha against 3.7 ha for the State, but the variations among the regions are notable. Average size of holdings in region 1 to 6 is smaller (less than 4 ha) than that for the other regions. Cropping intensities are lower than 110 in all regions except region 5 which has an intensity of 118. Irrigation intensity of 15.5 per cent for the command is lower than that of the State (18.5%). Regional variations in irrigation intensities are wide. Regions 2, 5 and 6 have intensities higher than 25 per cent, while most of the other regions have intensities lower than 10 per cent. The irrigation development is mostly due to ground water exploitation. Regions 2, 5 and 6 are the best regions, while regions 4, 7, 10 and 12 are the lower rung in this respect.

Cropping pattern

Cotton, bajra, jowar, wheat and paddy are major crops in the command. Cotton is the predominant crop (about one third) in the command but bajra and jowar, the low value cereals, loose their places in favour of high value cereals paddy and wheat. This points to the fact that farmers switch over to high value crops like cotton, paddy, wheat etc. whenever their risk aversion capacity is enhanced by irrigation.

Wheat in regions 4,7 and 11 is grown as an unirrigated crop. Toor is a long duration crop like cotton, but is favoured in regions 2 and 3 because of relatively higher level of prices and its low water and other input requirements. Ground nut is important in regions 8 and 9 which are part of Saurashtra area, traditionally growing this crop. Tobacco has its importance in region 1,2, and 5 which has fairly large pockets of sandy soils with good drainage conditions.

The consumption level of irrigating cultivate household is about 12 per cent higher than that of the nor irrigating cultivator household.

Net irrigated area has increased from 191 thousand hectares in 1965-66 to 310 thousand hectares in 1977-5 i.e. by over 60 per cent mainly on account of sinking tube-wells and wells by the cultivators in the command. As a result gross irrigated area as a percentage of gross cropped area has increased from 8.6 per cent to 15.5 per cent.

The increase in net irrigated area in the command upto Mahi (regions I to 4) is of the order of 94 per cent and in the regions beyond Mahi, it is 51 per cent. The difference in the increase partly reflects the semi arid conditions obtaining in most of the regions beyond Mahi and comparatively adverse ground water situations in regions 7, 8, 10 and 13.

The creation of irrigation facilities has emboldened the cultivators to adopt technological improvements and innovations to increase agricultural production. The availability of short duration varieties of paddy resulted in replacement of long duration un-irrigated varieties of paddy and the early release of land under paddy coupled with irrigation availability and high yielding varieties of wheat prompted the cultivators to expand area under irrigated paddy and in-gated wheat. The cultivators have also readily availed of the opportunity to improve their production both in quality and quantity by allocating in favourable agro climatic situations a large proportion of available irrigation to HYV of long staple cotton and in-gated tobacco. Comparing the average of the command for triennium ending 1967-68 with that ending 1977-78, the area under irrigated paddy increased by 40 per cent, under irrigated wheat by 23 per cent, under irrigated cotton by a whopping 72 per cent and eightfold under irrigated tobacco. The increase in irrigated cotton and tobacco is mainly accounted for by regions upto Mahi. It is indeed a feature of the agricultural scene in Gujarat, shared by the cultivators in the Narmada command, that even the marginal and small farmers allocate 25 to 40 per cent of the gross cropped area of their holdings to commercial crops.

Another feature of the farmers response to adoption of new technology of agricultural production is the level of associated inputs viz. fertilizers, pesticides and insecticides. The fertilizer consumption is estimated at around 50 kg / ha of irrigated area in the command.

Groundwater systems

Groundwater systems of SSP command area constitute a significant resource for cost effective augmentation of water for irrigation along with surface water from canals in a conjunctive use framework. They are also very important from considerations of dependable assessments, scientific exploitation, and management to ensure sustainable agricultural development of the command area with least environmental hazards of waterlogging and long-term salinity build-up in soils. They have been recognised and treated as such through systematic and scientific studies after 1980 by GOG, the Nigam, Gujarat Water Resources Development Corporation Ltd. (GWRDC) and the NPG.

Aquifers for groundwater development cover a gross area of 24320 sq. km. constituting 71 per cent of the gross command area and the remaining 29 per cent area is underlain by rocky sub-strata at shallow to medium depths. The geology of the command area is dominated by large outcrops of recent fluvial deposits in the form of an alluvial plain, bordered in the north east by hilly outcrops of deccan traps, Mesozoic and Paleozoic sediments and Precambrian metamorphic rocks. To the southeast, the plain comes up against outcrops of deccan trap volcanics, Gatacesu sandstones and tertiary sediments interrupted by the Gulf of Cambay and Little and Great Rann of Kachchh. The structure of the area is essentially that of a graben aligned in the NE-SE direction with a series of step faults on each side overlain by alluvial covers.

Taking into account the physical characteristics like region wise density of rivers and streams, outfall conditions, average stream gradients, salinity status of upper aquifer, depth to ground water table, soils and rock formations, area suitable for ground water development in each region has been estimated as follows :

Sr. No.	Region	Total area	Alluvial area	Hard area	Saline area	Net suitable area for ground water development
1.	1	2530	550	19600	-	2530
2.	2	2730	2730	-	260	2479
3.	3	1530	1530	-	650	880
4.	4	1110	1110	-	8800	310
5.	5	2960	2760	200	170	2790
6.	6	1820	1600	220	160	1660
7.	7	4760	4450	310	3590	1160
8.	8	2940	1580	1360	1150	1790
9.	9	2680	2400	280	1650	1030
10.	10	3450	3450	-	1650	1800
11.	11	1920	1920	-	1070	850
12.	12	4630	4630	-	2230	2400
13.	13	1230	820	410	820	410
14.	Total	34290	29530	4760	14200	20090
15.	%	100	86	14	41	59

It is found that regions 1,2,3 and 6 are good for ground water development. Regions 8, 9 and 12 are moderately good and other regions are relatively poor. The estimated ground water potential in regions 1 to 4 at present is about 530 Mcm per year (0.35 MAF) while that in regions 5 to 13 is 830 Mcm per year (0.67 MAF).

Considering the outfall conditions and average stream gradient for drainage, conditions vary between good to very good in all the regions except regions 4 and 7 which have unfavourable conditions.

The main aquifer of the command area underlies the plain and comprises quaternary complex of alluvial sands and clays. This occurs in most of the regions 1 to 7 and 10 to 13. Over a large part of the command area, the alluvium is over 100 meters thick with proportions of sands of 50 to 75 per cent. However, in areas near the coast (Gulf of Khambhat) and the trough between Saurashtra and the main land, the alluvium is largely clayey. The other aquifer of relevance is Mesozoic structure in region 9. Much of region 8 is underlain by deccan traps, which may possess limited secondary permeability. Rocky strata in general (deccan traps and sedimentary meta morphics), may have limited primary (inter-granular) and secondary permeability indicating some scope of exploitation by shallow wells.

Investigations of Ground Water

Because of their programme of exploitation of groundwater by drilling tubewells over the entire mainland command area since 1970, Gujarat Water Resources Development Corporation (GWRDC) have acquired an adequate database in respect of aquifers which has facilitated groundwater studies. GWRDC has been given specific assignments by GOG/Nigam in respect of ground water investigations of the command area and this has been treated in manageable hydrological parts comprising that between Narmada and Mahi, between Shedhi and northern boundary of the command area and that comprising Saurashtra and Kachchh peninsular command area. The investigations comprise:

- a. Installation of piezometers fo various depth in aquifers.
- b. Automatic water level recording installations,
- c. Drilling observation wells in aquifers,
- d. Conducting long duration pumping tests,
- e. Installing hydro-meteorological stations,
- f. Establishment of piezometer nests in the area beyond Mahi (being tackled at present).

The work in the area upto Mahi is completed by GWRDC with 78 piezometers and 18 observation wells in place and that in the area beyond Mahi with 144

piezometers and 33 observation wells in place is nearing completion. Regular observations are being taken in the command area upto Mahi.

The command areas of Saurashtra and Kachchh including areas with rocky sub strata (at small depths below) are being now taken up for assessing hydro-geological properties of available traps and sandstone formations including some sediments over a limited area. The investigations done have provided a dependable framework not only for ground water use planning and setting up of groundwater models (dealt with later), but also for providing a sound scientific data base for systematic monitoring of groundwater levels (including quality parameters) well before the project has started water delivery to the command area for irrigation.

Mathematical Modeling of Groundwater Aquifers

It was found convenient in consultation with the experts to treat the groundwater aquifer of the command area for mathematical modeling by its divisions into manageable hydrological units bound by natural large rivers like Narmada, Mahi, Sabarmati and Banas. Varying aquifer properties could be better handled and captured by such units and it was found that some outflows to the rivers could also be integrated treating the rivers as fixed head boundaries. The scheme of regionalisation for the command area of agro-climatic planning as well as irrigation inputs fitted very well with such a basin wise treatment.

Groundwater mathematical modeling techniques and solute transport models provide power instruments for planning, operating and managing complex ground water systems. Some of these techniques have been used for the command area aquifers. The models if adequately framed and validated can provide useful insights on the following:

- a. Broad quantities of usable groundwater that could integrate with surface water for conjunctive use.
- b. Areas vulnerable to waterlogging with their locations

Mathematical models have been developed using the services of Indian consulting firms for the command area at different time stages as under and these together represent about 71 percent of the command:

- | | | |
|----|---------------------------|-------------|
| a. | Narmada-Mahi doab | 6430 sq.km. |
| b. | Shedhi-Sabarmati doab | 1660 sq.km. |
| c. | Sabarmati-Banas doab | 11610 sq.km |
| d. | Banas to Rajasthan border | 4630 sq.km. |

The following strategies of conjunctive use by groundwater pumping, are highlighted:

- a. In general farmers or farmer organisations are expected to develop new or additional groundwater in the Village Services Areas (VSA's) through tubewells, bore wells, open wells etc. because of limited surface water allocations. The present groundwater use in the command itself is of the order of 980 MCM (0.80 MAF). The farmers would be fully supported in this venture and bankable projects for tubewells/wells may be prepared. Some incentives are also being considered.
- b. The present public tubewells operating in the command area under GWRDC will be integrated in the framework.
- c. Where groundwater development at VSA level is otherwise not viable (hard rock areas of poor yields or for saline areas where groundwater is to be wasted and pumped out), the Agency in charge of management will drill and operate the tubewells and wells as required.
- d. In general, as soon as water table is about to reach 5 m below ground in the command, the Agency will step in to ensure that appropriate arrangements for conjunctive use or pumping (and disposal outside) are set in motion so that significant waterlogging is not allowed to develop in the command area. The project provides for conjunctive use tubewells and tubewells for vertical drainage in the cost estimates, a feature unique to SSP.
- e. The experience of Mahi project indicates that farmers do come forward for conjunctive use once they have realised the value of water in their crop production systems.
- f. Education and training of farmers has been clearly recognised as an essential component for water management and conjunctive use.

Horizontal Drainage

SSP is planned and being implemented integrating therein a framework of vertical drainage as well as horizontal drainage, each fulfilling its technical and environmental role. Vertical drainage through conjunctive use or pumping is covered earlier is found useful because of its water augmentation value as well as that of countering waterlogging and salinity. On the other hand, horizontal drainage through surface or sub-surface drainage (as and when needed) is also planned and being operationalised to meet the following objectives:

- a. Draining excess rainfall storm water from agricultural lands for sustained crop productivity. This is at farm levels as well as at regional levels.
- b. Draining storm water accumulations from large depressions, borrow areas etc. by connecting it with regional drainage systems.
- b. Sustaining soil resource base for agriculture through better aeration and maintenance of soil structures.
- c. Mitigating environmental hazards relating to public health, conservation of biota etc.

Two studies catering to surface drainage have been completed covering the whole of command area. Horizontal surface drainage works in Narmada-Mahi Doab in respect of operational design and layouts of surface drainage network commencing from 40 ha chak units is under implementation concurrently with irrigation network for maximum farm outputs and environmental sustainability.

Special Problematic Areas

There are certain special areas in Narmada command along the gulf of Khambat which would pose problems, if irrigated conventionally. Parts of Dhandhuk Dholica, Vallabhipur and Bhavnagar talukas in region (generally known as Bhal) and Jambusar, Amod and Vag talukas in region 4 (generally known as Bara tract) fall under this category.

Bhal Area

In the Bhal area the elevation of the land is 15-30 ft above GTS (GTS is approximately mean sea level), whereas lowest points on the coast are below 15 ft contour. Below 15 ft contour, the land is flooded for prolonged periods during high tides. Apart from the natural slope slight difference in elevation occur within the area. These local differences of a few feet are caused by differences in soils.

The soils of the Bhal area belong almost entirely to two great soil groups, i.e. vertisols (black cotton soils) and inceptisols (recent alluvial soils). Vertisols which constitute 65 to 75 per cent of area are most problematic soils from management point of view. They are heavy clays, which shrink considerably when dry and swell when moist. Due to low permeability (0.04 to 1.0 cm/hour) waterlogging conditions are created during monsoon. The soils have pH values (1:2 soil water extract) between 7.5 and 9.5, the electrical conductivity (on 1:2 swe) is in the range of 2 to 80 mmho per cm; cation exchange capacity varies from 10 to 60 m.eq/100 g.soil. There is appreciable amount of exchangeable cations in the soils and the general order of exchangeable cations is Na⁺, Ca⁺⁺, Mg⁺⁺,K⁺. Exchangeable sodium percentage varies from 5 to 70. Inceptisols are characterised by high salinity and very low permeability; consequently they cannot be reclaimed by simple means and within a reasonable time. These are mainly found on the low-lying surface of the former creeks system and on the tidal flats.

The climate of the Bhal region is tropical semi arid, which has a marked influence on soil formation and cropping pattern. The average annual rainfall varies from 420 to 750 mm of which 80-90 per cent is received during July September. The rainy season usually starts in the middle of June and continues

upto middle of September. The distribution of rainfall is quite uneven. The interval between two successive rains in a month also varies widely resulting in uncertainty of water availability to kharif crops. The annual precipitation in Bhal area is very low accounting for about 45 to 50% of annual evapo-transpiration demand. The prolonged summers, short and mild winter and low erratic rainfall are main features of the climate. The coastal area on Bharuch side has conditions that are slightly more favourable. The amount of precipitation under prevailing conditions is too meager to leach lime and soluble salts to great depth and hence the soils in general have high base status. The flat topography of the region has made drainage and salinity problems more complicated.

Farm holding in these areas are bigger as compared to other regions of the state. Bhal area has bigger holdings as compared to Bara tract. The percentage of area and percentages of farmers relating to land holdings exceeding 5 ha in different talukas

Boundaries of Bhal area are not identified precisely. However, the land below 30 ft. contour along the coastline of the Gulf of Khambhat can be termed as Bhal in view of its general characteristics. Corresponding to region 7 of the Narmada Command (Dholka, Dhandhuka, Vallabhipur and Bhavnagar talukas),

Soils and drainage are the main limitations. In a sizable area both the limitations are present. Vallabhipur and Dhandhuka talukas have more arable land, whereas in Bhavnagar taluka the proportion of wasteland is more. Crops are grown on most of class 6 land also. The EC value (1:2) range from 1.27 to 14.00 mho per cm. This indicates that the local varieties of crops (jowar, cotton and wheat) are highly resistant to salinity.

National Agricultural Research Project, Arnej also in Dhandhuka Taluka has been concentrating on evolving suitable technology for improving dry land farming and is experimenting with water harvesting for protective irrigation. There are a number of social service organisation experimenting with methods of harvesting water and using it for light irrigation with very encouraging results (Dholera Bhal Sewa Samiti in Dhandhuka taluka and Khadi Gram Udyog Samiti at Dhingda in Dholka taluka). Khadi Gram Udyog Samiti, in lands situated at about 30 ft contour, is producing about 30-35 qtl. of paddy per hectare with 2-3 protective irrigation of 10-12 cm each from village tank. A well managed wheat crop has yielded 25 qtl./ha during 1981-82 with one protective irrigation.

Bara Tract

On the coastal fringe, there are coastal salines (kharlands) which almost non-reclaimable. Then there are patches of land which have turned saline because of frequent inundation during monsoon. The rest of land is cultivated, though, mostly without irrigation.

Cotton is the most preferred crop in the area. When the rainfall is timely and not excessive, the area under cotton is high. In years when the rainfall is high or there is flooding due to run off from the upper region the cotton crop is either damaged or not sown and the land is kept for wheat. Thus, the proportion of the area under cotton and wheat vary according to the total rainfall and its intensity. The variety of wheat grown belongs to durum group and fetches a premium over other varieties due to its quality as bread wheat. Jowar (kharif and partly rabi) is cultivated for fodder and grain. In some areas gram is also sown in rabi season. Rabi crops are raised on residual moisture.

Rainfall in this area is scanty and erratic. Drought situation is very frequent. Sub soil water is mostly saline. However, the villages have tanks, which are filled in during the monsoons and are the main sources of water for domestic purposes. Open shallow wells are located either on the sides of the tanks or in tank beds and such wells yield potable water. In general, there is scarcity of water for domestic needs and in bad rainfall years, the conditions become severe. The state government have a programme of supplying drinking water which is to be carried through pipelines over hundreds of kilometers. This has been attempted for a number of villages at heavy costs and yet the needs of even human and animal consumption in those villages are not fully met.

The essential points of irrigation (or water supply) strategy for these areas is that without attempting to reclaim the lands not cultivated, water is supplied to the relatively better patches of land in this area (which mostly form blocks of substantial sizes). It is envisaged to provide restricted irrigation to the crop varieties already prevalent in the area. Consistent with this restricted use of water, a simple network of water distribution system is visualised.

Region 4 covers a GCA of 1,11,000 hectares. The annual rainfall varies from 480 mm to 750 mm. The region comprises mainly alluvium derived from basalt brought down along the rivers Mahi, Dhadhar and Narmada and their tributaries. The alluvium consists of alternate beds of clay and silt, which are lenticular. The land has a flat gradient, becoming flatter towards west. Surface slope gradient changes from 1 per cent to 0.1 per cent. The soils have low permeability in most of the parts (clay loam to clay) and are poorly drained. However, extensive patches of soils with good drainage are also encountered (sandy loam to silty loam). The water table varies from 5m to 10m during pre-monsoon season. No monsoon inundation is reported in this area except for the portions near the mouth of arterial drains. The area under the command is not affected by tidal waters. The common species of natural vegetation encountered in the area are babul (*Accacia arabica*), *Prosopis juliflora*, *kerda (carissa)* etc. 6.2 The existing cropping pattern in region 4 is given in Statement 9.5. In order to have a further view of the possibilities of agriculture, its pattern and extent in region 4, a detailed land use mapping study was taken up for 46 villages of Jambusar taluka. This study was based on cadastral maps and consolidated village crop records and land use records for three year (1979-80, 1980-81 and 1981-82). Field wise uses of land for three years were looked into and field visits

were made to clarify ambiguities and to fill in the gaps in records. After bringing the filled-in maps to the laboratory, the plots or blocks with similar uses or crops were combined to make bigger blocks, their boundaries marked with red lines and unified letter-symbols or signs put in. The village cadastral maps with all the new 'blocks' shown were then reduced to one-fourth of their original scale with the help of pantographs, on sheets of tracing paper. These reduced maps were transferred to drawing sheets and the mosaic of the sheets was prepared to give a total view of the area. Reading the land use maps along with soil classification map it is seen that LI class I to 5 (Area I and Area II) are cultivated. Net sown area for these village;) worked out to 10.61% of total area of these villages. Uncultivable waste is more than 28% which mainly includes the coastal saline.

Reconnaissance soil surveys are carried out in this area. A land irrigability map is prepared based on the survey. The land in the entire region is grouped in three categories on which the strategy of irrigation is discussed hereafter. Land irrigability classification is given in Table 9.4. The areas covered by land irrigability (LI) Class 2 and 3 work out to 29,600 hectares. This area is designated as Area 1. The area covered by LI Class 4 and 5 measures 39,200 hectares. This area is designated as Area II. The areas in LI class 6 covering 18,300 ha are designated as Area III.

There is a general belief that Bara tract is bad for irrigation in view of difficult soils and difficult drainage. The land irrigability classification in region 4, however, indicates that there are extensive patches of good to bad soils in this area. Use of surplus water in the initial stages can be thought of for surface leaching to promote germination and initial growth of plants, which over time can sustain them.

Lands in Area I are comparable to other areas planned under normal irrigation in Narmada command. Area II has relatively flatter slopes and the soils can take very limited water for irrigation. Local inquiries and field visits have revealed that the cultivators prefer one or two watering of 100 mm depth per season both for kharif and rabi. The cultivators are very much aware of the limitations of land and prefer limited irrigation as per need rather than regular flow irrigation. One of the ways to irrigate this area is through excavated tanks, which can be filled through a conveyance system. Though lands in Area I are better, these are interspersed with Area II lands and hence would face drainage problems similar to those in Area II. Therefore, a common strategy for irrigating Area I and Area II in this region is proposed. However, Area I can have a little higher provision of water compared to that for Area II within the overall restriction on water application. Water can be made available to farmers who can lift it for irrigation through low heads. The tanks can have FSL at or below ground level (GL). The advantages of this type of water delivery are outlined below :

- (a) The land in this region is flat and distributaries or minors traversing in this area if planned for flow irrigation will have to be taken in full banking to

permit gravity flow to and within each field. This means relatively high costs for distribution system.

- (b) The surface soils being heavy in texture marginally saline in nature, and as such poor in strength the maintenance of the distribution system would be difficult.
- (c) As farmers have to make efforts to lift water for field application and in conveyance upto field water will be used judiciously by the farmers. The operational losses will be considerably reduced. This can avoid waterlogging and salinity problems.
- (d) The storage ponds being at or below GL, the problem of salinization of areas surrounding the tank will be avoided. Sizeable areas surrounding tanks for flow irrigation built on similar soils under the Mahi command have degenerated into saline areas.
- (e) Filling in of the tanks in this area enables tapping of sweet water from shallow wells located by the side of the tank or in the bed of the tank. This water is available for domestic use even after the tanks dry up seasonally.

Flora and Fauna

Based on the reports received from the three universities, which conducted the E.I.A. studies, the following are the identified impacts.

- + Irrigation will bring about sub-humid conditions in the various regions. This would be favourable for most crops trees of the area. Thus, semiarid regions of northern part of North Gujarat (region 12), Bhal area of Saurashtra (region 7) and Kutch (region 13) will also have partially sub-humid conditions in irrigated tracts.
- + SSP aims at diversified cropping patterns. Introduction of dry land horticultural crops on fallow and on areas not otherwise irrigable by gravity is also on the anvil.
- + Overall agricultural and tree-shrub biomass base will be substantially augmented. The range of biomass diversity adapted to sub-humid conditions is also likely to be larger. The following depicts the crop ranges of the area with stabilisation of irrigation and indicates that monocultures or limited ranges of cultures are not likely.
- + Studies show a rich potential for farm forestry, agro-silviculture, and forestry on saline and marginal lands. Including the canal side plantations on 18,000 ha, a conservative estimate indicates potential for plantations and tree culture of at least 3.27 lakh ha for the command area as a whole. Yields of grasslands in regions 4, 7, 8,9,10,11, and 12 will improve significantly with better propagation of perennial varieties like *Cynodon dactylon*, *Dichanthium annulatur* *Panicum*, *Paspalidium* etc.
- + Certain grass species and vegetation belonging exclusively to arid or desert climates may not thrive well as found from experience of Rajasthan Canal. However, since over 30 per cent of the geographical area will not

- have irrigation networks, the species may continue in these areas and this aspect is to be studied in depth.
- + Certain weeds may show accelerated growth of farmlands, drains, etc. and weed control strategies may have to be used. Weed problems in canals will not arise (when these are well maintained) because of lining down to 8 ha units.
 - + If waterlogging develops in certain areas, new aqua vegetative systems with weeds are likely to develop.
 - + There will be no impacts on major fauna since this is a present trend to agricultural regimes. Certain avifauna reptiles and rodents may proliferate. Avi fauna diversity will increase with a number of tanks and water bodies kept full as seen from the experience of Mahi command.
 - + Steps for protection of the following flora and fauna species indicated presently as rare in the region to be taken are in the form of conversation measures in specific areas identified or setting up herbaria etc. Universities will be involved for creation of gene bank pools to the extent required.

Sanctuaries

- For Nal Sarovar Bird Sanctuary (area 115 sq.kms. contribution from Sardar Sarovar Project waters will arise only when there are droughts and the lake does not fill up due to natural run-off from the catchment area. Studies done hitherto indicate that positive impacts can be expected with zoning out the lake area, protecting the habitat of migrant birds on the shore and a sound scientific plan which accommodates needs of the local communities for fishing and grazing. Utility of Nal Sarovar as a storage mechanism for supporting lift irrigation not likely to be favourable. Quality of agricultural run off to Nal Sarovar from the catchment area (which will be irrigated) is planned to be regularly monitored in the long run.
- As regards Wild Ass Sanctuary (area 4,953 sq kms), the overall impact is likely to be positive mainly because of availability of fresh water in waterholes for the wild Asses and better growth and sustenance of grasses. However, the sanctuary is under some pressure because of salt industries and intrusion of cattle. Wild asses often damage crops on the periphery. The Kachchh Branch crosses the neck dividing the Little Rann and the Great Rann and the most appropriate structure for the crossing is being worked out so as not to impede the movements of wild asses. Siphon type structure appears to be quite promising. Management plans will be worked out considering the salt industries, which have entered the Little Rann in a big way as also the pressure of cattle on the periphery. Better development of bio-mass on the islands, if brought about as a part of planned development, may reduce damages to the agriculture crops on the periphery by wild asses as observed at present. However, if the interior is not conserved, the impacts can be the just opposite.

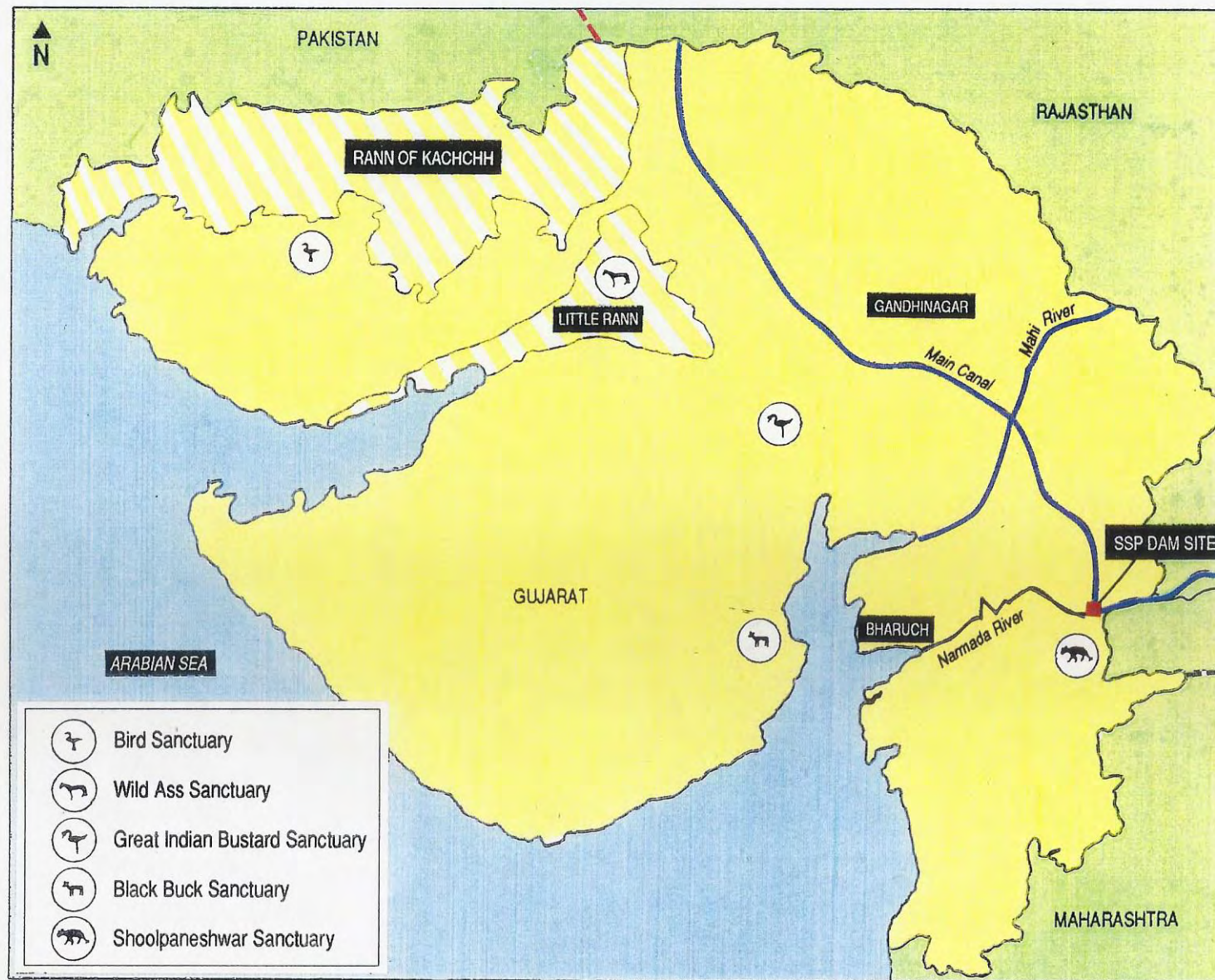


PLATE - XII

LEGEND

**A map of Wild Ass Sanctuary in Runn-off Kutchch
Inset Wild Ass from the sanctuary area.**



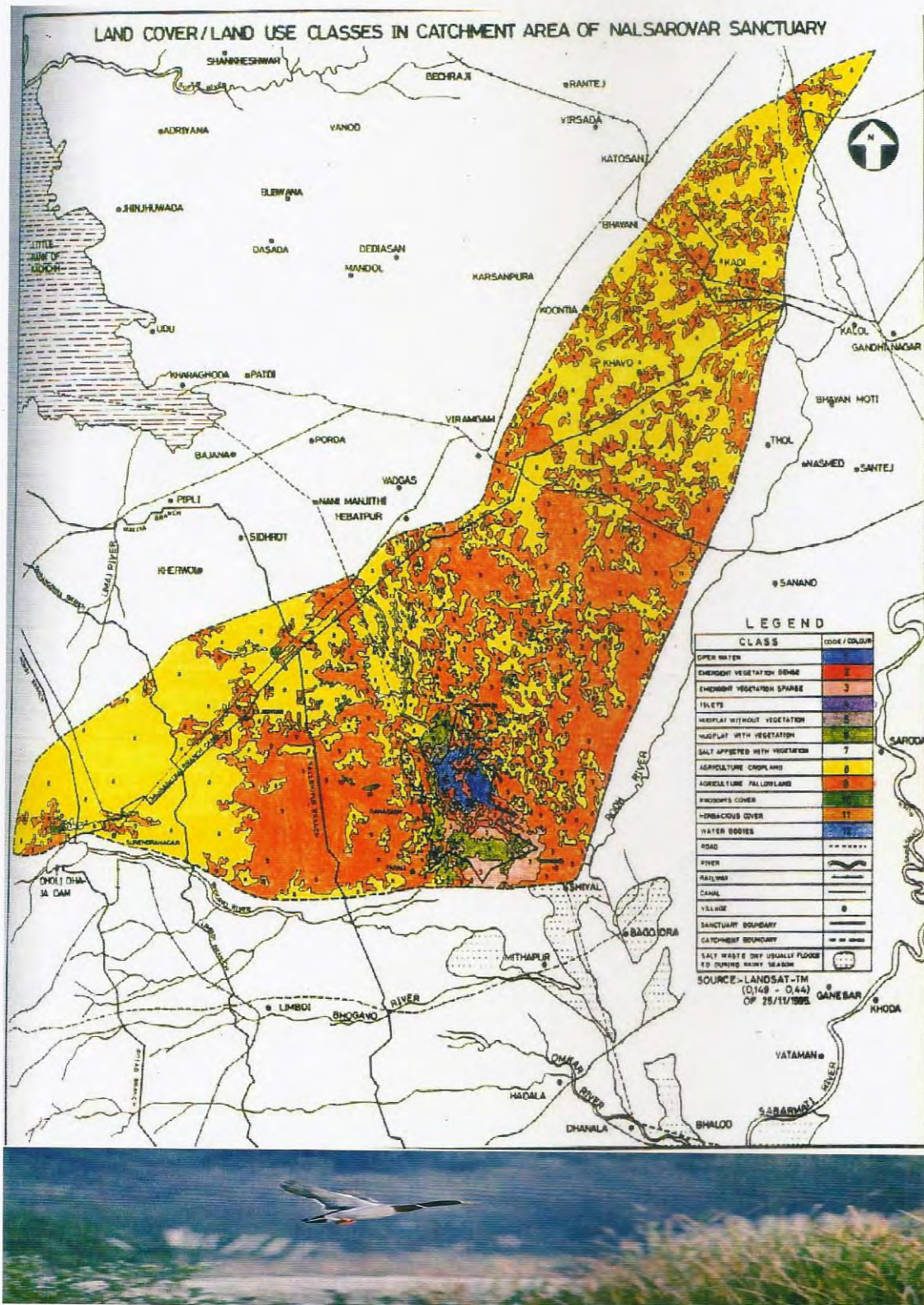
PLATE - XII

LEGEND - XIII

LEGEND

**MAP SHOWING CATCHMENT
AREA OF NAL SAROVAR BIRDS SANCTUARY**

PLATE - XIII



As regards the Black Buck Sanctuary (area 34 sq kms), the Sardar Sarovar Project will create a very positive environment because of supply of fresh water which is highly deficient in the area. However identified negative impacts are listed below :

- + Wildlife habitat may be reduced in ecological zone due to the change in the land use and cropping pattern.
- + With increase in agricultural production, Blackbuck may start frequenting the fields, thus possibly increasing human/animal conflict.
- + Through there is very little likelihood of water-logging in ecological zone, some patches may face waterlogging creating small patches of saline marshes for short period.
- + Likely increase of pesticides and insecticides may affect migratory harriers and some other avi-fauna in ecological zone.
- + There is very little likelihood of a change in the microclimate in or around the park area.
- + Possibility of increase in water/moisture content in the soil may bring some change in plant communities especially Cyperaceae, Gramineae and some herbaceous species. There is likelihood of increase in area under *Prosopis juliflora* in parts of ecological zone.
- + There may be some increase in human activity, disturbing some wildlife in the ecological zone.
- + Increase in Blue bull population, due to the changed circumstances may cause problems of crop damage in surrounding areas of the National Park.

In general, for all the three sanctuaries, the networks are so planned as not to create problems of wild life movement and these are not extending anywhere inside the sanctuary limits.

Fisheries

The Narmada River is a rich source for fresh water fisheries as well as fishes of the estuarine region. Impacts on these are dealt with in a separate chapter. As regards the command area, the present status of inland fishery development being modest, there is a potential for development of inland fisheries on which the Fisheries Department of Government of Gujarat is at present concentrating. Narmada waters will be available for inland fisheries development for at least 20 to 30 years and later on inland fisheries can sustain on groundwater and regeneration water. Large inland fisheries projects will be independent entities and will themselves invite environmental impact assessments. However, the project will be instrumental to a large inland fisheries development programme. Water quality standards and their maintenance would be important factors for this programme. Experience in Gujarat especially under Mahi-Kadana and Ukai-Kakrapar Projects has shown that inland fisheries will receive a major boost because of the Sardar Sarovar Project. Currently there are

no problems of related pollution of water bodies in the existing command areas of relatively larger irrigation projects where inland fisheries are developed. Yet, this is an important parameter to be kept in focus as the command area of Sardar Sarovar Project grows with numerous activities. Vigilance and monitoring of water quality, groundwater contamination, etc. would be inevitable as a part of development process and these would be finally attended to by Gujarat.

Public Health

Major environmental apprehensions are with reference to the water-related diseases of malaria, filaria and schistosomiasis. As regards schistosomiasis, studies done by the National Institute of Communicable Diseases under WHO auspices indicate no snail-based foci for the disease in Narmada Valley. There are no prospects of occurrence of this disease for Narmada Project and monitoring will be ensured.

Malaria is found to occur naturally in epidemic cycles in Gujarat, partly influenced by climatic factors. Effectiveness of the chosen control strategy has also a significant influence on transmission rates. Malaria is important both for urban and rural areas. Two of the three mosquito species are considered as principal vectors responsible for transmission, viz. *Anopheles stephensi* in urban areas and *A. culicifacies* in rural areas.

Experience of surface irrigation in Mahi Project of Kheda District has shown enhanced transmission rates during the dry months of April to June which may be ascribed to irrigation but, in general, there is no clear relationship between average annual malaria incidence and irrigated areas in the 19 districts in Gujarat. Irrigation, thus is not the principal causative factor for malaria. It may have, however, impacts if stagnations of water bodies, seepages from canal, etc. are not controlled. Under SSP the infra-structure itself, at a large cost, takes care of avoiding or minimising seepages and stagnations.

The following control strategies are expected to address to malarial problems arising on account of Sardar Sarovar Project .

- (a) Special health units to monitor and treat migrants (workers and resettled people) intensively under malaria control programmes.)
- (b) Effective monitoring and surveillance under the operative malaria control programmes.
- (c) Emphasis on 'tidy' irrigation and drainage.
- (d) Creating awareness among Sardar Sarovar Project staff as well as among command population through health education and extension programmes. This also includes preparation of a manual on malaria control.
- (e) Use of identified carnivorous fish in tanks, ponds, etc. inside and near command area.

Filaria which is caused by the mosquito species of *Culex quinquefasciatus* (fatigan) will also be controlled. It is confined to coastal areas of Saurashtra and South Gujarat and not significant for the command area as such. However, monitoring of the disease will be required.

As regards other water related diseases like dysentery, typhoid, hepatitis, gastroenteritis etc. these are related in a very limited context to irrigation. Other major factors like sewage disposals, septic tank discharges, overall hygiene of the rural population and quality of domestic water supply under cities and towns which often gets infected due to old pipe networks predominate. With current emphasis on health programmes under of the State Government and those of Municipal Corporations and municipal bodies and with increasing financial outlays and operationalisation of health care as well as health education programmes (in the context of overall commitment of "Health for all by 2000 AD"), these diseases will be kept in control. Effective monitoring and surveillance will be a part of the Health Plan for the command area of Sardar Sarovar Project.

Positive impacts due to reduction in scabies and skin diseases and availability of potable drinking water and bathing water through the SSP systems, as planned, would significantly prevail not only in the command area but also in the entire areas of Saurashtra, Kutch, and North Gujarat being served for domestic water by Sardar Sarovar Project. For scabies and skin diseases, the area benefited will not be only 20,000 sq. km. of Sardar Sarovar Project but about 80,000 sq. kms. of Saurashtra ad Kutch.

Water Quality

Domestic and Industrial Use of Water and Associated Impacts

Due to Sardar Sarovar Project, it will be possible to provide safe and potable drinking water to a population of about 36 million ,covering all water deficient area of mainland Gujarat and the whole of Saurashtra and Kutch comprising 8,215 villages and 135 towns and cities. This will be a major contribution towards improving the health of the people as well as stabilising populations in the areas, which are facing recurrent droughts. Salinity intrusions along coast lines and fluoride laden groundwater in many places have aggravated the water supply problems further in the last decade. Other options for drinking water in the areas are desalinisation, reverse osmosis etc. which are extremely expensive and unaffordable.

The associated adverse impacts, essentially pertain to sewage and waste-water disposals from the cities and towns being served by the Sardar Sarovar Project. In this regard, the following aspects need to be highlighted:

i) The rural sector will not have any major effluent problem because of limited supplies of water at the stand-post levels. Nevertheless, the State Government is committed to rural sanitation programmes. About 40,000 latrines in the rural areas have been constructed and this is an on-going programme. This programme will enable separation of normal water waste and night soils. With Sardar Sarovar Project, this programme will be further strengthened.

ii) Many of the cities like Vadodara, Ahmedabad, Nadiad, Anand, Rajkot, Bhavnagar etc. have underground sewerage systems partly in place and partly under construction. All these systems will be completed in the next 5 to 10 years with the result that large urban areas will no longer create environmental pollution and that of rivulets and rivers.

iii) Obviously, it will take a long time to have underground sewerage systems for all other towns and cities (out of 135 to be benefited) because of financial constraints in a country like India. However, the State Government will see to it that the concerned local and municipal bodies are enabled to attend to safe disposal of such waters by way of primary treatment, oxidation ponds, lagoons, chemical and biological treatments etc. It has also to be appreciated that the present discharges of sewage and waste waters will be considerably diluted because of water supply from Sardar Sarovar Project to these towns and cities and, to that extent, it will partially ease the problem. There will always be an effort to separate out water with night-soils which have a disease causing potential from waters of bathrooms, kitchens etc.

iv) Irrigation from sewage effluents of nearby towns and cities is also being practised in Gujarat at present and these efforts will be strengthened in case of Sardar Sarovar Project after primary treatment of the effluent waters.

Agricultural Runoffs and Groundwater Pollution Issues

Looking to low levels of use of chemical fertilizer, consumption of pesticides and insecticides in Gujarat compared to many other states in India, let apart developed countries, there are no apprehensions in near future about groundwater contamination due to use of nitrates on an extensive scale and eutrophication problems of water bodies in the command areas due to nutrient-rich runoff waters. Some of the harmful pesticides have already been banned in the country as well as in Gujarat and regulatory mechanisms are being tightened with increasing successful litigations. Some leaching of nitrates is observed in Mahi command where irrigation water use was high, soils relatively previous and local nitrogenous fertiliser consumption was also high (when urea and ammonium nitrates were cheaper). No correlation between nitrogenous fertiliser use and nitrates in groundwater is, however, seen. Mahi area will be studied in depth for a critical cause-effect relationship. Use of bio-fertilisers has commenced in Gujarat for obvious economic advantages, which bring about better fixation of nitrogen in soils. Although the percentage coverage is very

limited at present, this along with organic farming techniques provides a hope for long term future strategies. Bio-pesticides and biological control of pests are also being increasingly propagated. Nevertheless monitoring of groundwater and water bodies will be a part of Sardar Sarovar Project operational systems in addition to stress on bio-based farming as well as scientific management of chemical fertilisers under the command area programmes.

Impacts on surface water and groundwater quality due to industrial effluents can be a much more severe source of potential environmental concern compared to agricultural runoffs in a short run specially on account of industrialisation plans of Gujarat. This cannot be ascribed to Sardar Sarovar Project as such. It is, however, expected that environmental clearances for industrial projects by the state Government and Government of India will take care of these aspects with a good performance record of the Gujarat Water Pollution Control Board towards monitoring. Monitoring network for measuring pollution of groundwater as well as surface water bodies will have to be in place not only in the context of Sardar Sarovar Project but also in the context of the state as a whole in view of increasing environmental concerns in India and Gujarat.

5.2.2 Proposed Management Measures

The Sardar Sarovar Project service area has been classified into 13 agro climatic regions based on broad topographical, hydro meteorological and soil surveys. The drainage density is good in most of the regions except in regions 4, 7, and 11. Outfall conditions are sluggish in regions 4 and 7, parts of which are also affected by salinity. Sub areas or pockets likely to get waterlogged or saline due to irrigation in future have been identified for planning special measures to prevent development of such a situation.

The Phase-1 area of the project covering the command between the Narmada and the Mahi rivers has been taken up for detailed surveys, monitoring and planning. This comprises agro climatic regions 1 to 4. Detailed soil surveys and contour surveys have been carried out. Groundwater fluctuations in all the wells and special piezometers are being measured at regular intervals. Automatic water level recorders have also been installed at selected places. Hydro meteorological observation stations have been established. Studies for groundwater availability, annual recharge and mathematical modeling for surface and groundwater interaction have been carried out. Based on all these surveys and information as well as the data of rainfall intensities, the drainage plan for the Phase-1 area has been drawn up. The irrigation water allowances for the various regions in this area have been decided keeping in view the soil classification, groundwater availability, crops grown, and climatological factors. In poorly drained flat lands with relatively high water tables, limited water allowance and conjunctive use of surface and ground waters has been planned.

Similar exercises have been taken up for the command area beyond the Mahi river also. Regions 1 and 8 have very good surface topography and internal drainage. Surface drainage requirement, if any, will be in the form of minor drains for local patches. No sub-surface drainage works are required. A large part of region 9 is also similar. Regions 2, 5 and 13 also have good surface and internal drainage. Limited minor drains, remodeling of existing channels and ground water extraction for conjunctive use is considered adequate. Regions 3, 6, 10, 11, and 12 have relatively flat ground slope and moderate internal drainage. Minor drains, remodeling of existing channels, groundwater extraction, and a limited use of moderately saline ground water have been planned.

Regions 4, 7 and 11 together with bordering areas of regions 9, 10 and 12 are relatively difficult for drainage. The Bhal tract of Gujarat falls within these regions. A well-planned intensive drainage network is being worked out for these regions. A very limited irrigation water allowance would be permitted. Ground water extraction, part mixing of saline water, improved water management and agricultural practices, leaching of surface salts by flooding with surplus spill waters of Narmada, salinity resistant agriculture and continuous careful monitoring of the groundwater table and salinity status through observation wells and piezometers etc. will constitute the multipronged strategy for tackling the problem areas.

The following are the proposed measures to prevent environmental degradation.

waterlogging and salinity:

1. *Mechanised, well-controlled canal lining*

This would reduce seepage loss to only about 10% of that in unlined canals. The canal system planning, design and operation are also inherently tuned to ensure that these problems do not arise. Thus, all the canals right down to the 8 ha blocks would be carefully lined to reduce the seepage losses. The main canals and branches will be concrete lined with mechanical pavers. The distribution system will be brick lined with a sandwiched rich mortar layer. Use of polyethylene membranes is also contemplated. The lining will reduce the seepage losses to about one tenth of the losses that would have occurred if the canals were unlined. The risk of waterlogging from seepage would be reduced to that extent.

2. *Provision of surface drains.*

The drainage excess rainfall, storm water from agricultural land for better crop productivity has been proposed at farm levels as well as at regional level. Whole of command has been divided into two regions in respect of preparation of operational design and layout of surface drainage network commencing from 40

ha chak. The construction of the drainage system shall go on concurrently with the canals.

3. *Conjunctive utilisation of surface and ground water, limited water delta.*

The amount of water supplied per unit of area in the SSP command will be amongst the lowest in the country. The average depth of surface water supplies for the entire year measured at the main canal head will be only about 53 cm over the command area as compared to 75 to 100 cm per crop season on most of the projects in the country. This will naturally call for very judicious and economical use of water. If the farmers want to grow water intensive crops, they will have to supplement the canal water with well waters or reduce the area of their crops under irrigation. The project authorities have contemplated, conjunctive use of surface and ground waters. In the existing irrigated areas of other prefects where well irrigation is concurrently practiced, the problem of waterlogging has reduced.

4. *Better water management ,Automated canal regulation, Rotational water supply on volumetric basis ,and active participation of farmers*

A draft legislation has been already prepared to regulate the distribution and use of canal and ground water in the state. On the Sardar Sarovar Project there will be volumetric supply of water through a computerized semi-automated operation system. Under this system, the discharge from the canals down to 8.5 cumecs (300 cusecs) capacity will be regulated through automatic computer control. These measures will not allow the canals to draw more water than planned. As the tariff for the water will be on the basis of the quantity supplied, the farmers will naturally try to use it most economically. This will be further ensured through better water management through farmers' associations and rotational water supply. The irrigation water depths actually required will be worked out through a system of soil moisture sensors and observations of hydro meteorological and climatological parameters as related to crop growth stages and the supplies will be regulated accordingly. Wherever possible drip and sprinkler methods of water application will also be encouraged.

5. *Carrying out water balance and salt balance studies and the necessary monitoring.*

During monsoon, when surplus waters are likely to be available in the canal, such waters will be used for flooding and leaching the saline soils. Continuous monitoring of salt and water balance has also been planned for such marginal soils.

6. *Bhal and Bara Tract*

Special problematic areas of Bhal and Bara are difficult for irrigation in view of high water table and salinity. A possible way of developing this area can be through suitable forest development programme. Salt loving plants, having a high evapo-transpiration rate can be preferred. These plants can help in controlling the water table. In the initial stage of development of irrigation in the command, there will be excess water available. This can be used over this area for initial leaching by way of surface diffusion. This can promote initial growth till the plants develop some resistance. Species like *Prosopis juliflora*, *Eucalyptus* *Artiplex* and other suitable plants can be tried. No irrigation system can be thought of for this area.

Flora fauna

due to availability of water. Present fallow lands may also be brought under cultivation. Some cultivable wasteland may also be brought under cultivation.

- Increased moisture content along the sides may bring some change in the floristic composition of the area.
- Increased use of insecticide and pesticides will result in more residue of it in the drainage.
- Increased human activity due to intense agriculture.

National Park / sanctuaries :-

Velavadar National Park

Food availability, water and climate are some of the important factors regulating the population. Following are some of the resultant impacts on ecosystem :

- + More water can be made available for the wildlife in the National Park area.
- + Habitat improvement in some fringe areas of the park.
- + Increased availability of food in the ecological zone outside the park in agricultural fields. There may not be much change deeper in the park.
- + Decrease in biotic pressures, especially the cattle grazing on fringes of the park due to the availability of more forage outside the park.
- + Likely increase in the carrying capacity of Blackbuck, Nilgai, Wolf and other wild animals due to increase in the forage productivity and better water regime.
- + Increase in agricultural production and more area coming under
- + agriculture, outside the park.
- + Likely change in cropping pattern, with two crops instead of one in some areas.
- + Fallow and cultivable wastelands can be made productive.
- + Possibility of taking more areas under tree cover, and agro-forestry. This may also increase the availability of fuel wood and fodder.

- + Adequate supply of drinking water in the area.
- + At some spots canal structure (distributaries) may obstruct the migration of Blackbuck outside the park area on northern side. This canal structure will act as a natural barrier to Blackbuck going in cultivated fields.

Following measures are suggested with a view to take advantage of it.

The park area should be provided water from the canal network for different purposes. It is suggested that water should be provided through pipeline at two major points. One at Velavadar and second near the south watch tower towards Bhadbhid in the park. This is preferably by a pipeline from SD-1A and SD-3 respectively. For further distribution, it would be necessary to provide overhead tanks. Hence, it is proposed to construct two IS overhead tank cum watch towers where water can be stored, and the same structure can be used as watch tower also.

As the requirement of water would be during the late winter and summer, provision will be required to be made to supply adequate quantity of water during the months from February to June. Drinking water would be supplied in the neighbouring villages and arrangement has to be made for supplying stored water at appropriate site to the park in consultation with Gujarat Water Supply & Sewerage Board and Forest Department.

The water thus made available should be used for providing drinking water to wild animals. For this purpose cemented trough or saucer pits should be made in the park area and they should be connected with the overhead water tank through pipeline and guzzlers. It is proposed that at least 4 waterholes should be made, 2 each in northern part and southern part of the park.

Raising of green fodder by using the canal water should be taken up on experimental basis initially. Two sample plots, each of 2-3 ha. should be selected for raising fodder. Non agricultural area between park boundary and canal can be used for fodder development and entire such area should be integrated with park management. These fodder plots are to be irrigated by using sprinklers or drip irrigation and in no circumstances flood irrigation should be used. Within the fodder plots only grass species occurring in the park area, like *Dichanthium* and *Sporobolus* is to be raised. In addition above fodder plots, one or two plots should be experimented at suitable sites in the eco-development zone.

From the canal, water should also be made available to few waterholes made outside the park area. Use of these waterholes by domestic livestock should be contra if not possible to avoid totally, so that chances of disease transmission are minimised.

The activities suggested at above (ii) & (iii) are purely on experimental basis and they should be monitored continuously for first three years. The activity can be continued later on, if no adverse impacts are observed and is found useful.

The negative impacts, likely to occur due to the network revolves mainly around four aspects

- (i) Water logging
- (ii) Change in the land use pattern and cropping pattern
- (iii) Wildlife-human conflict in the ecological zone
- (iv) Canal structure as an obstacle to the movement of wild life

For minimising the negative impacts, following measures are suggested.

- No change in the land use pattern within the eco-development zone of the park as envisaged in the management plan should be permitted. In other words, area currently under the cultivation should not be allowed to increase. All the wastelands and grazing land as well as forest land in the area should not be diverted to other use. This will not only ensure availability of the area for wild life use, but will also ensure availability of the area for grazing of livestock. This can be best achieved by declaring some of these areas as the sanctuary as buffer zone for the park, so that certain rights and privilege of local people can be protected, simultaneously safeguarding interests of wild animals. The fallow la are freely utilised by the blackbuck at present, especially during winter & summer. Such areas may not be available once the intensive cultivation starts with supply of canal w This will result into drastic reduction of habitats used at present by the blackbuck. During the workshop on draft final report, it was strongly felt that the present protected area (PA) has to be expanded to compensate this loss. Forest Department should seriously explore the possibility of inclusion of Panchayat land, government waste land and forestland with the PA to provide ideal extended habitat for all wildlife. The Government should also explore the possibility of exchange/acquisition of some of the private land lying in between such selected site to enhance the conservation value of the unique national park of the country.
- Entire canal network including sub minors and distributaries of all types within the ecological zone should be lined right from the beginning itself. The lining work will have to be done before releasing of water and not in due course at later stage.
- As canal SD-3 is likely to obstruct movement of animals, with a view to allow movement of animals, it is suggested that at two points corridors of atleast 50 mt. width should be provided. This can be done either by

providing siphons or by covering the canal from the top with gentle slopes on either sides of the canal, or by putting up pipeline of appropriate diameter, or by any other suitable structure which is technically feasible. These corridors are to be provided on routes frequently used by animals as shown in the fig. 5.1

- As the agency (SSNNL) proposes to construct all water courses including field channels, it would be appropriate to use lined system. Feasibility of lining the field channels should be worked out and if possible it should be resorted to. Moreover, precast RCC channels also should be considered in place of traditional field channels.
- *Prosopis juliflora* has been found beneficial on one hand, while it has been found to posing a threat to the grassland. Hence it is necessary to control and regulate the area under it, i.e removal of it from certain areas as well as allowing it to grow in other area. Prescriptions made in the management plan for the area (Singh & Rana, 1995) is felt adequate in this regard. However, in addition, it would be necessary to take up removal of it in subsequent years from the areas where they have been removed once, in order to remove it completely from such areas. Moreover, there should be continuous monitoring of entire area and *Prosopis* should not be allowed to invade in the grassland. This invasion has to be controlled by eradicating so that grasslands are protected and improved.
- As agriculture would be more intensive with the availability of irrigation, denning areas for wolves outside the park may reduce. The shrub land habitats of the VNP will play a critical role in the continued survival of the wolves in the region. Thus, denning area of wolves in the park should be protected by retaining adequate coverage of *Prosopis* as mentioned in the management plan.
- Increased human intervention may bring negative impact on wolves because they do tolerate disturbance. Thus, adequate care has to be taken to protect denning and breeding sites of wolves by protecting the dense *Prosopis* cover at the sites.
- For entire region-7 projected quantum of saline water to be pumped is about 0.1208 J Total estimated quantity of water to be supplied for irrigation is 1.035 MAF. This irrigation includes 0.125 MAF ground water, conjunctive use of which should be made very cautiously only after ensuring its impact on soil.
- Farmers in the area should be encouraged to use sprinklers and drip irrigation inst the flooding. This can be done by giving higher subsidy than the present, in the from of additional subsidy and low interest loans from the agency itself. This will result in reducing water logging and more efficient use of the water.
- Facilities for drinking water to wild animals should be provided in the ecological z as to prevent wild ungulates entering in the cultivated areas for this purpose. Moreover, it is felt that certain areas like

Devalia-Paliyad zone should be managed as "satellite core" areas and management of them should be handed over to the park authorities.

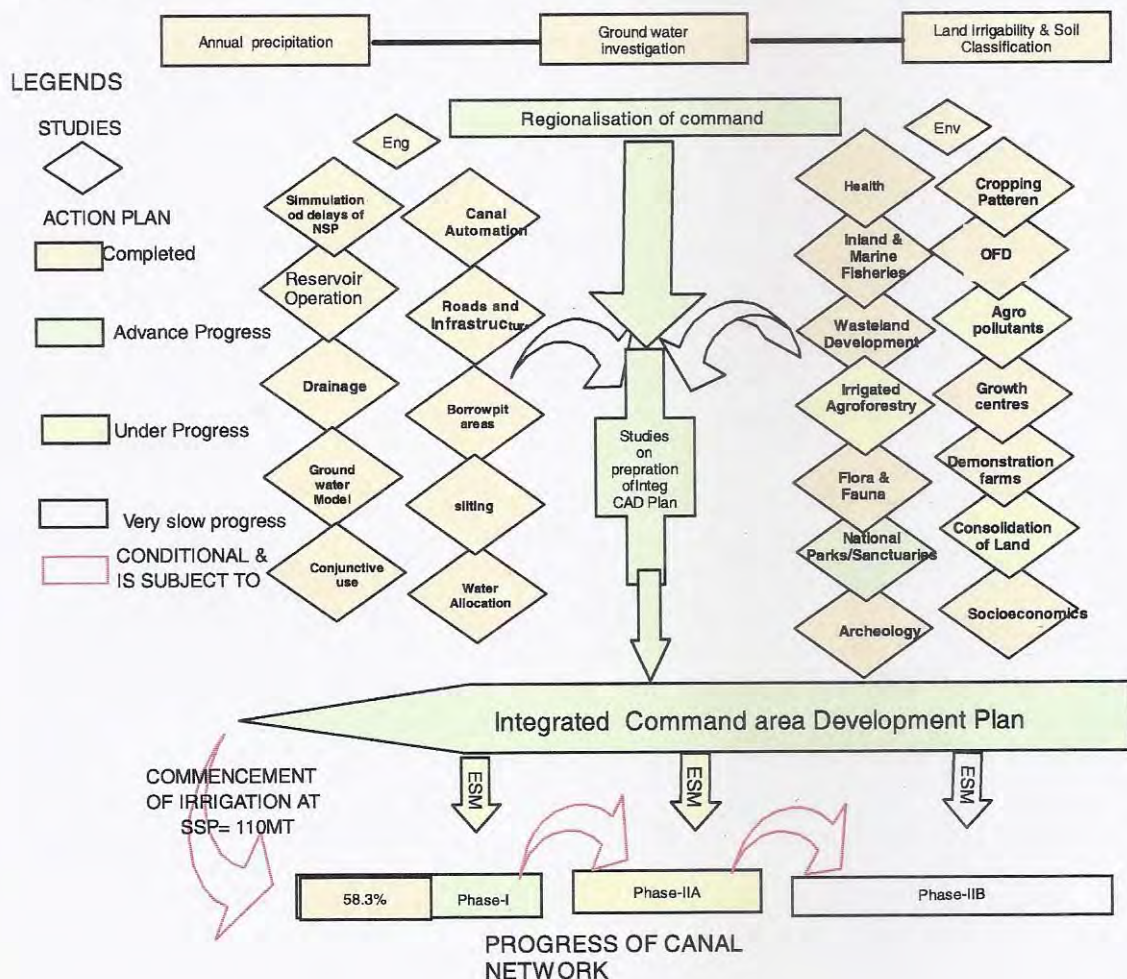
- The increase in salt pans in the area poses a threat to the ecosystem, resulting into increase in the salinity in the long run. Looking to the requirement of the society at growth potential of salt industry, it is not feasible to stop the activity in the area. Hence it is proposed that permission for new salt pans should not be given in the western part of the road between Adhelai and Madhia only. Attempts will have to be made to stop the existing salt pans in the area by providing alternative sites.
- Programmes for overall development of the area should be taken up. This should include propagation of bio-gas plants, cattle improvement and immunization programme, cultivation of tree crops and horticulture etc.
- Need is felt for raising general awareness among people residing in the ecological zone, as their attitude is hostile towards blackbuck due to damage caused by them to the crop. People should be made aware about the benefits accrued to them due to the conservation efforts. A planned awareness programme will be required and it should also include establishment of an interpretation centre with different audio-visual aids for carrying out interpretive programmes. The awareness programme should also include nature education camps for different target groups.
- Population of blue-bull should be controlled below present level to avoid crop damage to reduce increasing competition between the two antelopes

Wild Ass Sanctuary

The Kutch branch canal will cross the narrow neck of the northern tip of the LRK, which joins the GRK near Adesar. During the meetings of multi-disciplinary experts' group, this issue was discussed at length. It was concluded that siphon type structure might be the most appropriate. It is suggested that site selection and design of siphons may be prepared on the basis of the study on movement of wild ass. Wide bridge or passage should be kept the canal to facilitate movement of the wildlife at appropriate places. Such structures would work as corridors for ungulates, wolf, jackal, foxes, cats, hyaena etc. Maliya, Jhinjuwada, Rajpura, Amarpaur and Kutch branch canals will pass through surrounding area of the Sanctuary. Therefore, there may be some impact of Narmada Canal in future on the Sanctuary. For this purpose, it is suggested that environmental impact assessment study may be carried out.

5.3 ACTION PLANS

Integration of all developmental activities related to irrigation, drainage, agriculture, co-operation, roads, marketing, forests, rural electrification etc. is considered as a basic requirement for the command area development programme targeted for SSP. The emphasis is on long term balanced and environment-friendly growth. Action Plans have been drawn up on the issues like health, fisheries, flora fauna etc. for the Command Area.



Narmada Main Canal (NMC)

For the construction purpose, the main canal has been considered in four segments on the basis of major off-take branch canals.

Phase I. Ch. 0.0 km to 144.5 km (Mahi crossing).

Phase II (A). Ch. 144.5 km to 263.165 km (off-take of Saurashtra branch)

Phase II (B). Ch. 263.165 km to 388.164 km (near off-take of Kutch Br.canal)

Phase II (C). Ch. 388.164 km to 458.412 km (up to Gujarat-Rajasthan Border)

NMC Phase - I : 0.00 Km to 144.500 Km

Phase-I of the NMC was earlier programmed to be completed by June, 1995 and the irrigation was proposed to commence with the construction of Dam up-to RL 110 m by the end of July / August 1995. Under Phase-I, an irrigation potential of about 4.3 lakh ha. is envisaged. The Government of Gujarat have proposed to complete the works of main canal in phase-I in all respects soon. There are total 23 branch canals under Phase-I upto Mahi river crossing of Narmada Main canal, out of which 13 canals off-take directly from NMC and the remaining 10 canals off-take from branch canals. Total length of these 23 branch canals is about 656 kms. Out of 23 branch canals, civil works of 21 branch canals are almost completed. The remaining 2 Branch Canals viz. Jambusar and Kundhela Branch Canals off-taking from Vadodara Branch Canal are likely to be completed soon.

NMC PHASE - II: 144.500 Km to 458.412 Km

For Phase-II, from 144.5 km to 458.412 km i.e. up-to Gujarat - Rajasthan border, the works in the initial reaches have been started. The detailed construction programme for the balance reach are under finalisation. There are 27 branch canals including two major branch canals, off-taking at 263 km and at 386 km to convey water for irrigation, domestic and municipal water supply and for industrial uses. The Saurashtra Branch Canal (SBC) off-taking at 263.20 km of NMC, is 104 km long. The special features of this branch canal is that in a length 104 km, there will be a fall of about 32.73 m and water will be required to be lifted for about 71.23 m to cover the command area and to cover the entire Saurashtra region for supply of drinking water. At 3 canal fall sites, hydropower will be generated and will be utilised to lift water at 5 pumping sites in the same branch. The canal system is fully lined and designed for a discharge of 8.5 cumecs based on controlled volume concept of operation through computerised remote controlled regulating structures constructed along the canals, which will keep the canals full. The flow will vary according to demands from the delivery system. This system will help in avoiding excessive operation losses and will help in controlling damages to canal due to excess discharge. The Kachchh branch crosses a depression connecting Little Rann of Kutch. This depression is planned to be negotiated through falls and lifts. The branch canals would have structures and turnouts similar to those in the main canal with side slopes increased from 2:1 to 1.5 All diversions from branch canals to distributaries would be through radial gated turnouts. The distributaries would be operated to maintain a stable water surface adjacent to the service area turnout to facilitate constant delivery rates to all service areas. Works related to command area development like construction of sub-minors, land levelling, internal roads, agriculture extension, credit, inputs, research and development, agroindustries will be taken once the water flows in the canals.

Health

When the project becomes fully operational 8215 villages and 135 urban centres both within and outside the command area will get benefit of drinking water facilities while 55 lakh population residing in 3393 villages spread over 62 talukas and 12 districts, comes under the command area will get water for irrigation through the network of canals. Therefore mosquitogenic conditions and breeding places are likely to increase. Looking to the current endemicity of malaria in the command area there are possibilities that increase in the incidence of malaria may go up in spite of the built in precautionary measures taken by SSNNL like drainage and lining of canals etc. A project of this magnitude has not ever been built in India and hence adequate remedial measures both curative and preventive are very essential not only to control malaria but also other vector borne and water related diseases.

The primary health care delivery system is responsible for the implementation of all National Health Programmes and therefore has its limitations in terms of manpower as well as resources to undertake integrated vector and disease control measures in a special situation like this.

In view of the large area and population to be covered under the project and the current endemicity of malaria in the command area the following action plan are suggested for implementation to control water related diseases particularly malaria in the SSP command area.

Preventive health organisation already sanctioned at Kevadia Colony in 1992 may be operationalised as early as possible. This consists of the following :

Health Monitoring Cell

An Health monitoring cell headed by an health expert with inter disciplinary team of other experts and workers should be created at SSNNL.

- + This cell will function under the administrative control of SSNNL (GOG) and in close liaison with NPG, CHMS and Narmada Control Authority.
- + This cell will be responsible for collecting and preparing a data base regarding cases and deaths due to malaria and other vector borne/water related disease; from the studies already conducted and also from secondary data available with CHMS and Dist. Health authorities.

- + If necessary to initiate further studies in co-ordination with NPG and CHMS as suggested by Namada control authority.
- + To plan and undertake all anti-malarial measures including integrated vector control measures in the project and command area through the preventive health organisation already created at Kevadia (but not functioning) and the vertical malaria units proposed to be created for each 5 lakh population.
- + Guidelines for the implementation of NMEP at the national level can be followed with suitable changes depending on local situation. Technical guidelines can also be obtained from CHMS and MRC & N.I.C.D.
- + The Vertical Units and the preventive health organisation will function under the technical guidance of this cell. Anti-malaria and other disease control activities carried out by these units will be supervised and monitored regularly and necessary corrective measures will be taken as and when required.
- + All necessary data and reports will be collected from the units/districts by the cell, which will be computerised and feedback will be provided to CHMS, SSNNL and GOG and Namada Control Authority.
- + This cell will intensify health education activities in the command area to promote awareness and community participation in malaria and other disease control activities. Necessary health education materials as mentioned below will be prepared in consultation with CHMS and will be distributed to the peripheral level.
- + Prominent voluntary organisation involved in health related activities will be contacted and will be involved in disease control activities particularly health education campaign.
- + To organize orientation workshops for engineers of SSNNL and irrigation department. At least one workshop will be conducted every two years.
- + A Malaria Vertical Unit for each 5 lakh population in the command area may be established for carrying anti-malaria measures. The total population residing in Narmada Command Area is approximately about 55 lakhs. So 11 such units require to be established. Functioning

5.4 IMPLEMENTATION

Construction of canal Phase -1 Ch 0.00 Km to 144.500 Km (Mahi crossing) along with the distributaries is almost complete. Surface drainage is being provided up to 40 ha chaks concurrently with the construction of canals. The command coming under Phase - 1 extends up to Narmada-Mahi doab and areas coming under this belongs to agro-climatic zone no 1 to 4. Development of the command area is a long drawn process. Gujarat has taken steps in accordance with the covenants of the investment clearance accorded to the project by the Planning Commission and *pari-passu* clause stipulated by the MOEF. By now, almost all the major studies have been completed and impacts are known. Action points have also been determined. State Govts. have taken steps for implementation of the identified action points in accordance with the requirement of the environmental control. The command area development activities and environmental safeguard measures will be taken when water starts flowing in the canals.

5.5 SUMMARY OF WORKS TO BE DONE

The following studies are in progress.

1. Agricultural Research Studies.	Gujarat Agricultural University.	Study commenced in 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 on People's Participation in Water Management in SSP.	Gandhi Labour Institute, Ahmedabad.	1991

Though work done hitherto on groundwater and drainage has provided 'invaluable information to prepare a sound and integrated project framework, further work on the following aspects needs to be pursued for more detailed ground plans for operating the project and for mitigating environmental concerns relating to waterlogging, salinity and associated issues.

- i. The groundwater models available have to be reviewed and sharpened in respect of input assumptions for rainfall recharges, present water balance in terms of evapo-transpiration losses occurring through vegetations, trees, crops etc. in pre-irrigation scenario and better delineation of confined and unconfined aquifers and leakage parameters. Recalibration of models may also be warranted. Irrigation recharge needs to be looked into in much greater details with reference to existing larger projects like Mahi, Dantiwada etc. and available information on other projects. Better consistency between the four models needs to be achieved linking up soil parameters to recharges with combinations of operational scenarios

conforming to ranges of real life values (around firm scenarios planned for). Sufficiently large periods need to be worked in. Since more detailed data from GWRDC is available, adequate details can be captured in the operational models. Sub-modeling for saline areas (coastal sub-regions) may be worthwhile.

- ii. Setting up of an overall computerised integrated groundwater model for the command area as a whole may be worthwhile and is under consideration. In such a macro model, the existing models can be fitted in as sub-models including those to be set up for rocky areas. International expertise for such a framework model may become necessary for more precise outputs. Such a model will also take care of inter-model linkages and flows across presently developed fixed head boundaries.
- iii. The surface drainage study for regions 5 to 13 will have to be reviewed with reference to broad economic analysis of annual investment costs vis-a-vis annualisation of occasional crop damages that may have to be faced with reduced possible values of drainage co-efficient that may be worked out.
- iv. The outputs of drainage studies will have to be operationalised for distribution and branch commands in the form of a detailed manual. Pilot studies for flat coastal areas may be necessary.

5.6 SSP COMMAND: RAJASTHAN

Narmada Main Canal

Rajasthan has been allocated 0.5 MAF (616 MCM) of Narmada water under the final award of NWDT. To utilise its share of the Narmada water, Govt. of Rajasthan have planned a 74 km long Narmada Canal to irrigate 73,157 ha. of land in the drought prone districts of Jalore and Barmer. The canal system will cover Gross Command Area (GCA) of 1,42,020 ha. of which 1,35,476 ha. is culturable Command Area (CCA). Besides irrigation benefit to 89 villages (74 in Jalore & 15 in Barmer), the project also envisages to provide drinking water to a population of about 3.0 lakhs living in 124 villages around the irrigation canal.

The canal will be trapezoidal in section and will be lined by cement concrete. Maximum capacity of the canal at the head is 74.58 cumec while discharge requirement is 69.43 cumec. There are 9 major distributories with a total length of 282.30 km. The total length of minors and sub-minors is 485.0 and 636.0 km respectively. Additional project activities would include construction of head regulators, bridges, cross drainage works, escapes etc.

A map showing the command area and the layout plan of the canal system is given at plate-III. The detailed Project Report (revised) for appraisal was submitted to Central Water Commission for approval during February, 1990. The project was considered in the 51st meeting of Technical Advisory Committee on Irrigation, Flood Control and Multi-purpose Project held on 04.12.91 and investment clearance was accorded by Planning commission vide their letter No.2(307)/92-I & C AD, dated 23.01.1996 for Rs.467.53 crores at 1989-90 price level including Rs.280.14 crores share cost payable to Gujarat. The benefit cost ratio and internal rate of return of the project are 1.01 and 10.42% respectively.

The construction of Main Canal in the first 42.0 Km reach has been taken up and the earthwork is under progress. The entire Narmada Main Canal works in Rajasthan is scheduled for completion by 2005-2006.

Water Delivery Network

The water delivery system will cater to irrigation needs of the vast areas through irrigation units. Each unit of irrigation service area, called Village Service Area (VSA), has been planned to be served through a single outlet from the distributory. This outlet will remain fully open for a fixed period during irrigation water demand and will be closed during periods of no water demand and no water availability. Water will be delivered only on the basis of the demand to a group of organised cultivators on a volumetric basis at the head of VSA, and not to individual cultivators.

In the VSAs, network for water distribution is planned through minors and sub-minors feeding different chaks and sub-chaks. For the entire system below VSA outlets, water will be supplied in proportion to the area served. Within the chak, the water will be rotated to individual fields over fixed times in proportion to the holdings.

The Distribution System Under VSAs

A Village Service Area (VSA) will generally constitute an area between 300-500 ha. of a village under command. For villages extending over areas larger than 500 ha. or if required on the basis of topography or other physical features, the VSA may cover a larger area. The VSA is planned to be divided into chaks of 30 to 60 ha.. In a chak there will be 4 to 6 sub chaks. A minor will lead the water from the VSA outlets to the heads of chaks. A sub minor will convey water into the chak up to heads of sub chaks. Field channels will carry water from heads of sub-chaks to individual fields. The chaks will be ungated and water will be rotated into sub-chaks through turnouts. In a sub chak, water will be rotated to individual farms.

The VSA outlets will either be 'on' or 'off'. A constant discharge will be released. The flow will be divided proportionately at each chak head, by fixed proportional devices. Within the chak, the flow will be rotated. The flow will continue over a fixed continuous period during a week. Generally, it will run over a period of one week. The schedule of rotation among farmers during the period of supply to the service area will be fixed for each season so that each farmer will know the day of the week and precise hours during which he is required to draw. Prior to the commencement of each crop season, the schedule may be altered so that night operations can be rotated among all farmers.

The water will flow in the VSA when demanded. Depending upon water availability, the number of waterings will be made available, at intervals, to the entire VSA. Each watering will start on a prefixed day of a week every time. During periods of peak demand, water can be supplied for consecutive weeks also. The periods between the irrigation will generally be in increments of seven days. Irrigation water will be delivered at an approximate rate of around 30 litres/sec to farmers. The actual stream size will be proportional to the area of the chak.

The farmers within a service area will, in association with the agricultural extension staff, collectively determine their common schedule for delivery of allocated water to the VSA in terms of size and number of irrigation waterings and dates of delivery. Any changes in the schedule during a cycle will be likewise determined. Short term altering of the delivery schedule to a VSA as a sequel to the rainfall, will be carried out under codes/procedures agreed upon between the agency and the VSA Committee.

Drainage System

Surface drainage would be an integral part of irrigation net work and is being provided for to cover 40 ha. chak unit in all the areas needing surface drainage. The vertical drainage as required will be through Tube Wells and Open Wells. The drainage system would consist of surface network of open channels and ground water control wells. The natural drainage shall be suitably modified and additional drainage will be provided where ever necessary to take care of excess water during monsoon to ensure that the flood water gets drained out in a reasonable period and there is no spill over and choking of drainage. The sub-surface water drainage control will be through judicious ground water exploitation and with adequate planning so that there is no water logging in the areas. The drainage system shall be constructed and maintained up to 40 ha. block synchronising in general with a chak distribution unit. The maintenance of drainage within the chak will be left to the farmers. The construction of the drainage network will be completed simultaneously with the construction of major distribution network and completed on block to block basis so that it is ready for use by the farmers by which time the surface water becomes available for irrigation.

The Government of Rajasthan had submitted a report on Environmental and Ecological aspects and remedial measures for 'Narmada Canal Project'. Copy of the report was submitted to Ministry of Environment and Forests. Government of Rajasthan have assigned studies on EIA of Command area in Rajasthan portion to WAPCOS. Revised draft final report is available, which is in the process of approval by State Government.

- Overall the command area development in both the states will need establishment of CADA which will continue monitoring of the following
 - Water courses and field channels,
 - Land leveling and shaping,
 - Field drains and chak drains,
 - Support and assistance to farmers in development of ground water in conjunction with the surface water,
 - Network of approach roads and eventually farm roads,
 - Marketing and warehousing,
 - Establishment of agricultural, research-cum-demonstration farms.
 - Co-operatives or farmer-friendly structures for inputs and credit facilities,
 - Timely supply of seeds, fertilizers, pesticides etc.,
 - Consolidation of land holdings where possible.
 - Well designed and well maintained network of water delivery systems inclusive of minors, sub-minors, field channels, regulating structures, along with drainage at field as well as regional levels.

- Availability of water at the heads of services areas (VSA) in the command, for controlled releases on demand without loss of any response time and without operational losses.
- Regionalisation of the extensive command area in appropriate zones for rational irrigation planning, and responding to scientific water needs without wastages.
- Cropping pattern studies for each region with a view to maximising social benefits with available water for irrigation inclusive of ground water. This has also provided basis for water allocations.
- An efficient system of canal network and its operation planned to achieve over 60 per cent efficiency of irrigation water use.
- Farmers' participation aided by specific technical support by agricultural extension system for efficient water management and minimum ill-effects.
- identification of special areas, difficult for irrigation and development of strategies for limited irrigation water use.
- Planning of experiments and research work for problems associated with irrigation, drainage, ground water development and agricultural management.
- Training of farmers and project personnel in grass root water management, scientific agricultural practices, balanced use and management of fertilizers (including bio-fertilisers), adopting IPM practices and in general sound environment friendly agricultural management.
- Responsive and scientific system of water monitoring and comprehensive agricultural monitoring system will be required and these are being studied for setting up.
- Association with NGO's on worthwhile projects for organising farmers and supporting them on land-water based eco-friendly programmes.
- These measures taken together are expected to provide sustainable and efficient irrigation-based farm production systems.

6. PUBLIC HEALTH

6.1 The Issue

6.1.1 Context

A water resources development project causes spread of economic well being over large areas. Poverty alleviation is one of the most visible impacts. The development acts as a trigger for all round development, which enables beneficiaries, attain better health due to better hygiene, nutrition & general increase in standard of living. It has been found that the positive impact is substantial. One of the benefit's of the SSP will be the increased availability of fresh water for domestic, agricultural and industrial use in areas, which are otherwise drought prone. This improved domestic water supplies has the potential of substantial improvement in general health of public. There are however, health risks since without proper control, the transport and storage of water can lead to increase in the incidences of water-related diseases. Plans & then proper implementation is needed to control disease vectors and to provide health facilities for migrant construction workers and the resettled population.

Health provision in India is defined by the National Health Policy (NHP) and national disease programmes such as the National Malaria Eradication Programme (NMEP). The NHP entitles access to medical facilities to all Indians, the number and distribution of which is determined by the local population density. The NMEP was developed, as a nation-wide strategy to combat the spread of malaria with regard to SSP all the three State Governments will integrate development of new facilities with proposals already made under the NHP and NMEP. Such integration will avoid duplication, maintain parity within the project area and provide better access to health care than would otherwise be achieved.

In addition to the general obligations of the State under national policy, a specific requirement for the SSP contained in the environment clearance order of GOI was that, that plans for the provision of health facilities to workers and residents of the affected areas should be prepared. Each State should take necessary measures to minimise the risk of malaria, filarial, schistosomiasis and other diseases associated with water that may result from implementation of the project Preparation of an Action Plan for the surveillance and control of malaria was also stipulated.

This chapter examines the potential effects on general health of the public residing in the impact zone of SSP.

6.1.2 Sources of Impact:

The two main potential sources of health impact associated with the reservoir and Irrigation projects are as follows:

- The occurrence of pools of standing water, during construction and operation of the reservoir, may provide breeding areas for disease vectors:
- Immigrant construction workers may bring with them diseases or parasites, to which the local population may have low immunity.

The SSP is expected to confer significant public health benefit's since increased water availability will help to reduce the Incidence of 'water-washed' and 'waterborne' diseases which are associated with poor hygiene and restricted water borne water supply. Management of the potential health Impacts of the SSP will focus, therefore, on the exclusion and/or control of the disease vectors which spread 'water-based' and 'water-related' diseases.

6.2 IMPACTS AND MANAGEMENT

6.2.1 Studies and Findings

Studies

A large number of studies have been carried out on the health profile of villages in the three beneficiary States. The key studies are summarised below:

1. Narmada Programme - Schistosomiasis - Back-to-Office Report by Good land. 1986 described the schistosomiasis assessment carried out. Consultant to the World Bank, the National Institute of Communicable Diseases (NICD) and the World Health Organisation (WHO). The assessment confirmed the Incidence of schistosomiasis in Gimvi Village, Ratnagiri District, Maharashtra about 700 Km away. This is the only location where the disease had been recorded. The report also concluded that the Ratnagiri pocket was stable and that concerns expressed over the spread of schistosomiasis due to the SSP were unfounded.
2. Proceedings and Recommendations of the Meeting on Schistosomiasis Research and Surveillance held at NICD on 22nd November 1985. In 1985 the NICD carried out a survey of several Narmada submergence villages In Gujarat and Madhya Pradesh. Several thousand urine samples were tested for parasite eggs yielding negative results. The results and conclusions of the survey were presented and discussed at the 1985 workshop.
3. Disease Profile of Command Area by the Commissariat of Health, Medical Services and Medical Education (SCHMS), 1986 contained an analysis of the

disease profile in the Command Area and formed the basis of the Gujarat state work plan for environmental health. As part of the study, the potential impacts of the SSP on public health were considered and discussed with the World Bank and GOI officials. Conclusions from these consultations were used to assist in formulation of the work plan on health.

4. Health Statistics, GOM, 1987. The State department of health produced a report on the health profile of 33 project-affected villages in Dhule District, Maharashtra. This report concluded that:
 - Schistosomiasis was only found in one village and was unlikely to spread because of the SSP;
 - The influx of labourers, formation of irrigation canals and cesspools along the canals could lead to increased incidence of malaria;
 - Measures should be taken to prevent the possible spread of cholera and gastroenteritis due to misuse of irrigation waters for washing etc.
 - Filaria is not present in SSP areas but careful monitoring should be undertaken to ensure it does not enter the area. These results were used to formulate the Initial GOM Action Plan on public health, which was subsequently modified in the years 1991-92. Final revised Action Plan was submitted in 1993.
5. Health Statistics 1982-84, GOMP: This study, published by GOMP in 1985. Presented an analysis of the distribution and prevalence of water-related diseases in the Narmada Basin and provided baseline data for the State Action Plan for public health. The study concluded that malaria; guinea worm infections, goiter, gastroenteritis and worm infestations were the most common diseases. Schistosomiasis and leishmaniasis were not found to be endemic to the area. The study concluded that careful monitoring for malaria and filaria would be needed & that guineaworm was likely to be eradicated once the reservoir was full.
6. The Sardar Sarovar Narmada Project "Studies on Ecology and Environment" by Maharaja Sayajirao University (MSU), Vadodara in 1983 considered public health in earlier Chapter. To obtain an overall picture of the health profile of the Narmada River, MSU visited 42 sites from Hamfeshwar to the river mouth. Data was collected from public health centres and public health units to establish the rates of occurrence and distribution of disease over the previous five years. This data was used to produce an assessment of the likely health impacts upstream and downstream of the dam site.
7. Existing disease distribution data indicates that malaria occurs sporadically throughout the region from the Narmada source to its estuary in the Gulf of

Cambay. Levels of malaria are generally low although the anopheline mosquito vector has the potential to proliferate in the reservoir, drawdown area and canals. Numerous studies have been conducted on the incidence of malaria in India by, amongst others, the Malaria Research Centre (MRC) and Kaira. This work is summarised in a consultant's report to the World Bank.

8. Health Aspect and Water Quality by the NVDA, 1988, reports on the status of the more common diseases in the Narmada Sagar area but suggests that its conclusions apply also to the SSP. The report also outlines the likely health impacts of submergence.
9. Environmental Impact Assessment study of Water Related Diseases in Sardar Sarovar Project command area, Gujarat, Volume-I & Volume-II, This study was commissioned by SCHMS, Gandhinagar, Gujarat in 1992 to ascertain the likely impacts of project on public health living in the command area & in downstream areas of the dam. Volume-I of the study contained preliminary report on Water Related Diseases in the command area. Volume-II of the study presents profile of Water Related Diseases in the SSP command, likely consequences of the project when it becomes operational based on the morbidity data of Water Related Diseases available with SCHMS, Gujarat. The main objectives of the study were as follows:
 - a) To collect base line data.
 - b) To collect time series data on Water Related Diseases, from health institutions located in CA & Downstream of dam.
 - c) To provide indicators of the problem areas for specific diseases needing special focus & in-depth studies.
 - d) To indicate positive impacts on preventive health.
 - e) To indicate cost effective mitigatory measures to control diseases.
10. Baseline survey to assess the health & morbidity pattern in the rising of SSP. (Phase-I) 1995-96 by Department of preventive & social medicine of T.N. Medical College & B. Nair Charitable Hospital, Mumbai and Directorate of Health Services Maharashtra. This study was aimed at epidemiological surveillance in the vicinity of SSP to study its impact on health & morbidity patterns of the population directly or indirectly affected. The main objectives of this study were:
 - a) To study the socioeconomic & demographic profile.
 - b) To determine the status of health, morbidity & mortality pattern.
 - c) To study the changes & degree of impact in the status of health, morbidity & mortality pattern.
 - d) To develop suitable indicators for monitoring.
 - e) To establish effective disease surveillance mechanism.
 - f) To strengthening existing facilities.

Findings

The MSU study of 1983 and other studies concluded that the most of the important diseases in the Narmada Basin were malaria, scabies, dysentery and diarrhea of these diseases, only the threat of Increased Incidence of malaria is the prime concern of the SSP project authorities. Occurrence of the other diseases is, in general, results from poor hygiene, poor sanitation and the lack of drinking water. The study concluded that the incidence of these hygiene-related diseases would be reduced by better water availability.

Several other studies have also identified malaria and Japanese Encephalitis as the greatest potential health threats in the SSP affected areas, but have indicated that timely mitigative measures would greatly reduce any risk. The SCHMS report, for example, pointed out that much of the Command Area was already under Irrigation and that the addition of new areas would not have a marked impact on malaria Incidence. Moreover, the vector would not be able to breed in the irrigation branch canals under flow. The report did recommend, however, that the incidence of malaria should be subject to surveillance and recommended that practical measures to be Implemented where necessary, to protect agricultural communities.

A consensus was reached that schistosomiasis will not constitute a serious health issue. This view was put forward in the NICD report and confirmed by the subsequent World Bank/WHO missions.

According to the MSU report of 1983, filaria is confined to the coastal areas of Saurashtra and South Gujarat. Filaria has also been reported in Surat, near to the reservoir site, but the study concluded that the disease was unlikely to spread to the reservoir area.

The baseline study conducted by the Department of Health & Medical Services, Maharashtra, recommended for :

- Posting 2 Medical officers one at Kevadia & other at floating dispensary with required health assistants.
- Existing norms of 1 PHC for 2000 population shall be modified to 1:1000. This called for 16 PHC's instead of 8 PHC suggested on the final work plan on health of GOM in 1993.
- New upgraded health unit with OT & Lab. facilities at Dhadgaon & Mulgi.
- A new rural hospital at Mulgi or Kathi.
- Establishment of anganwadis to cater to the nutritional needs of children & other programmes for nutritional necessities.
- Additional posts of lab. Technical at each PHC.
- One dispensary for each 3-4 villages in remote areas.
- Educating youth, periodic spraying of deltamethrine, for which organizational setup has been proposed.

PLATE - XIV

LEGEND

Health aspects

- | | |
|-----------------------------|---|
| Fig. 1
& 2 : | Use of Narmada water without conventional treatment. |
| Fig. 3 : | Transporting sick from long distances. |
| Fig. 4 : | Science of malnutrition discernible. |
| Fig. 5 : | Inauguration of sub-centre health in village Somaval, a R&R site in Maharashtra. |
| Fig. 6 : | Hospital building at Somaval, newly constructed. |
| Fig. 7 : | Hospital treatment at project site. |

PLATE - XIV



The NVDA report concludes that, given the rise of the water table and consequent reduced potential for cyclopic proliferation, the likelihood that guinea worm infestation will increase is extremely remote.

6.2.2 Proposed Management / Mitigation Measures

In accordance with MOEF, GOI, guidelines each of the three States affected by the SSP have submitted environmental work plans on public health aspects.

Studies on the disease profile in the SSP region and past experience with major water resources projects suggested that health Action Plans for the project should focus on the following:

- + Provision of health care for displaced people and immigrant workers;
- + Control of malaria and potential breeding sites for malarial vectors;
- + Monitoring for the incidence of other water-related and waterborne diseases with a view of preventing their establishment.

6.3 ACTION PLANS

Gujarat

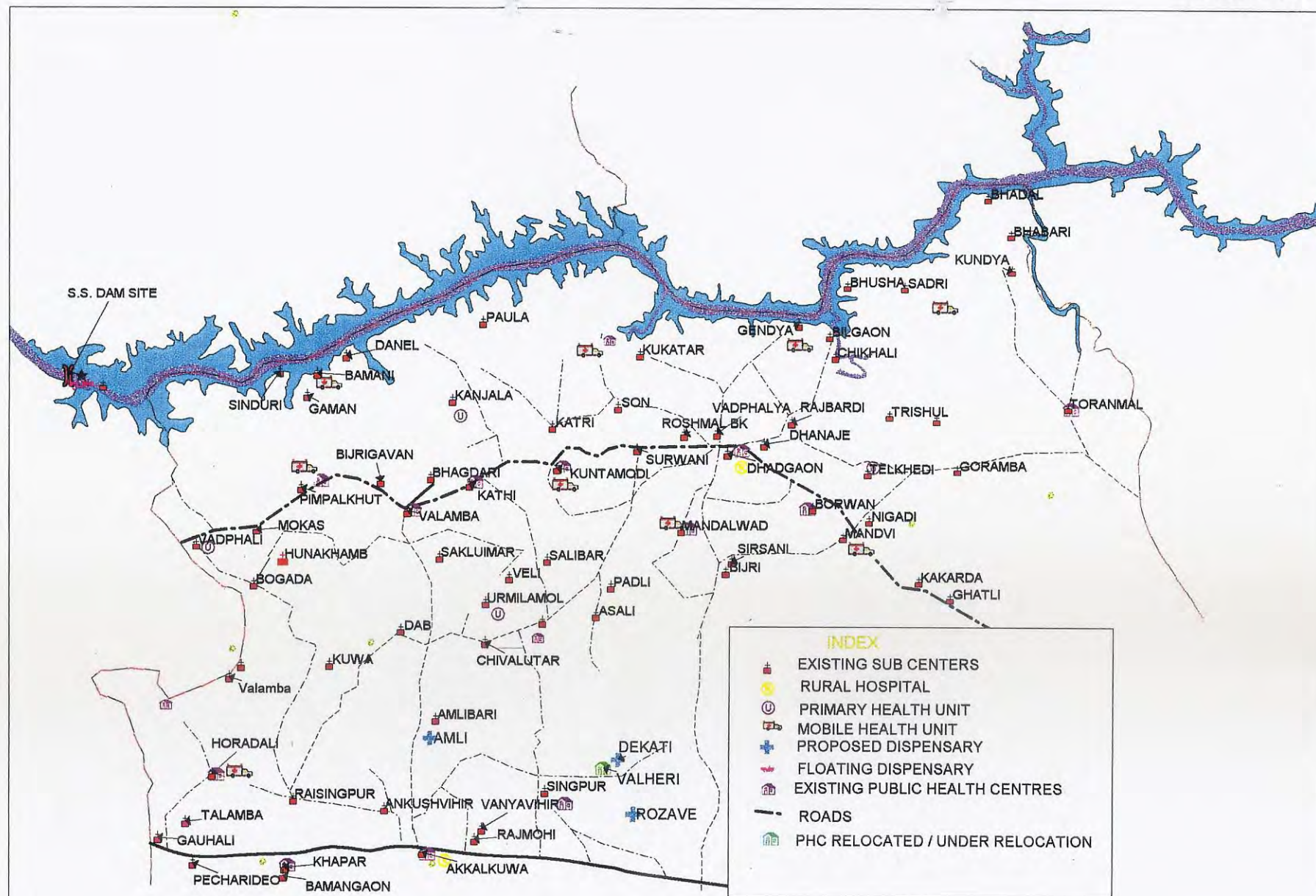
An Initial work Plan for Environmental Effects: Sector Public Health for the Command Area of Gujarat was drawn up in 1986 by the NPG in coordination with SCHMS. This plan covers villages within a 10 km radius of the reservoir including resettled populations and makes provision for the monitoring, surveillance and control of malaria. The 1986 plan is under implementation with certain modifications and additions.

The principal objectives of the work plan are:

- To provide for systematic and continuous monitoring of the health profile of the project area;
- To provide suitable Infrastructure for health provision in the project area.

The plan also outlines actions for the surveillance and control of malaria. The main components of the plan area summarised below.

- + Establishment of hospital at Kevadia.
- + Strengthening of laboratory facilities including establishment of mobile unit.



SSP : HEALTH PLAN - MAHARASHTRA : PROPOSED AND EXISTING FACILITIES

- + Provision for laboratory technicians in existing public health centers (PHC's).
- + Expansion of malaria treatment depots.

Proposal to establish Urban Malaria Scheme for centres over 40,000 (anti-larval operations) not currently covered. Strengthening of state level health organisations to ensure monitoring of malaria, filaria, dengue and encephalitis, strengthening of district level health organisations for monitoring or implementation, residual insecticidal spraying operations are included in the plan.

In the work plan, cost and staffing estimates are included for each of the proposed actions and presented in detail in the annex to the plan. Implementation of these actions is designed to coincide with the three-phase (17 year) implementation schedule of the irrigation component of SSP. GOG has prepared final Action Plan on malaria control.

Maharashtra

GOM submitted an Initial Work Plan for Public Health Sector In 1987, which was modified and resubmitted for consideration in 1991 and further updated in 1992 & 1993. The work plan was based on the state health department survey of Dhule District. The principal objectives of the plan were as

- To monitor closely health conditions in Dhule district
- To provide facilities for carrying out this monitoring
- To adopt precautionary measures against the spread of diseases
- To be prepared to combat epidemics that might arise.

The work plan also contained provisions for the strengthening of state and district health facilities in existing villages and in resettlement areas. The provisions included the establishment of a monitoring and laboratory cell at the Rural Hospital and strengthening of the existing Primary Health Centre. It contained full descriptions of the likely costs and staffing requirements of these measures.

Madhya Pradesh

An initial Work Plan for the Public Sector was submitted to the NVDA the state health department in 1988. This plan included a summary of existing health profile in the submergence villages and discussed the likely impacts of the SSP. The plan contains specific provisions for:

- Strengthening of health facilities already in place under the NHP and Minimum needs programme of the Seventh Five Year Plan;
- Establishment of a Health Monitoring Cell;
- Strengthening of health centers for construction workers;

- Establishment of district organizations for malaria control established of the NMEP.

An extension to the MP Health Plan was published by the NVDA in January 1990 and was revised and re-submitted in 1991. This report provides additional detail concerning the provision and training of health care staff, numbers of specialist staff required, funding and responsibilities for management.

In addition to the State Health Plan, a Memorandum of Understanding was signed between Gandhi Medical College, Bhopal and the NVDA to provide further arrangements for the monitoring of malaria and other diseases. This memorandum included provisions for the following:

- Study of mosquito vectors in the Narmada area:
- Comparison of SSP with other similar project situations and analysis of lessons learned:
- Collection and analysis of time-series-data on disease incidence:
- Recommendation of health promotion and disease preventative measures in the SSP area.

6.4 IMPLEMENTATION

Gujarat

It is clear from the 1986 GOG work plan for public health that a great deal of attention has been paid to the issue of malaria control. By the end of 1992, the intensified malaria control programme was underway in several villages impacted by the project in Gujarat and the construction of a 25-bed hospital at Kevadia was complete.

Maharashtra

In accordance with State provision for health care facilities, two cottage hospitals, eight primary health centres and 55 primary health unit's have already been established in Dhule District. Taking Into account the inaccessibility of some of the villages, provisions were made for eight additional public health unit's, 10 mobile unit's and a floating dispensary for villages within 10 km of the submergence zone. One hospital at Somawal resettlement village, is already functional.

Madhya Pradesh

During 1992, Gandhi Medical College continued surveillance studies of the impact area of Madhya Pradesh and work commenced on additional facilities for the Nisarpur village hospital, Dhar District. Extension of the Nisarpur hospital is

due for completion by 1994-95 when submergence of areas in Madhya Pradesh is due to commence.

The study recommended that the health services should be strengthened in the affected areas. It also recommended community participants in the health programmes, devising, health curative strategies & accelerating overall socio-economic development.

Status of Health Plans and their Implementation

Implementation of Actions for Public Health is summarised in the following table :

Action	Gujarat	Maharashtra	Madhya Pradesh
• Baseline studies	Initially conducted in 1986 then EIA was conducted in 1993.	Complete, 1987 being extended further.	Complete, 1994 being extended further.
• Preparation of state Action Plan	<ul style="list-style-type: none"> Modified work plan submitted in April 1986 which included schemes for "Surveillance & Control of Water related & Commissionerate diseases" and surveillance & control of Malaria. Draft Health Management Plan submitted in 1997. 	Original Action Plan was submitted in 1987 and subsequently revised in 1991 and 1992. Final revised Action Plan was submitted in 1993.	Original Action Plan was submitted in 1986 and then revised in 1988. Final plan was submitted in 1991. Cost details were incorporated in the Final Action Plan in 1996.
• Survey of existing facilities	Complete	Complete	Complete
• Establishment of health facilities	<ul style="list-style-type: none"> 50 bed hospital at Kevadia including a malaria unit. Medical laboratory and 20 mobile unit's. 61 dispensaries. 7 new dispensaries at R&R sites for PAFs of MADHYA PRADESH and Maharashtra and 26 dispensaries at R&R sites for PAFs of Gujarat are under construction of which 4 dispensaries have already been completed. 	<ul style="list-style-type: none"> Hospital at Somawal village. One primary health centre, three sub-centres & one floating dispensary have been established in which laboratory facilities have been provided. 	<ul style="list-style-type: none"> Tenders for 30-bed hospital at Nisarpur are being floated. Provision for a mobile unit and civil dispensaries has been made in the Action Plan.
• Vector control	Under National Malaria Eradication programme,	Under National Malaria Eradication	Under National Malaria Eradication Programme

measures in place	SSNNL organized workshops on malaria control. In addition, laboratories have been established	Programme, guidelines for malaria control by Irrigation Department have been adopted.	State malaria control organizations have been strengthened.
<ul style="list-style-type: none"> • Appointment of staff 	<ul style="list-style-type: none"> • One senior health officer has posted at Kevadia hospital. Medical Cell SSPA is headed by Deputy Director (Health) and is assisted by 3 specialist doctors besides 1 pharmacist and 6 ministerial staff. 	51 posts have been filled up.	Needs identified.
<ul style="list-style-type: none"> • Disease monitoring and responsibility 	<ul style="list-style-type: none"> • Has been entrusted to State Council of Health & Medical Services and EIA report has been submitted by SCHMS. • Draft Health Management Plan was submitted in 1997. • Total 212 diagnostic and treatment camps have been organized. 	<ul style="list-style-type: none"> • Has been entrusted to State Health Department. • Surveillance studies had commenced and survey report for Phase-I of the study has been submitted by Topiwala National Medical College, Mumbai. Phase-II of study is under implementation 	<ul style="list-style-type: none"> • Has been entrusted to Evaluation Cell established by NVDA. • Gandhi Medical College, Bhopal was entrusted with epidemiological surveillance studies. Five interim reports of the studies have been received so far. Sixth and final report is under compilation.

6.5 SUMMARY OF WORK TO BE DONE

Substantial work has been carried out to identify health risks and diseases within the SSP-affected area, particularly on the prevalence of malaria. In future, efforts will be needed to follow-up the results of these studies and to take the necessary management steps to protect temporary and permanent populations. In order to ensure health protection in the SSP area, two principal tasks remain:

GOG need to complete it's work plan for the surveillance and control of malaria.

District health authorities should be enlisted to monitor compliance with guidelines for malaria control in drinking water supply areas under the national directives.

7. SEISMICITY AND RIM-STABILITY

7.1 The Issue

7.1.1 Context

Earthquake-resistant design parameters need to be adopted for all dam projects in order to minimize the risks associated with earthquakes. The possibility of induced seismic activity is difficult to establish. The destructive potential of earthquakes, including landslides, must be considered in project design, adequately.

There are no specific stipulations on aspects of a seismic dam design in either MOEF Clearance Order or the World Bank Loan Agreement. Dam design for seismic forces is obviously out of scope of MOEF. World Bank depends for this purpose on national standards.

Dam design in India is regulated by a national standard developed by the Bureau of Indian Standards (BIS). The BIS has classified the Indian sub-continent into 5 zones depending on tectonic, geologic and seismic consideration using available data. The Zonal classification is used to establish a set of Criteria for Earthquake Resistant Design of Structures whereby the appropriate conditions would be imposed on engineering structures falling into different zones. Engineering structures must be designed to withstand the maximum earthquake forces within a given category. Any new dam project must meet the BIS standard and vetted through Central Water Commission (CWC) for technical clearance.

The River Narmada lies in the seismotectonic provinces of Cambay Basin and Peninsular Shield (including the Deccan Trap) and comes under Zone 3 of the BIS classification. Moderate seismic activity has been recorded in the Cambay Basin (up to 5.4 on the Richter scale) although the majority of seismic events in the dam vicinity have been of sub-zero magnitude.

Rim stability refers to the competency of reservoir base rocks to maintain natural slopes and to contain the stored water. Under stable conditions, there should be no significant losses of reservoir water due to ground water percolation or seepage. Where rocks are found to be highly permeable, mitigation measures are needed to ensure the longevity of the reservoir.

7.1.2 Seismic Threat

A dam site situated in earthquake prone zone is posed to tectonic earthquakes which is taken into consideration by designers after elaborate consideration of seismogenic faults and their lengths, associated magnitudes

of possible earthquakes, distance from dam site and media transverse etc. to determine ground motion.

Besides, It has been viewed In recent times by some researchers that the man-made reservoirs could also trigger earthquakes.

There are two principal situations In which reservoirs are considered to perhaps contribute to seismic activity :

- + where reservoirs are present in areas of naturally high seismic activity and the additional mass of the lake increases the pressure on highly-stressed rocks or readjusted fractured material;
- + where clay beds are located within layers of harder material and seepage from the reservoir base might have lubricated a slipping plane.

Where seismic activity has been associated with either of these factors. the tremors recorded have usually been very minor (magnitudes 0-4); these are detectable by sensitive instruments but of no material significance.

7.2 IMPACT AND MANAGEMENT

7.2.1 Studies and Findings

Studies

The Geological Survey of India (GSI), Central Water and Power Research Station (CWPRS) have carried out studies of reservoir-induced seismicity (RIS) and rim stability. The principal studies are described below :

University of Roorkee. 1980. Geological and Seismological Investigations of the Environs of Narmada Valley around Navagam Dam Site in Gujarat :

Roorkee University carried out a micro seismic survey of the SSP dam site for a period of 6 months in 1980. This survey indicated that no active lineament could be identified in the region, the river bed fault did not show any seismic activity and the magnitude of an earthquake would normally not exceed 5 and. in any case, be under the design specification of 6.5 (Richter Magnitude).

G.S.I. 1981-82 and 1982-83. A Geotechnical Report on the Reservoir Competency Investigations In Parts of Sardar Sarovar Area. Bharuch & Vadodara Districts. Volume I & II.

The first volume of this report describes the background geology and tectonics of the SSP site and analyses the problems of reservoir seepage and landslides in order to assess reservoir competence. Brief conclusions are presented and

recommendations made for additional work. A second volume was published in 1983 in which further information was presented on the composition and location of faults and the risk of landslides.

Shenoi et al. 1982 presented a paper at the New Delhi conference on the significance of seismotectonic aspects on reservoir development.

The paper discussed the Narmada valley reservoir projects as a case study and demonstrated how a conservative horizontal seismic coefficient had been adopted for the dam design to ensure protection of the structure from potential RIS.

Balsundaram, M.S. 1982. Sardar Sarovar Project.

A Geotechnical Report Compiled and Edited for the Government of Gujarat.

This report gives a full account of the geotechnical aspects of the SSP and was conducted during feasibility investigations early in 1982

MSU. 1983. The Sardar Sarovar Narmada Project Studies on Ecology and Environment.

The MSU report contains a full description of the geology, tectonics and pattern of fault structures within the Narmada Basin. MSU based their report on the initial work of the Geological Survey of India and Government of Gujarat but carried out additional verification surveys using ground checks, aerial photographs and topographical maps.

NVDA published a Position Paper on Seismic Studies in January, 1986 summarising the results of detailed studies on the seismic aspects of the Narmada Sagar dam.

Krishna, J. 1989. Dams and Seismicity.

In this document, Dr Krishna presented a layman's guide to the issue of dams and seismicity. He described in some detail the relationships between reservoir depth, base rock materials, fissure zones and the conditions needed to induce an earthquake. He also discussed the likelihood of reservoirs to induce seismic activity and cited case studies from amongst other, India, the former USSR and Africa.

G.S.I. 1990. Study of the Rim Stability of the SSP.

This is an ongoing study of the assessment of rim stability in the states of Madhya Pradesh and Maharashtra. The study has established that the

reservoir rim is stable but has recommended that further seismic refraction studies be completed by CWPRS to confirm these findings.

GOI. 1993. Sardar Sarovar Project Seismicity and Sardar Sarovar Dam.

This report, produced by the Central Water Commission for the NCA provides a concise summary of work done to date on the seismological aspects of the SSP 1401. The report begins with a description of the tectonic setting of the dam and goes on to discuss the evolution of earthquake dam design parameters including the seismic coefficient and Design Basis Earthquake (DBE). The general conclusions of the study, as reflected in earlier reports, are that the design parameters for the dam comply both with national and international standards and that safety requirements have been scrutinised and approved at the highest level.

Findings

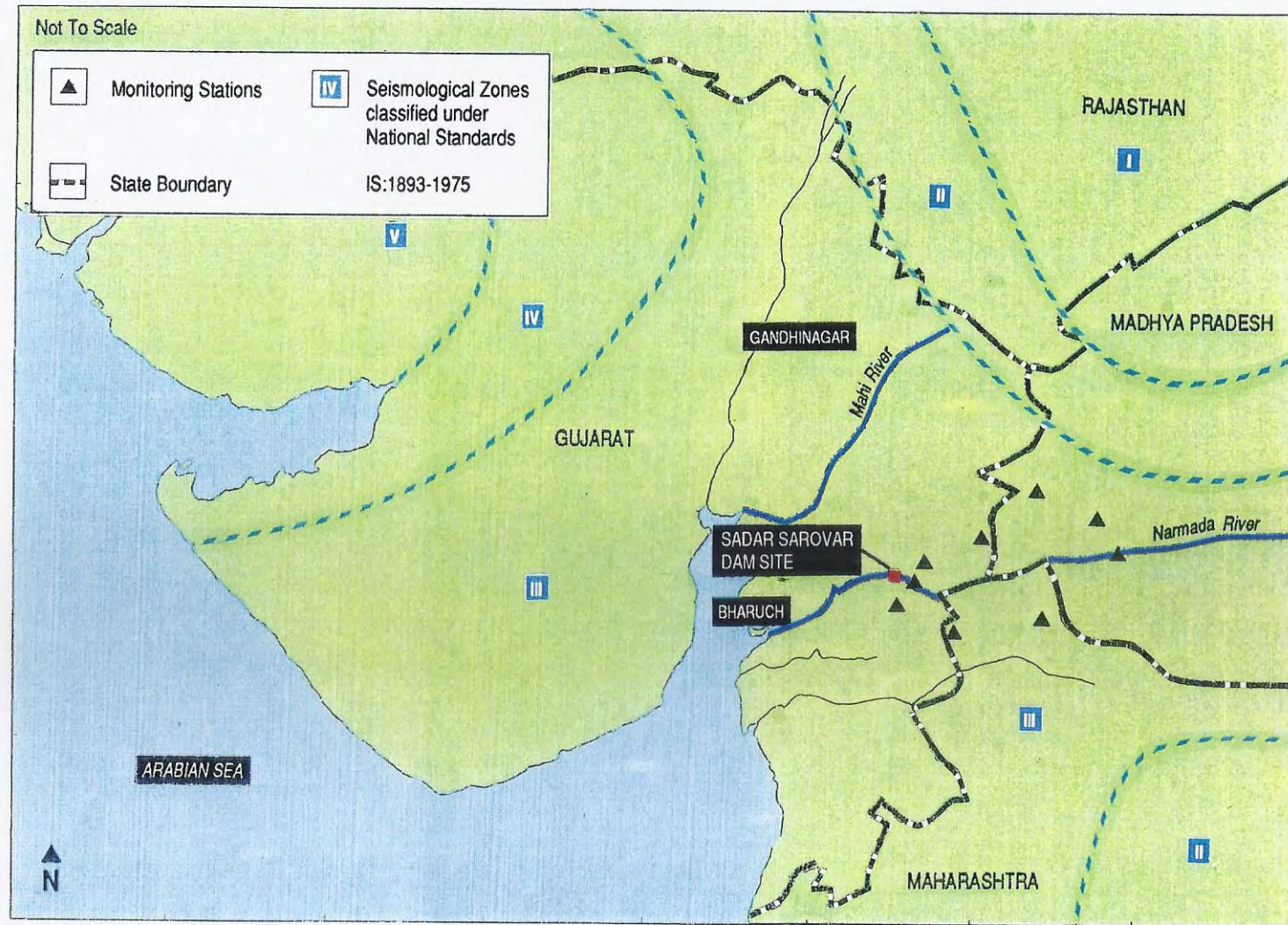
Seismic Sources

The data on earthquake occurrence in peninsular India show that the MCE can have a maximum magnitude of 6.5. The fault and tectonic lineaments of relevance for SSD are as follows:

Rajpardi and associated faults forming the Eastern boundary of Cambay basin West Coast seismotectonic province.	shortest distance to the lineament from dam site is 55 km towards West.
Barkhadi-Barwani fault.	Shortest distance from site is 110 Km East.
Piplod fault.	Shortest distance 12 Km South of dam site.
Tilakwada-Bardoli fault.	Shortest distance 17 Km North of dam.

While it is plausible to apply the earthquake with Richter magnitude 6.5 only to cases (i) & (ii) above which are the only seismogenic lineaments that are capable/active, a 'worst case scenario' of a Richter magnitude 6.5 earthquake has been postulated at a epicentral distance of 12 Km with a depth of focus of 18 Km for case (iii) in order to have conservative estimates of ground motion characteristics for design purposes.

It has been concluded that reservoir impoundments may in some cases trigger earthquakes where tectonic deformations already exist in the geological structures. The threat of reservoir-induced seismic activity by the SSP is extremely low. The dam has been designed to accommodate the Maximum Credible Earthquake (MCE) Richter Mag. 6.50 and as it is established that the



levels of Reservoir Induced Seismicity have never exceeded 6.3, the safety requirements are adequately met with.

The rim of the reservoir has been found to be stable; further seismic refraction studies are in progress to strengthen this finding.

7.2.2 Proposed Management Measures

The principal mitigation measures for the prevention of earthquake damage can be summarised as :

- + Construction of dams and Infrastructure (Incorporating seismic design coefficients) to withstand the maximum credible earthquake;
- + Establishment of seismic monitoring stations at key locations around the reservoir;
- + Strengthening of new properties around the reservoir perimeter which may be susceptible to minor tremors.

Design parameters for the SSP were examined in the draft report of the University of Roorkee entitled Design Earthquake Parameters for Navagam Dam Site In Gujarat. This report summarised the seismotectonic setting of the SSP dam site and made recommendations for the seismic parameters needed to be accounted for aseismic dam structure.

The initial study concluded that the potential occurrence of a medium sized earthquake, which had occurred in parts of the Deccan Trap in the past, should be taken into account when deciding the design parameters for the dam. In addition, a Maximum Credible Earthquake (MCE) with magnitude 6.5 and with It's epicenter at the nearest capable fault could be adopted for estimating ground motion characteristics.

The GOG appointed a Dam Review Panel, comprising engineers and geologists, to evaluate the report findings and a revised final report was submitted to the project authorities in 1982. The Review Panel came to the following conclusions :

- + the adoption of a MCE magnitude 6.5 to estimate ground motion was a conservative choice, greater than any recorded event in the region and with a very low probability of occurrence during the dam's life span;
- + no evidence had been found for movement along the river bed fault;

- + the principal criterion which should be applied to the Design Basis Earthquake (DBE) is that no structural damage should occur to the dam as a result of this event.

Following the recommendations of the Dam Review Panel, an effective peak ground acceleration of 0.25 g was adopted and approved for the SSP. The dam design was also referred to the University of Roorkee, the World Bank and CWPRS, Pune, for dynamic analysis.

It was then decided that certain modifications would be made to the initial design and that sophisticated monitoring equipment would be installed to measure stress on the body of the dam.

The CWPRS report recommended early installation of a seismic monitoring network so that data would be available in the pre-impoundment stage; increase in seismic activity could be monitored during impoundment. This recommendation gained full support from the Review Panel and responsibility for finding suitable sites for the monitoring stations was allocated to GOG.

The General need and specific requirements for seismic monitoring are outlined in the SSNNL report of 1991 entitled 'A Note on Seismic Instrumentation around the Periphery of the Reservoir of Sardar Sarovar'. This report includes a detailed summary of the instruments and status of building construction at each of the monitoring stations up to September 1991.

Institutional responsibility for the installation and upkeep of the monitoring stations lies with the SSNNL under the overall supervision of the Government of Gujarat.

The third possible mitigation measure, namely, reinforcement of buildings around the dam and reservoir perimeter, is not thought to be relevant in the case of the SSP. In the first place, a majority of the dwellings in the vicinity of the dam are simple structures for which there are no appropriate design measures. Secondly, it is considered that the reservoir will not generate a seismic activity in excess of a tectonic earthquake which can, as a natural phenomenon occur.

7.3 ACTION PLAN

The action plan for seismicity comprises the mitigation measures outlined above, namely:

- Modification of the dam infrastructure to withstand the MCE
- Installation of monitoring instruments within the dam body
- Establishment of a monitoring network around the reservoir.

7.4 IMPLEMENTATION

The Government of Gujarat has identified 9 locations for the Installation of seismic monitoring stations, 4 each on either side of the Sardar Sarovar reservoir in Madhya Pradesh and Maharashtra and 1 at Kevadia in Gujarat. Selection of the initial sites was carried out by the SSNNL.

The various recommendations for modification of the dam design have all been carried out and are summarised as :

- Adoption of an effective peak ground acceleration of 0.25 g on the recommendation of the Dam Review Panel:
- Installation of stress monitors In the main body of the dam:
- Increase of the depth of the foundation to 30 M below the lowest riverbed at the dam site in due consideration to foundation geology.

The Government of Gujarat has identified 9 locations for the installation of seismic monitoring stations, 4 each on either side and one at the downstream of the Sardar Sarovar reservoir, out of a total of 9 stations, 3 are in Madhya Pradesh, 1 in Maharashtra & 5 are in Gujarat. Construction and instrumentation installation work is completed at all the 9 seismic monitoring stations. The seismological observatory at Kevadia Colony is in operation since 1973. The data of Kevadia Colony seismograph station for the period from 1973 to 1984 was analysed by CWPRS, Pune and GEAR, Vadodara. Also, Micro-earthquake surveys around Navagam Dam were carried out in the year 1980 by Dept. of Earthquake Engineering, University of Roorkee. The Micro-earthquake activity was found to be of low level and was generally scattered in the Narmada basin.

The seismological network with latest instruments was established in the year 1989. After the installation of new seismic instruments at new sites, local micro-earthquakes as well as global earthquakes are being recorded. The events which are recorded at network are analysed and located using the computer program 'FASTHYPO' incorporated with seismic Data processing and Analysis Computer (DAC - 300). The progress of implementation is illustrated in Table below:

Status of implementation of seismicity aspects

ACTION	STATUS
Dam design modifications	Completed
Monitoring stations	Construction and instrument installation work is completed at all 9 seismic monitoring stations.
GSI (Nagpur Division) Rim Stability studies	Completed
Tracer Studies by CWPRS	Reports submitted

7.5 SUMMARY OF WORKS TO BE DONE

The seismic design is a structural engineering issue and has been taken care by the designers of the dam . SSNNL has already installed the required monitoring stations and the experts are carrying out data collection and analyses.

8. THE CULTURAL HERITAGE

8.1 The Issue

8.1.1 Context

River Narmada originating from Amarkantak in the Maikhal mountain flowing through the Vindhyas and Satpuras to the plains of Bharuch (Gujarat) and finally merging into Arabian sea has a rich historical culture. The river Narmada is considered as one of the seven sacred river in India. The ancient shrines, temples and places of worship of the Narmada Basin form part of the cultural heritage of the Indian sub-continent and have an intrinsic value for the people of all faiths who visit them. The Sardar Sarovar Project has necessitated afresh look at the archaeological and cultural heritage available in the Narmada valley. The Government of India recognises the value of such cultural sites and has enacted a series of laws to maintain and protect them from decay, misuse or development activities. Principal amongst these is The Ancient Monuments and Archaeological Sites and Remains Act, 1958 (1964 MADHYA PRADESH) which charge the central and or state Department of Archaeology with responsibility for the protection of important cultural sites. Under the Act, sites are classified into three categories as follows :

Type 1: monuments of national importance which are protected by central government:

Type 2: monuments of religious or cultural importance which are protected by the state governments;

Type 3: monuments which are neither centrally or State-protected but which are considered to be an Important part of cultural heritage.

Under the same law, authorities charged with the protection of the monuments are permitted to take suitable measures to ensure the preservation of any protected site under threat from decay, misuse or economic activity.

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

8.1.2 Sources of Impact on Sites of Cultural interest:

The principal impacts of the SSP on the cultural environment are likely to be as follows:

- + the loss of access to historical, cultural or aesthetic sites which are submerged by the reservoir;
- + alteration of the configuration or regime of water bodies, especially the Narmada River, of religious significance;
- + direct disruption or damage to sites through construction activity or indirect effects resulting from resettlement of people.

8.2 IMPACT AND MANAGEMENT

8.2.1 Studies and Findings

Studies

The three State governments carried out a complete survey of cultural and religious sites within the submergence zone under the direction of the project proponents. The principal aim of these studies was to list all archaeological sites, identify and name any sites under state-protection and further identify sites of religious or cultural significance which, although not protected under national law, are of sufficient value to merit relocation. These studies are summarised below :

Gujarat

- + Archaeological Survey of Nineteen Villages submerged by Sardar Sarovar Reservoir, 1989: - The Department of Archaeology was instructed to carry out a survey of archaeological sites in 19 villages of the proposed SSP submergence zone in Gujarat. By June, 1989, 12 villages had been surveyed. The initial report, submitted by the Director of Archaeology, contained a full list of villages surveyed and photographs of the Shoolpaneshwar and Hamfeshwar temples. Two further studies of sites in the remaining seven villages were carried out in March 1992 and a supplementary report issued.

Maharashtra

- + **State Department of Archaeology** : A survey was carried out by the Department of Archaeology of cultural sites in 24 villages of Akkrani Taluk and nine villages from Akkalkuva Taluk, Dhule District. A brief summary note was submitted by the Director of Archaeology in February 1992 which stated that no state-protected monuments were located in the area but recommended the preservation of monuments at the village of Manibeli, Dhule District.

Madhya Pradesh

- + **State Department of Archaeology and Museum** : The Archaeology Department of Madhya Pradesh compiled a detailed report of archaeological

sites in 120 villages likely to be affected by SSP. A second study of 73 villages was completed in July, 1991. Each study contained photographs together with detailed descriptions of the current use and historical significance of the sites.

In addition to baseline studies on archaeological aspects, work has been carried out on the anthropological heritage of the Narmada Basin including examination of evidence of ancient dwellings and cultural artifacts. The principal studies in this area are described below.

- + Anthropological Survey of India. Narmada Salvage Plan : The Narmada Salvage Plan contains detailed background data on palaeo-anthropological, human ecological and other aspects of the Narmada valley. By May 1992, surface scanning of 17 sample villages coming under submergence had been carried out, 424 specimens including ancient tools etc had been collected.
- + Anthropological Survey of India. Peoples' of India : This project entailed a complete survey of 33 tribes of India including those of the Narmada Basin. The study covered all aspects of tribal culture in India and was published in 61 volumes in 1992.
- + Parishad, A.K. Survey of Material Culture in the Narmada Valley : Work was completed and a report published by the National Museum of Humanity, Bhopal, on cultural objects from tribal artisans in Madhya Pradesh in 1990. Copies of the interim report were circulated to the Ministry of Environment and Forests and the Narmada Control Authority in April 1991.

Findings

No centrally or State-protected cultural sites are located in the submergence area of the SSP. Baseline studies, however, identified several sites which were considered of cultural value and should be relocated where practicable.

Gujarat

The Department of Archaeology concluded that the temples of Shoolpaneshwar and Hamfeshwar were important monuments and should be shifted to high ground. Six other temples within the submergence zone were not considered of sufficient value to merit relocation.

Maharashtra

No State-protected sites were found in the villages surveyed; however, the Department of Archaeology and Museums recommended the relocation and

proper preservation of the Shoolpaneshwar temple in the village of Manibeli, which lies on the border of Gujarat and Maharashtra states.

Madhya Pradesh

Following the initial survey of the State Department of Archaeology and Museums, in 193 villages yielded 36 monuments, 88 images and 33 archaeological mounds as per Action Plan 1993. No state-protected anthropological sites were found within the submergence zone. The numbers of cultural sites Identified In the SSP area in the survey reports are given below.

8.2.2 Cultural heritage in SSP

State	Relocation of temple		Excavation		Sculptures	
	Target	Completed	Target	Progress	Target	Progress
• Gujarat	2	1	-		-	
• Maharashtra	NIL	N.A.	NIL	N.A.	NIL	N.A.
• Madhya Pradesh						
□ As per Action Plan 1993	7	*	5	2**	186	118***
□ As per Action Plan 1997	13	3	5	1	68	NIL

* Four structures are included in the Action Plan 1997 and remaining 3 nos. are handed over to ASI.

** Work was possible on 2 mounds and the remainings are handed over to ASI.

*** Remaining works are included in Action Plan 1997.

8.2.3 Proposed Management Measures

The only practicable mitigation measures for the protection of archaeological sites is the relocation of monuments to areas away from the submergence zone. In the case of excavation sites of anthropological interest, where appropriate, material should be removed prior to submergence.

Specific mitigation measures adopted for the SSP are as follows :

- + timely relocation of temples in areas away from the submergence zone;
- + relocation of temples with significance for ritual ablution or cremations close to water bodies or within a short distance from the reservoir;
- + movement of sculptures and other artifacts to museums.
- + Excavation of mounds etc.

8.3 ACTION PLANS

Gujarat

The Action Plan for two temples, i.e., Shoolpaneshwar and Hamfeshwar is ready.

Maharashtra

The Director of Archaeology, Maharashtra reported that no state-protected sites would come under submergence. However, plans would be needed to relocate the Shoolpaneshwar temple at Manibeli village. GOG has been entrusted with responsibility for relocation operations.

Madhya Pradesh

A large number of sites were identified for relocation although none of these sites are protected under the 1958 Act. It was proposed, therefore, that any decision on whether they should be relocated would be made on a case-by-case basis by an independent expert panel. This panel comprised representatives of the Archaeological Survey of India, Central and State Governments and was established by GOMP. The panel's decisions were ratified by a joint Inspection committee of the Irrigation Department and Archaeological Department.

The expert panel proposed, a 4-phase Action Plan framework for relocation operations :

Phase-I – Survey work, survey report, listing of monuments and sculptures, estimates for shifting.

Phase-II – Action Plan, documentation, detailed estimates.

Phase-III – Building construction, shifting of sculptures, shifting of monuments.

Phase-IV – Display arrangements, model preparation, video library, publication report, excavation reports, new findings (if any).

State Department of Archaeology and Museum had conducted a survey covering 193 villages coming under submergence of SSP and pointed out the monuments for protection and relocation works. GOMP earlier prepared the Action Plan 1993. The details are as below:

Sl No	Particulars		
	Name of monument	Village	District
1.	Shiv Mandir	Roligaon	Jhabua
2.	Kanjaleshwar Mandir	Semalda	Dhar

3.	Jalaleshwar Mandir	Khujawa	Dhar
4.	Bhawani Mata Mandir	Khujawa	Dhar
5.	3 nos. big statues	Khujawa	Dhar
6.	Shiv Mandir	Barda	Dhar
7.	Rock-cut sculptures	Pipaldagarhi	Dhar

Excavation

Sl. No	Particulars	
	Name of archaeological mound	District
1.	Mound at village Khaparkheda	Dhar
2.	Mound at village Utavad	Khargone
3.	Mount at village Brahmangaon	Khargone
4.	Mound at village Krimohigaon	Khargone
5.	Mound at village Kheda	Dhar

GOMP prepared another Action Plan in 1997, in which, some more monuments and excavation sites were included. The details are as under :

Relocation / Protection

Sl. No	Particulars				
	Name of monument	Village	Tehsil	District	RL in m
1.	Shiv Mandir	Bada Barda	Manavar	Dhar	130.970
2.	Bhawani Mata Mandir	Khujawa	Dharampuri	Dhar	147.825
3.	Shomeshwar Mandir	Khujawa	Dharampuri	Dhar	129.530
4.	Shiv Mandir (S.No.1)	Khujawa	Dharampuri	Dhar	135.460
5.	Shiv Mandir (S.No.2)	Khujawa	Dharampuri	Dhar	135.475
6.	Shiv Mandir (S.No.3)	Khujawa	Dharampuri	Dhar	135.165
7.	Rock-cut caves	Khujawa	Dharampuri	Dhar	135.075
8.	Big statues	Khujawa	Dharampuri	Dhar	146.395
9.	Shiv Mandir (Mauni Baba Ashram)	Pipaldagarhi	Dharampuri	Dhar	153.775
10.	Rock-cut-sculptures	Pipaldagarhi	Dharampuri	Dhar	130.440
11.	Shiv Mandir	Bodhwada	Kukshi	Dhar	138.685
12.	Narmadesh-war Mandir	Dehar	Kukshi	Dhar	134.665
13.	Baneshwar Mandir (Shiv Mandir)	Navadatoli	Kasarawad	Khargone	137.765

Excavation

Sl. No	Particulars		
	Name of mound	District	RL in m
1.	Mound at village Maruchichli	Khargone	151.635
2.	Mound at village Ekalwara	Dhar	146.875
3.	Mound at village Katnera	Dhar	139.865
4.	Mound at village Khalghat (Khalkhurd)	Dhar	156.310
5.	Mound at village Kalyanpura	Dhar	148.035

8.4 IMPLEMENTATION

Gujarat

Shoolpaneshwar temple which was on the border with the State of Maharashtra is relocated 15 kms. downstream of the SSP in village Gora. Relocation work is completed. Relocation work of Hamfeshwar temple is under progress.

Madhya Pradesh

State Department of Archaeology and Museum had conducted a survey covering 193 villages coming under submergence of SSP and pointed out the monuments for protection and relocation works.

Status of implementation for Action Plan of 1993 are as below:

Sl No	Particulars			Status
	Name of monument	Village	District	
1.	Shiv Mandir	Roligaon	Jhabua	Handed over to ASI by State Department of Archaeology, MADHYA PRADESH Progress is awaited.
2.	Kanjaleshwar Mandir	Semalda	Dhar	- do -
3.	Jalaleshwar Mandir	Khujawa	Dhar	- do -
4.	Bhawani Mata Mandir	Khujawa	Dhar	The monument is taken in Action Plan 1997. Relocation is remaining.
5.	3 nos. big statues	Khujawa	Dhar	- do -
6.	Shiv Mandir	Barda	Dhar	The monument is taken in Action Plan 1997 and relocated completely.
7.	Rock-cut sculptures	Pipaldagarhi	Dhar	- do -

Excavation

Sl. No	Particulars		Status
	Name of archaeological mound	District	
1.	Mound at village Khaparkheda	Dhar	Detailed excavation works was done by ASI.
2.	Mound at village Utavad	Khargone	- do -
3.	Mount at village Brahmangaon	Khargone	Archaeological survey was done. Later on mounds were vanished due to soil erosion by agricultural practices.
4.	Mound at village Krimohigaon	Khargone	- do -
5.	Mound at village Kheda	Dhar	Handed over to ASI. Progress is awaited.

Status of implementation of Action Plan 1997 are as under

Relocation / Protection

Sl. No	Particulars					Status
	Name of monument	Village	Tehsil	District	RL in m	
1.	Shiv Mandir	Bada Barda	Manavar	Dhar	130.970	Relocated completely.
2.	Bhawani Mata Mandir	Khujawa	Dharampuri	Dhar	147.825	Scrapping of lime plaster done for numbering purpose.
3.	Shomeshwar Mandir	Khujawa	Dharampuri	Dhar	129.530	Progress is nil.
4.	Shiv Mandir (S.No.1)	Khujawa	Dharampuri	Dhar	135.460	Work of relocation started but due to public resentment, it was stopped by the collector.
5.	Shiv Mandir (S.No.2)	Khujawa	Dharampuri	Dhar	135.475	
6.	Shiv Mandir (S.No.3)	Khujawa	Dharampuri	Dhar	135.165	
7.	Rock-cut caves	Khujawa	Dharampuri	Dhar	135.075	Progress is nil.
8.	Big statues	Khujawa	Dharampuri	Dhar	146.395	Progress is nil.
9.	Shiv Mandir (Mauni Baba Ashram)	Pipaldagarhi	Dharampuri	Dhar	153.775	Relocated completely in village Nimbola.
10.	Rock-cut-sculptures	Pipaldagarhi	Dharampuri	Dhar	130.440	Relocated completely in village Nimbola.

11.	Shiv Mandir	Bodhwada	Kukshi	Dhar	138.685	Progress is nil.
12.	Narmadeshwar Mandir	Dehar	Kukshi	Dhar	134.665	Progress is nil.
13.	Baneshwar Mandir (Shiv Mandir)	Navadatoli	Kasarawad	Khargone	137.765	Progress is nil.

Excavation

Sl. No	Particulars			Status
	Name of mound	District	RL in m	
1.	Mound at village Maruchichli	Khargone	151.635	Progress is nil.
2.	Mound at village Ekalwara	Dhar	146.875	Progress is nil.
3.	Mound at village Katnera	Dhar	139.865	Progress is nil.
4.	Mound at village Khalghat (Khalkhurd)	Dhar	156.310	Excavated. Records are with the o/o the Archaeologist, Archaeology & Museum, Rajwada, Indore.
5.	Mound at village Kalyanpura	Dhar	148.035	Progress is nil.

Collection and display at Museum

Sculptures, 118 in nos. were collected from the regions coming under the submergence area of the Sardar Sarovar dam. This sculptures were obtained from Pipladgarhi, Khujawa, Dharamapuri and different other villages. These are displayed at Distt. Museum in Dhar Distt.

Since these sculptures were lying open for a very long time they bear traces of weathering effect on them like salt formation, red-oxide deposition, besides accumulating dust, dirt and fungus on them. They were cleaned by the chemists using necessary chemicals like Ammonia, Sodium hydroxide, Benzene P.V.A. etc. After cleaning the sculptures were coated with preservative for saving them from further deterioration.

Museum

- + Narmada Park and Museum at Lalbagh at Indore, besides Museum at Barwani and Kasarawad proposed. Land for museum at Barwani and Kasarawad requested.

- + Construction of a section on 'Narmada Dirgha' in the museum at Bhopal has been started.

Besides, Film documentation of all the monuments of SSP is in progress through an agency 'Madhyam', engaged by State Department for Documentation of the important monuments.

Anthropological Salvage Plan for Narmada Valley :- To date, surface scanning of the anthropological sites of 17 villages has been completed and 424 specimens taken. In this plan the Udaipur Branch of the Archaeological Survey of India has collected information and specimens from 19 villages in Gujarat.

Summary of Current Situation and Progress

	Gujarat	Madhya Pradesh	Maharashtra
Survey of villages in submergence zone	Complete for all the items in all the States.		
Identification of cultural sites	Complete for all the items in all the States.		
Collection of data and documentation of sites	Complete	In progress	No required
Estimates of financial resources for relocation			
Selection of appropriate sites	Complete	In progress	No required
Action Plan	Complete	In progress	No required
Responsibility for removal identified			
Expansion of museum sites			
Quality control / inspections *			

* Quality control of relocation operations will be the responsibility of the Departments of Archaeology of the three States. Each of these departments have proven expertise in this area and are entrusted to conduct regular inspections of temple reconstruction to ensure that no damage ensues.

8.5 SUMMARY OF WORK TO BE DONE

From the results of the three States surveys, it is clear that the impacts of submergence on cultural properties will be minimal in the States of Gujarat and Maharashtra although there will be more significant impacts in Madhya Pradesh.

List of works to be done :

- ≤ Relocation of Hamfeshwar temple by GOG.
- ≤ Relocation of remaining monuments and excavation of archaeological mounds as reflected in status by GOMP.

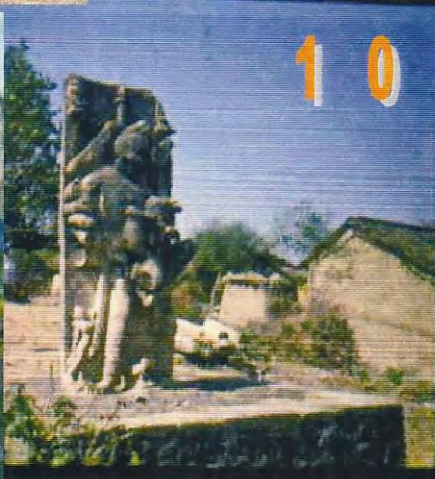
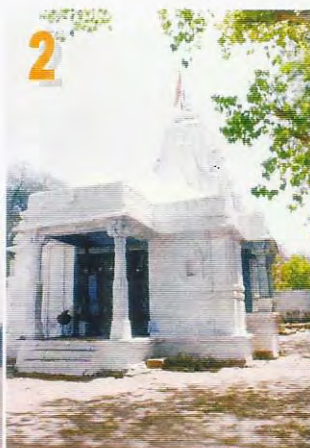
PLATE -XVII

LEGEND

Archaeological aspects

- Fig. 1 :** New Shoolpaneshwar temple in village Gora, 5 km. Downstream of SSP.
- Fig. 2 & 3 :** Old Shoolpaneshwar temple on the border of Gujarat and M.P. before submergence.
- Fig. 4 :** New Hamfeshwar temple under construction.
- Fig. 5 :** Old Hamfeshwar temple.
- Fig. 6 a & b :** Rock-cut-sculptures and relocated Shiv temple of Barda village.
- Fig. 7 :** Ruins of temple at Pipladagadhi, M.P.
- Fig. 8 :** Dismantled old temple at village Barda.
- Fig. 9 :** Statue collected from the submergence area, displayed at Dewas Museum.
- Fig. 10 :** Life size statue in Dharampuri, M.P.
- Fig. 11 :** Rock-cut-caves in village Dharampuri, M.P.

PLATE - XVII



The NCA and State archaeological departments have overall responsibility for coordination of relocation operation. The quality of these operations will be assured by the close involvement of experts from the respective State departments of archaeology.

9. RESETTLEMENT & REHABILITATION (R&R)

9.1 The issue

9.1.1 Context

The submergence area of SSP extends 245 K.M from the dam and will spread into three states namely Gujarat , Maharashtra , Madhya Pradesh. The submergence villages are situated on the banks of river Narmada having gentle to steep slopes of the Satpura and Vindhya mountain ranges.

The Sardar Sarovar reservoir at FRL 455 ft. would affect 245 villages of which 193 villages are in M.P., 33 villages are in Maharashtra and 19 villages are in Gujarat. The villages are considered affected when the water level touches the farm / hut situated at lowest level, both due to pondage and back water effect corresponding to 1 in 100 year flood. Only 4 villages (3 villages in Gujarat and 1 village in M.P.) are getting submerged fully and the rest 241 villages are getting affected partially. Due to floods in Narmada even without the dam, 87 villages are affected during the monsoons.

The affected population is mostly tribals.. The majority of the PAFs are involved in primary agricultural activities for their own sustenance and there is partial employment in forestry sector. The area is hilly with difficult terrain, agriculture is rain fed and normally single crop is raised. Most of the villagers are rearing cattle for their livelihood during drought. The main crops grown by the PAFs are coarse grain due to lack of assured source of irrigation. In M.P., 29% PAFs are tribals and mainly belong to 'Bhilalas' and 'Bhils' tribes. In Maharashtra, 100% PAFs are tribals and belong to Tadvi, Vasawa, Pawra, Bhil, Nayak tribal groups. In Gujarat, 97.4% PAFs are tribals namely, Tadvi, Dhanka, Tetaria, Bhil, Rathwa, Nayak, Dungri Bhil. There are no primitive tribal groups in the submergence area.

9.1.2 R&R Stipulations under NWDT Award

The requirement for Resettlement and Rehabilitation (R&R) of the project affected families due to the reservoir submergence was considered by the Narmada Water Disputes Tribunal (NWDT). The decisions and final orders of the Tribunal contain detailed directions in regard to acquisition of land and properties, provision of land, house plots and civic amenities for resettlement of the project affected persons at rehabilitation sites which are described below ;

Every displaced family from whom more than 25% of its land holding is acquired shall be entitled to and be allotted irrigable land of its choice to the extent of land acquired subject to the prescribed ceiling in the State concerned and a minimum of 2 ha. land.

- [-] The project affected persons have to be offered 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.
- [-] If Project Affected Persons (Paps) select land outside the command area as per their choice, the Project Authorities will provide irrigation facility.
- [-] In case of Maharashtra and Madhya Pradesh PAFs who are unwilling to resettle in Gujarat, they have to be resettled in their respective territories.
- [-] In no event shall any area in Madhya Pradesh and Maharashtra be submerged under the Sardar Sarovar unless all payment of compensation, expenses and costs is made for acquisition of land and properties and arrangements are made for the rehabilitation of the PAFs therefrom in accordance with NWDT directions and intimated to the PAFs.
- [-] Gujarat shall acquire and make available a year in advance of the submergence before each successive stage, irrigable land, and house sites for rehabilitation of the project affected families from Madhya Pradesh and Maharashtra who are willing to migrate to Gujarat. Gujarat shall in the first instance offer to rehabilitate the project-affected families of Maharashtra and Madhya Pradesh in Gujarat territory.
- [-] Gujarat shall at each successive stage of submergence intimate to Madhya Pradesh and Maharashtra the area coming under submergence at least 18 months in advance. The inhabitants of the area coming under the respective stages of submergence will be entitled to occupy or use their properties without being required to pay any thing for such occupation and use till a date to be notified by the state concerned which date shall not be less than six months before submergence. They must vacate the area by the notified date.
- [-] Hon'ble Supreme court has given directions in the Writ Petition No.1201 of 1990 filed by Shri B.D.Sharma, Ex-Commissioner SC/ST, Govt. of India (now disposed off) that rehabilitation should be so done that at least six months before area is likely to be submerged, rehabilitation should be completed and should be in respect of home-stead, substitution of agricultural property and such other arrangements as are contemplated under the rehabilitation scheme.
- [-] All the three State Governments are arranging for relocation of project affected families as per the directives of the Supreme Court and NWDT stipulations. Resettlement of the persons affected by the project, their relocation, economic betterment and social integration at their new place

of resettlement is the responsibility of the concerned State Government(s) and the costs thereof are to be charged to the project. Option for the choice of relocation site rests with the affected people. The project administration and the concerned States have to help them accordingly

9.2 IMPACTS AND MANAGEMENT

9.2.1 Studies and Findings

Studies

In order to devise Action Plans on R&R, baseline studies need collection of information in the following categories:

- o Survey of the project affected people:
- o Survey of the submergence area:
- o Socio-economic land cultural data on the PAF's in submergence area.
- o Environmental and socio-economic data on the areas selected for relocation

Findings

Survey of all the affected villages has been completed in all the three States. Accordingly, 40,827 families would be affected due to submergence and backwater effect at full height of dam (FRL 455 ft.). State wise breakup of affected villages and number of project-affected families (PAFs) is given below:

Village and Families Affected

States	(No. of PAFs)			Families to be rehabilitated including major sons/daughters.	Population affected 1991 Census
	Full	Partial	Total		
M.P.	1	192 *	193	33014	89796
Maharashtra	-	33 *	33	3213	19650 ⁺⁺
Gujarat	3	16	19	4600	18000
Total	4	241	245	40827	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 backwater, in nine villages only Government wasteland will be submerged.

+ Out of 33 villages coming under submergence in Maharashtra, 12 villages have less than 25 ha. of private land being submerged, six have less than 50 ha. and one village is deserted. Thus, 19 villages out of 33 are only being marginally affected.

** This number may change due to addition of 100 more genuine PAFs in Maharashtra.

Category wise Project Affected Families

Different category of project affected families in three States are as given below: -

STATE	Different category of PAFs						Total
	Land Owners	Co sharer	Encroacher s	Major Sons	Landless Agricultural Labourers	Other landless Labourers	
Gujarat	647	850	487	2204	392	20	4600
Mahara shtra	1472	-	-	993	748	-	3213
M.P	9985	-	-	15018	5776	2235	33014
Total	12104	850	487	18215	6916	2255	40827

Scheduled Castes & Tribes

A large percentage of the affected population is tribals, being 100 percent in Maharashtra and 97.4 percent in Gujarat. In Madhya Pradesh, 29 percent population belongs to Scheduled Tribes and 12% belong to Scheduled Castes. Details of the affected Scheduled Castes (SC) & Scheduled Tribes (ST) population in three States is as given below: -

(Population as per census 1991)				
Sub-caste	States			Total Population
	Gujarat	Maharashtra	M.P.	
Scheduled Tribes (ST)	17532	19650 *	26041	63223*
Scheduled Castes (SC)	-	-	10775	10775
Others	468	-	52980	53448
Total	18000	19650 *	89796	127446*

* This number may change due to addition of 100 more genuine PAFs in Maharashtra.

Since tribals and schedule castes form a large proportion of population being displaced, utmost care has been taken to protect the tribal culture, their life styles and traditions while designing and evolving of the resettlement and rehabilitation programme.

In Madhya Pradesh, most of the tribals are "Bhilalas" and "Bhils", in Maharashtra they mainly belong to "Tadvi" & "Vasava" groups and in Gujarat they belong to Tadvi, Rathwa, Dungribhil, Vasava and Nayaka.

Special studies have been carried out in the tribal submergence villages of Gujarat, Maharashtra and Madhya Pradesh regarding their socio-economic and cultural status by the reputed Independent Social Science Institutions and the tribal needs have been identified for the planning of R&R. The recommendations are being implemented by the States in all earnest for the betterment of tribal project affected persons.

9.2.2 Resettlement and Rehabilitation Principles and Packages

The policy for Resettlement & Rehabilitation is oriented towards the following principles:

- ☐ Improving the economy and standard of living of the PAFs, which they had been enjoying before their displacement.
- ☐ Relocating the PAFs as far as possible as village units, village sections falia (hamlet) or families in accordance with the PAF's preference.
- ☐ Full integration of the PAFs in the community in which they are resettled.
- ☐ Providing with the appropriate compensation and adequate social and physical rehabilitation infrastructure including community services and facilities.
- ☐ Ensuring participation by the PAF's in their Resettlement and Rehabilitation.
- ☐ The basic approach of rehabilitation is to convert the dislocation into a potential beneficial opportunity for economic betterment of the project affected persons with States support & resources.
- ☐ The PAP's are to make their own choice of relocation sites as per their own preferences out of three options given to them. This would also help to ensure the cultural, ethnic and other community oriented identity to the maximum extent possible.
- ☐ The PAP's or their representatives are being associated/involved in the implementation process of the R&R work. For Monitoring and Evaluation (M&E) of the R&R work, specialised social science agencies at the State levels have been engaged to evaluate the socio-economic status of the PAP's before and after their resettlement. The detail key Indicators have been identified and the same are being evaluated by M&E Agencies. The

intention of the Government is to see that the socio-economic status, of the project-affected families, after resettlement, improves substantially. Besides, the Narmada Control Authority (NCA) is also monitoring the progress of R&R to ensure proper Rehabilitation.

Resettlement and Rehabilitation of the PAF'S is to be carried out in accordance with the directions set out in the NWDT Award and state policies. Considering the socio - economic background of the population and the need for improving the living conditions of the affected people, the three State Governments have formulated and announced their policies for R&R which are more liberal than the provision envisaged in the NWDT Award. These policies are being liberalised from-time-to-time as and when necessity arises. A statement highlighting NWDT Award provisions and States liberalized R&R packages is shown at **Annex-VII**.

9.3 ACTION PLAN

9.3.1 Annual and Long Term Plan

All the three state governments had prepared the R&R Action Plan based on the detailed survey carried out by them. Based on the Action Plans prepared by them, NCA prepared a consolidated R&R annual action plan and indicative long-term plan in May 1993. Because of liberalization of R&R, policy and other reasons the state governments had to undertake the work of re-survey in all the villages. All the three State Governments are implementing the various R&R works as per the guidelines given in the NWDT award and various directions regarding the shifting of PAFs at least six months prior to the date of actual submergence etc. are being followed in the right earnest. Every year the construction programme of dam is decided keeping in view the progress of R&R. As per the original construction programme approved in December, 1989 the height of the lowest block of the dam in the year 1994-95 was to be kept at EL 110.00 m. However, after reviewing the progress of R&R, it was decided to keep the height of the lowest block to EL 80.3 m. Meanwhile, it was decided to prepare revised R&R annual and long term indicative plan until the completion of the project. Based on latest information, the master plan for R&R has been prepared in 1995, which describes plans of rehabilitation of PAFs in Gujarat, M.P. and Maharashtra. The plan could not become operative due to stay of construction work of SSD by Hon'ble Supreme Court, since May 1995. In the 43rd R&R Sub-group Meeting held on 6.1.1999, the States have shown their preparedness to resettle PAFs up to EL 90.0m. In view of this, an action plan has been prepared based on information provided by States and got it approved in a special Inter-State Meeting held on 21.1.1999 under the Chairmanship of Secretary to the Government of India, Ministry of Social Justice and Empowerment.

9.3.2 Desired State for Relocation

As per the provision in NWDT Award, the willing PAP's from Madhya Pradesh and Maharashtra are to be rehabilitated in the command area of the project in Gujarat. Accordingly, choice has been given to the PAP's of Madhya Pradesh and Maharashtra for their resettlement in Gujarat. It may be mentioned here that some PAP's have also preferred to resettle outside the command area near the Madhya Pradesh border for ethnicity reason for which assured source of irrigation is being provided by Government of Gujarat. As per the latest indication given by the PAFs, out of total 40827 project affected families, 48.43%, are likely to be resettled in Gujarat, 5.19% in Maharashtra and 46.38% in Madhya Pradesh. Thus apart from resettling all of its 4600 project affected families, Gujarat is likely to receive 999 families from Maharashtra and 14124 families from Madhya Pradesh.

9.3.3 Agricultural Land Requirement

As per the State policies and their land ownership, 22644 project affected families out of the total 40827 will be entitled for allotment of agricultural land in the States of Gujarat, Madhya Pradesh and Maharashtra. However, all 40827 project affected families will be eligible for house plots.

9.4 IMPLEMENTATION (At FRL 138.68m.)

All the three State Governments are implementing the R&R activities in their respective States. The R&R works are implemented with the aim that they should be completed atleast six months prior to expected date of submergence. The present status of R&R of Sardar Sarovar Project in the States of Gujarat, Maharashtra and Madhya Pradesh upto March, 2000 is briefly described below:

Gujarat

The total number of affected families in Gujarat is 4600. The Government of Gujarat is making land available for resettlement of these families in the following manner:

- ☐ Government lands.
- ☐ Private lands through land acquisition.
- ☐ Private lands purchased through land purchase committee established by the Government.

So far, 16903⁺ ha. of agricultural land have already been allotted to 8509 project affected families resettled in 180 R&R sites in Gujarat up to 31st March, 2000 (Gujarat - 4554, Madhya Pradesh - 3245 and Maharashtra - 710).

Besides this, 5253 ha. additional land is available for allotment to PAFs from State of Madhya Pradesh and Maharashtra willing to resettle in Gujarat.

Out of 4600 families to be affected in Gujarat, 4554 families have been allotted 9014 ha. agricultural land and 4441 families have been allotted house plots at 110 developed relocation sites up to 31st March, 2000.

Maharashtra

In Maharashtra 33 villages comprising 3213 PAFs will be affected by submergence. As per the preferences given by PAF's, 2214 families will be rehabilitated in Maharashtra and balance 999 families in Gujarat.

Maharashtra Project Affected Families (Pafs) in Gujarat

As per the preference given by the PAF's, 999 families from Maharashtra are likely to be resettled in Gujarat. The requirement of land for agricultural and Abadi purposes for these PAF's will be of the order of 2100 ha. So far 710 families have been allotted 1407⁺ ha. agricultural land and 680 families allotted house plots.

Maharashtra Project Affected Families (PAF's) 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 and preference into consideration, as a special case Govt. of India, Ministry of Environment and Forests has released 4200 ha of forest land which includes 2700 ha. in Taloda Taluka and 1500 ha. in Taloda and Akkalkuwan Talukas in Dhule district to settle the PAFs in similar forest ethnic environment in their own State.

Out of 2214 PAFs to be resettled in Maharashtra, 1596 families have been allotted 2382.08 ha. of agricultural land and 1460 families allotted house plots up to 31.03.2000.

Madhya Pradesh

The number of affected families in Madhya Pradesh has been assessed as 33014. As the number of affected families is linked with the date of issuance of notification under Section-4 of Land Acquisition Act, the total number of affected families may increase further. In 9 villages only Government land will be affected, hence no resettlement will be required in these villages.

As per the NWDT provisions, the PAP's of Madhya Pradesh have been given choice to either resettle in the command area in Gujarat or in their home state i.e. Madhya Pradesh. About 14124 families (this number may change after due verification of PAFs choices) from Madhya Pradesh have preferred to

resettle in Gujarat and balance 18890 families in Madhya Pradesh (this number may change due to change in PAFs options/choice).

Madhya Pradesh PAFs In Gujarat

As per the GOG policy about 28,248 ha. of agricultural land and about 1000 ha. of residential land will be required for resettlement of these project affected families. Preference in allotment of house plots and agricultural land has been given to those families whose land or houses have been affected during monsoon of 1999 or likely to be affected during monsoon 2000.

So far 3,245 families have been allotted 6,482 ha. agricultural land and 3,093 families have been allotted house plots. In addition subsistence allowance, productive assets, ex-gratia grant for construction of pucca plinth etc. are also being provided.

Madhya Pradesh PAFs In Madhya Pradesh

18,890 families are likely to be resettled in Madhya Pradesh. These families belong to the category of PAF in which either only house will be submerged or less than 25% of the agricultural land of the PAF will be submerged. Hence, they will be relocated in 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 sites in Barwani district. 1973 ha. land for agricultural purpose have been identified. Notification under Section-4 of Land Acquisition Act (LAA) have been issued in 118 submergence villages. Notification under Section-6 & Section-9 of LAA has been issued in 110 and 107 submergence villages respectively. Award has been passed for payment of compensation in 91 villages and 30 other cases (acquiring land for relocation sites, roads, etc.) and a sum of Rs. 17.082 crore (up to 31.03.2000) as compensation has also been distributed among the project-affected families from the submergence villages. House plots have been allotted to 808 project affected families.

9.4.1 Status Of Resettlement And Rehabilitation (R&R) At Different Heights Of Sardar Sarovar Dam (SSD).

The Review Committee for Narmada Control Authority (RCNCA) Chaired by Union Minister of Water Resources in its 7th meeting held on 13.11.1996 at New Delhi decided that review of the implementation of Resettlement and Rehabilitation (R&R) measures will be undertaken for every

5 meter height of the dam jointly by the concerned R&R Sub-group and Environment Sub-group comprising representatives of States also so that the construction work could progress *pari-passu* with the implementation of R&R measures. In compliance to Review Committee of NCA's decision, the R&R Sub-group of NCA, chaired by Secretary to the Govt. of India, Ministry of Social Justice & Empowerment since then is reviewing the R&R measures at every 5 m. height of the dam to ascertain the R&R status *pari-passu* with the construction of the dam and State's preparedness to resettle balance project affected families (PAFs) at different height of the Sardar Sarovar Dam (SSD).

The Hon'ble Supreme Court in its interim order dated 7.5.1999 has permitted the construction of 3-meter humps over and above EL 85.0m. In view this, humps of 3 meter height have been constructed uniformly above 85.0m., thus making the effective height of dam EL 88.0m.

The R&R status at different elevations was reviewed during the 44th R&R Sub-group Meeting held on 8.6.1999 wherein, all the three States agreed that the dam height EL 90.0m. is being taken as the basis for R&R purpose which covers the PAFs to be affected at EL 88.0 m.

Regarding balance PAFs in M.P. and Maharashtra at EL 90.0m. who have not yet resettled, it may be mentioned that concerned States have issued notices including the offer of R&R package. Some of the PAFs have not exercised their option under influence of anti-dam groups/NGOs working in the area. State Governments are permitting such PAFs to exercise their option to resettle either in home state or in Gujarat. All the required arrangements for R&R as per NWDT Stipulations have already been made such as land, house plots and civic amenities etc. to settle the balance PAFs up to EL 90.0 m. by the States.

Among the balance PAFs, besides those PAFs who are influenced by anti-dam activists, most of the PAFs are not feeling urgency of resettling at R&R sites or not responding because of the fact that they may be affected temporarily only during 1 in 100 years floods, so temporary shifting to higher elevations will serve their purpose.

9.4.2 Monitoring And Evaluation

9.4.2.1 Resettlement & Rehabilitation Sub-group

To monitor the overall implementation of programme/ progress of land acquisition, Resettlement and Rehabilitation, etc., a Sub-group of the Narmada Control Authority has been constituted under the Chairmanship of Secretary, Ministry of Welfare, Government of India. Thirteen members and fourteen invitees presently represent this Sub-group. The Sub-group held its first meeting on 8.1.1988 and so far 45 meetings have been held, the last one was on 27.01.2000.

The Governments 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 Center for Social Studies, Surat is the monitoring agency for the Govt. 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 has been disengaged and the engagement of a new agencies is in pipeline. In Maharashtra, the M&E works is now being carried out by Mahatma Fuley Centre for Social Studies and Social Work, Taloda, Nandurbar. Each of the State M&E agency submits Bi-annual M&E reports (one for the period April to September and the other for the period October to March) to the concerned State Governments. State Governments and their M&E agencies then discuss these reports jointly. Narmada Control Authority (NCA) also assesses the reports and the observations/ recommendations are forwarded to the party states for further action.

9.4.3 Supreme Court Case

Judgement (IA No.1201 of 1990)

In an interlocutory application No. 1201 of 1990 in the writ petition filed in the Supreme Court by Shri B.D. Sharma Vs. Union of India, (now disposed off) Supreme Court has directed that a Committee should be constituted under Chairmanship of Secretary, Ministry of Welfare, Govt. of India to visit submergence villages and Resettlement and Rehabilitation sites in the States of Gujarat, Maharashtra and Madhya Pradesh and furnish a report of the developments and progress made in the matter of Rehabilitation to the Supreme Court. Accordingly, a Rehabilitation Committee under Secretary, Union Ministry of Welfare has been constituted to undertake the field visits in the submergence villages, Resettlement and Rehabilitation sites in the States of Maharashtra, Madhya Pradesh and Gujarat. The Committee has so far undertaken 20 visits to submergence villages and rehabilitation sites in three States and submitted all the reports to the Supreme Court.

The last visit was undertaken to 6 R&R sites namely; Thuvavi, Sinore Road, Vadaj-I, Vadaj-II, Gopalpura, Golagamdi in Gujarat and one submergence village namely; Manibeli in Maharashtra during 12th -13th January, 2000

Writ Petition (Civil) 319 of 1994

The Narmada Bachao Andolan (NBA) has filed a Writ Petition (Civil) No. 319/1994 against Union of India and others in the Hon'ble Supreme Court of India. The main issues of the Writ Petition are: Rehabilitation, environment, hydrology, human right, etc. The Union of India through Ministry of Water

Resources had filed first Counter Affidavit-in-reply on behalf of all the respondents and later on all the party states filed Affidavit-in-reply separately. The Hon'ble Supreme Court while hearing this case on 18.02.1999, and 7.5.1999 permitted the State of Gujarat, to raise the level of the dam to EL 85.0m. and construct 3.0m. humps respectively above 85.0m. for safety of the dam. The matter was heard from 27.2.2000 to 7.5.2000 and the order of the Hon'ble Supreme Court is reserved.

Constitution of the Grievance Redressal Authority

Vide Resolution dated February 17, 1999, the Government of Gujarat has constituted an independent Grievance Redressal Authority (GRA) for redressing the grievances in the work of Resettlement and Rehabilitation under the Sardar Sarovar Project. The Authority has Mr. Justice P.D.Desai, retired Chief Justice, as the Chairman. The powers, terms and conditions of the Authority have also been detailed in the resolutions. The Grievance Redressal Machinery has been established to:

- Create an Authority before whom oustees who have resettled in the State of Gujarat can ventilate their grievances relating to the R&R measures taken by the State of Gujarat;
- Ensure that the oustees already settled and the oustees settled hereinafter in the R&R sites created for resettlement and rehabilitation of the oustees from the States of M.P. and Maharashtra receive all the benefits and amenities in accordance with the award and the various Government resolutions made from time to time.
- Ensure that Gujarat oustees resettled in Gujarat have received all the benefits and amenities due to them.

GRA has taken an innovative step in installing a permanent in-house Grievance Redressal Mechanism known as Grievances Redressal Cell (GRC) within Sardar Sarovar Punarvasavat Agency (SSPA). GRC deals grievances in the regular course on the basis of applications, on the spot through Tatkal Fariyad Nivaran Yojna (TFNY) and through Single Window Clearance System. So far, GRC has dealt with and decided 6,581 grievances. Out of these 5,636 have been decided in favour of the PAFs. The details are given below.

Source	Number of Grievances Redressed				No. of positive redressals
	Land Related	Civic Amenities	Others	Total	
1. Applications	2856	395	756	4007	3191
2. TFNS (33 sittings)	667	31	206	904	775
Single window clearance system	469	1201	-	1670	1670
Total	3992	1627	962	6581	5636

Government of Madhya Pradesh had constituted an Independent Grievance Redressal Authority under the chairmanship of Mr. Justice G.G. Sohani for redressing grievances relating to Resettlement and Rehabilitation of the Project affected families under the Sardar Sarovar Project . The Government of Maharashtra had also constituted an Independent Grievance Redressal Authority for redressing grievances relating to Resettlement and Rehabilitation of PAFs under the Sardar Sarovar project and Mr. Justice S.P. Kurdukar, being the Chairman of the Authority. The Grievance Redressal Authorities set up by the States of Madhya Pradesh Maharashtra and Gujarat has been directed by the Hon'ble Supreme Court to

- Survey the Resettlement and Rehabilitation sites, which have already been established by the States and find the civic amenities already established in these sites and report on the availability of suitable Agriculture land, before 1st of July, 2000.

9.5 SUMMARY OF WORKS TO BE DONE

The original submergence schedule was based on the Revised Implementation Schedule (RIS) of 1989 . Based on the actual yearly construction programme ,resettlement of PAF's were carried out *pari-passu* with the construction of dam. The original RIS is not operative due to litigation in the Hon'ble Supreme Court. But, the progress of R&R works is linked with dam construction keeping in view the interim orders/directions of the Hon'ble Supreme Court.

About 30,000 PAFs are remaining to be settled in M.P., Maharashtra and Gujarat. To resettle the balance PAFs corresponding to dam height EL 110 m. and keeping in view the preparedness of the States, the Action Plan is being finalised.

Action to take care of balance families corresponding to the F.R.L is underway.

10. MONITORING MECHANISM AND BUDGETING

10.1 Introduction

The Central Govt. under Section 4 of the Inter State Water Disputes Act, 1956 constituted the Narmada Water Disputes Tribunal in Oct. 1969 to adjudicate upon the water disputes regarding the inter-state river, Narmada and the river valley thereof. The Tribunal investigated the matters referred to it and forwarded to the Central Govt. a report in Aug. 1978 setting out the facts as found by it and giving its decision on the matter referred to it. The Central Govt. and the concerned State Govts, as provided in the Act, sought explanation/guidance on certain points contained in the report from the Tribunal. The Tribunal classified the points after which the Central Govt. on 12.12.1979 gazetted the Award of the Tribunal.

The Award *inter alia* stipulates the FRL of the Sardar Sarovar Project in Gujarat and Narmada Sagar Project in M.P., the regulated releases to be made by Narmada Sagar for utilisation at Sardar Sarovar, sharing of cost by Sardar Sarovar in Narmada Sagar and has also stipulated that the construction of Narmada Sagar be taken up by M.P. concurrently with or earlier than the construction of Sardar Sarovar dam. Thus the two projects lay down the foundation for the integrated development of the basin. NWDT laid down the concurrent construction of NSP & SSP for the optimisation of the Water Resources. Since Environmental impacts emanate from alterations in hydrological regime to be effected by construction of SSP & NSP, negative cumulative impacts of upstream developments have to be assessed, evaluated & mitigated. It is in this context that the environmental issues of the basin as a whole have to be viewed rather than project specific issues.

10.2 INTER-STATE ADMINISTRATIVE AUTHORITY (NCA)

The Award also stipulated the setting up of an inter-state administrative authority called Narmada Control Authority for the purpose of securing compliance with the implementation of the decision and directions of the Tribunal. The Award envisaged a coordination and direction role for NCA but in respect of the following items, the Authority was charged with the power and under a duty to do any or all things necessary, sufficient and expedient for the implementation of the Award with respect to:

- i. Storage, apportionment, regulation and control of Narmada Waters;
- ii. Sharing of power benefits from Sardar Sarovar Project;
- iii. Regulated releases by Madhya Pradesh;
- iv. Acquisition by the concerned State for Sardar Sarovar Project of land; and properties likely to be submerged under Sardar Sarovar;
- v. Compensation and rehabilitation and settlement of oustees and
- vi. Sharing of costs.

10.2.1 Expanded Role for NCA

The Central Govt. notified the Narmada Water scheme in Sept. 1980 setting up the NCA with the above duties & functions.

Subsequently the scope of the Narmada Control Authority was enlarged through amendment brought-out by MOWR under clause 9(i) 4 9(2) a of the gazette notification.

1. "The role of the Authority will mainly comprise of overall coordination and direction of the implementation of all the projects, including the engineering works, the environmental protection measures and the rehabilitation programme and to ensure the faithful compliance of the terms and conditions stipulated by the Central Government at the time of clearance of the aforesaid projects".

2(a) "The Authority may constitute one or more sub-committees and assign to them such of its function and delegate such of its powers as it thinks fit".

10.2.2 Environment Sub-Group

In the 26th meeting of the NCA held on 29.9.87, it was decided to set up a group of nodal officers of participating states for deciding the terms of reference and composition of the Environment Sub-group of the NCA. The group met on 30.10.87 and finalised the composition and terms of reference. It was decided that the sub-group would be headed by Secretary, MOEF and have as members one representative each from the four participating states, representative of ICAR, MOWR, Technical Experts in the field of forestry, wild-life, hydrology, flora, health, archaeology, anthropology, agriculture, and environment. The decisions taken in the meeting of the nodal officers on the constitution and the terms of reference of the sub-group were put up to NCA in its 27th meeting held on 8.1.88.

The Environment Sub-group is headed by Secretary to the Government of India, Ministry of Environment & Forests and includes representatives of each of the party States and experts in the field of Soil Science, Health, Forestry, Archaeology, Anthropology, Environment, Hydrology, Zoology, Botany, Ecology, Wildlife, Ichthyology, Medical Research etc. There are subject specialists in NCA for assistance to the Sub-group.

Progress of the implementation of ESM is reviewed / discussed periodically. During review of the status of works on the Project, Sub-group identifies the issues, which require attention from time to time. The studies are then suggested, TOR framed by the State Government and put up to the Sub-group. Agencies for undertaking studies are identified as per their expertise. After the approval of study and TOR, the studies are entrusted to the identified agencies by the Project authorities. The reports are examined by the experts in

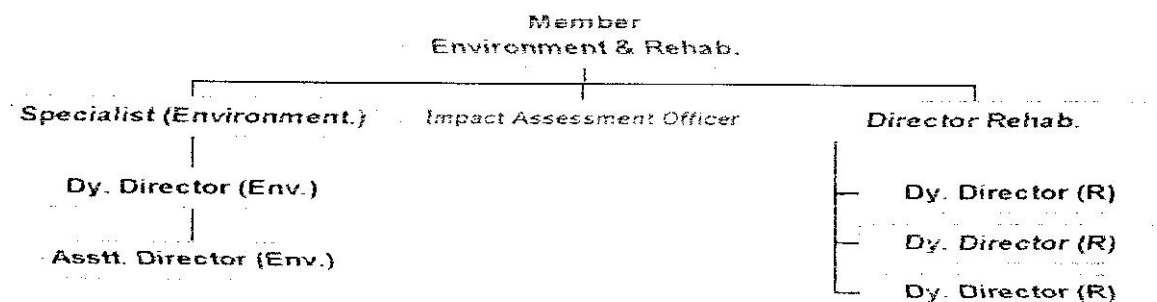
NCA and placed before the Sub-group for consideration. In addition, workshops are also organised by the project authorities/agencies and findings discussed. Thereafter, recommendations are communicated to the State Government for further action in the field. The follow up is reviewed by the Sub-group and if necessary, the Sub-group forms committee to undertake field visits for verification and reporting back to the Sub-group.

10.2.2.1 Functions Of The Environment Sub-Group

- i. To work out the environmental safeguard measures to be planned and implemented for the entire Narmada Basin so that environmental safeguard measures are executed and remain fully in consonance with the clearance accorded to the Narmada Sagar and Sardar Sarovar Projects.
- ii. To determine the terms of reference of required surveys and studies necessary for implementation of environmental safeguard measures inclusive of data base required, the methods by which the data base is to be prepared and also to identify the institutions/individuals to undertake the preparation of such documents.
- iii. To get prepared for clearance by the Ministries and NCA the action plans with regard to all environmental safeguard measures and the assessment criteria thereof.
- iv. To devise a suitable monitoring and evaluation mechanism so that the action plans are effectively implemented in consonance with stipulations at the time of clearance of the projects.
- v. To assess the necessary organisation with management capability being set up for adequate implementation of environmental safeguard measures.
- vi. To undertake all measures necessary to assist Narmada Control Authority in the planning and implementation of environmental safeguard measures.

10.2.3 Environment & Rehabilitation Wing of The NCA

Organisation Chart of E&R wing



To monitor provisions of the acts related to Narmada river basin projects and the necessary clearances granted by Ministry of Environment & Forests and also in accordance to cope up with the modified role bestowed to the Narmada Control Authority.

Besides this, proposal of establishing EDC in NCA was approved by the Advisory committee of MOWR and twelve posts recommended by the advisory committee were created by NCA vide decision of its 41st meeting.

10.3 OTHER SUB-GROUPS AND SUB-COMMITTEES

As environment is a multi-disciplinary subject interactions with the experts of various subjects was considered essential for proper planning and monitoring of the safeguard measures. Therefore a number of experts and institutions are involved in periodic assessment / evaluation of the studies / surveys and for guiding environmentally sound development of the Narmada projects. On the recommendations of the Environment Sub-group several groups / committees have been formed for expert opinion on the identified issues and these committees acts Peer groups on the subjects. Key committees presently working are listed below.

1. High-level expert group on fisheries development and conservation in Sardar Sarovar reservoir.

This committee was formed by NCA on the recommendation of Environment Sub-group in pursuance of the recommendations made by the Env. wing. This expert committee formed three working groups with definite task and time frame. Five meetings of the committee are held so far. This is chaired by the Joint Secretary, MOEF. Member (E&R), NCA is the Member Secretary for this committee.

2. Committee on flora and fauna aspect of Sardar Sarovar and Narmada Sagar Project

This committee was formed on the recommendations of Environment Sub-group to coordinate the work being taken up by various agencies on flora & fauna aspect of NSP & SSP within the Narmada valley and for putting up its recommendations to the Sub-group. This committee is chaired by Member (E&R), NCA. Three meeting of the committee is held so far.

3. Committee on archaeological and anthropological aspects

This committee was formed on the recommendations of Environment Sub-group to coordinate the work being taken up by various agencies on archaeology & anthropological aspects within the Narmada valley and for putting up its recommendations to the Sub-group. This committee is chaired by Member (E&R), NCA. Three meetings of the committee are held so far.

4. Committee on Health aspects

This committee was formed on the recommendations of Environment Sub-group to coordinate the work being taken up by various agencies on health related issues within the Narmada valley and for putting up its recommendations to the Sub-group. This committee is chaired by Member (E&R), NCA. Three meetings of the committee are held so far.

5. Committee on Seismicity and Rim Stability

This committee was formed on the request of the Govt. of Gujarat to discuss the various reports produced by GSI, CWPRS, CWC, etc. as they relate to SSP and to evolve a common work programme. Two meetings of this committee were held.

6. Multidisciplinary Groups ,by Govt. of Gujarat

There are four high level expert multi disciplinary groups directing, coordinating and monitoring various studies commissioned by Govt. of Gujarat for the vast command area of SSP formed in pursuance of the directives of the Environment Sub-group for initiating such studies. Member (E&R) is included as regular member and Specialist (Environment) as invitee. Meeting of the expert group are convened by NPG from time to time to discuss the progress/interim reports of the studies commissioned by the Govt. of Gujarat.

7. Focus Group, by Govt. of Maharashtra

GOM has formed a Focus Group for coordination , planning , and implementation of Environmental Safeguard Measures..

8. Wild Life Committee ,by Govt. of Madhya Pradesh

GOMP had constituted Wild Life Committee to discuss and decide the implementation of the directions coming from Govt. of India / NCA regarding studies planning , implementation and environmental management.

10.3.1 Field visits

All the above sub-group & committee undertake field visits where the need requires. Since vast area was involved, pari-passu clause was introduced in environmental clearance to continue further monitoring of environmental work plans as the project proceeded. The task was assigned to Environment Sub-group, which look after survey, studies and implementation of Environmental Action Plans. An Environment Committee headed by the Member (E&R), NCA has been formed by the Environment Sub-group for undertaking periodic field visits to the project areas in Madhya Pradesh, Maharashtra & Gujarat. In

addition the other committees of experts also undertake field visits. Specialists in NCA also periodically monitor the progress of works through field visits.

10.4 REVIEW COMMITTEE OF NCA

This Committee was framed to review the decisions of the NCA Review Committee of the Narmada Control Authority was reconstituted and the Union Minister of Environment & Forests was included as a member. Special status was granted to the environmental issues by modifying the composition & function(s) of the review committee. Vide notification No. 554(E) dated 3.6.87 Accordingly not only that Union Minister of Environment & Forests was included as a member to the review committee but also a provision was made that Review committee *suo moto* on the application of Secretary, MOEF may review the decision of the authority. In urgent cases Chairman, Review Committee was empowered to grant stay of any order of the Narmada Control Authority pending final decision on review.

10.5 BUDGET FOR ENVIRONMENTAL SAFEGUARD MEASURES

i) COST OF SURVEY & STUDIES (in Rs. Lacs)

	Gujarat		Maharashtra		Madhya Pradesh		NCA/GOR		Total	
Compensatory Afforestation	4.52	4.52	5.29	5.29	2.44	2.44			12.25	12.25
Catchment Area Treatment	8.77	8.77	7		7	3.28			19.05	18.57
Flora & Fauna	101.84	80.47	38		20.33	15.27			175.44	129.37
Health	2.5	2.5	10		29.63				42.13	32.84
Archaeology/ Anthropology	1.3	0.6	N.A.		59				60.3	36.93
Seismicity	5.05	5.07	N.A.		23	1.98			30.03	19.55
	11.25	11.25				N.A.			11.25	11.25

ii) Cost of Implementation (in Rs. Lacs)

	Gujarat		Maharashtra		Madhya Pradesh		
Compensatory Afforestation	1809.1	1722.82	2116		1650.27	1800	331.16
							4204.25
Catchment Area Treatment	3509	2776.67	2894.67		8835.05		15238.72
							8003.467
Flora & Fauna	75.31	64.42	117		NA		192.31
							2399.68
Fish			102.1				102.1
Health	3800	192.28	546.6		1354.63		5701.23
							722.74
Archaeology/ Anthropology	156	95.55			700		856
							108.52
Seismicity	219.57	318.55					219.57
							318.55
Command Area Development	NA					NA	

ANNEXURES

ENVIRONMENTAL CLEARANCE (24.6.87)

**GOVT. OF INDIA, MINISTRY OF ENVIRONMENT & FORESTS.
NEW DELHI**

No. 3-87/80-IA

Dated 24 June, 1987

OFFICE MEMORANDUM

Subject : Approval of Narmada Sagar Project, Madhya Pradesh and Sardar Sarovar Project, Gujarat from environmental angle.

The Narmada Sagar Project, Madhya Pradesh and Sardar Sarovar Project, Gujarat have been referred to this Department for environmental clearance.

2. On the basis of examination of details of these projects by the Environmental Appraisal Committee for River Valley Projects and discussions with the Central and State authorities the following details were sought from the project authorities:

- (i) Rehabilitation Master Plan.
- (ii) Phased Catchment Area Treatment Scheme.
- (iii) Compensatory Afforestation Plan.
- (iv) Command Area Development.
- (v) Survey of Flora and Fauna.
- (vi) Carrying Capacity of surrounding area.
- (vii) Seismicity; and
- (viii) Health Aspects.

3. Field surveys are yet to be completed. The first set of Information has been made available and complete details have been assured to be furnished by 1989.

4. The NCA has been expanded and Its terms of reference have been amplified to ensure that environmental safeguard measures are planned and implemented In depth and in Its pace of Implementation part passu with the progress of work on the project.

5. After taking into account all relevant facts the Narmada Sagar Project, Madhya Pradesh and the Sardar Sarovar Project, Gujarat are hereby accorded environmental clearance subject to the following conditions :

contd....2/

- i. The Narmada Control Authority (NCA) will ensure that environmental safeguard measures are planned and implemented pari passu with progress of work on projects.
- ii. The detailed surveys/studies assured will be carried out as per the schedule proposed and details made available to the Department for assessment.
- iii. The Catchment Area Treatment programme and the Rehabilitation plans be so drawn as to be completed ahead of reservoir filling.
- iv. The Department should be kept informed of progress on various works periodically.

6. Approval under Forest (Conservation) Act, 1980 for diversion of forest land will be obtained separately. No work should be initiated on forest area prior to this approval.

7. Approval from environmental and forestry angles for any other Irrigation, power or development projects in the Narmada Basin should be obtained separately.

Sd/-
(S. MAUDGAL)
Director (IA)

The Secretary,
Ministry of Water Resources,
New Delhi.

FOREST CLEARANCE (8.9.87)

**GOVT. OF INDIA, MINISTRY OF ENVIRONMENT & FORESTS.
NEW DELHI**

No. 3-87/80-IA

Dated 8TH September, 1987

To,

1. The Secretary,
Agriculture Forest and
Cooperative Department,
Govt. of Gujarat,
Sachivalaya, Gandhinagar.
2. The Secretary,
Forest Deptt.,
Govt. of M.P.,
Bhopal.
3. The Secretary,
Revenue & Forest Department,
Govt. of Maharashtra,
Mantralaya, Bombay.

Sub: Diversion of 13385.4S ha (6488.54 ha in Maharashtra 4165.91 ha in Gujarat and 2731.00 ha in Madhya Pradesh) of Forest land in Dhule, Bharuch and Khargone district respectively for Sardar Sarovar Project.

Sir.

1. I am directed to refer to your letter Nos. (1) FLD-1282-78159-V-1 dated 17.2.83 (Gujarat) (2) 5/58/83/10/3 dated 31.8.84 (Madhya Pradesh) and (3) FLD. 1080/111531-11-F3 dated 8.9.83 (Maharashtra) on the above mentioned subject seeking prior approval of the Central Government under Section 2 of the Forest (Cons) Act. 1980 and to say that the proposal has been considered by the Advisory Committee constituted by the Central Government under Section 3 of the Forest (Cons) Act. 1980.

2. After careful consideration of the proposal, the Central Government hereby conveys its approval for diversion of 13385.45 ha of forest land for Sardar Sarovar Project as per details given below :

S.No.	State	Forest land to be diverted (ha)
1.	Gujarat	4165.91
2.	Madhya Pradesh	2731.00
3.	Maharashtra	6488.54

contd..../2

3. This approval is strictly subject to the following conditions :

- i) Legal status of the land will remain unchanged.
- ii) The full details of the non-forest lands for retaining compensatory afforestation with complete details viz. Khasara No, village etc. will be reported by the State Government before 30.9.87.
- iii) The non-forest areas available for rehabilitation of all the oustees will be reported by the State Governments or a proposal to the satisfaction of Govt. of India In this regard will be furnished by the State Governments before 30.11.87.
- iv) No work on the project In forest area will be commenced until and unless condition under (II) & (III) above are fulfilled.
- v) Since the project Involves violation and also most of the non-forest areas for compensatory afforestation are away from the project area. the State Govts. will raised compensatory afforestation In double the degraded forest lands also In the project Impact areas In addition to the afforestation on equivalent non-forest land. A scheme for this will be submitted by 30.11.87.
- vi) The State Governments will prepare by 30.11.87 a plan for the treatment of catchment areas failing which the Central Government will appoint a team for this purpose at the cost of the project for this purpose.
- vii) No Forest land will be utilised for the rehabilitation of oustees.
- viii) Tree felling will be permitted In submergence area only up to 4 M below FRL.
- ix) Tree planting will be done on either side of the canals, roads, forest area of the reservoir and In the wasteland/vacant land under the control of the Irrigation Department.
- x) Water will be supplied free of cost to the Forest Department for raising nursery and for irrigating forestry plantations In the command area.
- xi) In order that the construction labour & staff while working on the project In the forest area may not allow destruction to the forest area for meeting their fuel wood needed, the user agency will establish fuels depots and will provide suitable alternative domestic fuel such as fuel wood, coal, kerosene oil etc to them free of cost or at cost deducted from their salary and wages.

Yours faithfully,

Sd/

(R.S. Bisht)

Under Secretary to the Govt. of India.

INVESTMENT CLEARANCES (5.10.88)

**GOVERNMENT OF INDIA, PLANNING COMMISSION
New Delhi**

No. 2(194)/88-I&CAD.

October 5, 1988

To

The Secretary,
Planning Department,
Government of Gujarat,
Gandhinagar.

I am directed to convey that the Sardar Sarovar Project, estimated to cost Rs. 6406.04 Crores (Rupees six thousand four hundred six crores and four lakhs) as per the salient features vide Annexure-I enclosed herewith, has been considered acceptable for Investment subject to the conditions as laid down below:

- (i) The State shall comply with the conditions as laid down in the O.M.No.3-87/80-IA dated 24.6.1987 and 8-372/83-FC dated 8.9.1987 Issued by the Ministry of Environment and Forest while according the environmental clearance and the approval for diversion of forest lands for this project respectively (copies enclosed).
- (ii) Looking to the size and Importance of this project, the State Government will give sufficient priority to this project in the Eighth Plan by ensuring adequate funding to match with the construction schedule as indicated in the concurrence of State Planning and Finance Department vide Government of Gujarat in Narmada Development Department's letter No. NPP/1084/GOI-4/Pat.V/J dated 3.10.1988. The state will also complete other on going projects at advance stage in time to ensure that there is no difficulty in funding the peak requirements of Sardar Sarovar Project.
- (iii) A programme of drainage and ground water balance studies has been completed for Mahi Narmada-Doab. Such a programme must be completed for the areas beyond the Mahi. The Bhal, Saurashtra, Kutch, Sami-Harij and other areas require this as a pre-condition. The State should submit to Planning Commission a detailed programme of studies, with milestones of achievements, duly vetted through Central Water Commission for monitoring the same by Planning Commission.

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- (iv) The State should take suitable advance measures, as may be necessary, to ensure that annual revenue to be accrued from this project covers at least annual operation and maintenance charges including depreciation charges by setting the water rates suitably.
 - (v) The State should set up a special group of experts to study the siltation aspect in the main canals under all operating conditions since such siltation, if it occurs, is likely to pose a serious problem during the actual operation of this project and may require a huge expenditure for desilting as well as result in serious operational difficulties.
 - (vi) State should draw up a detailed time schedule for completion within five years the investigation, detailed survey, planning and working out the detailed cost estimates for micro level network system for the balance area of the total command of this project.
 - (vii) Past experience of Irrigation projects have revealed that main and branch canals are completed upto the end but, in absence of micro-level networks to take irrigation water upto outlet, corresponding Irrigation benefits do not start accruing in spite of huge financial investment made. To avoid this, the State should draw up an implementation schedule, segmentwise, for completion of canal network, in such a way that a segment of the canal network, taken up from head reaches, is completed in all respects so as to make the irrigation waters available, for the designed potential of that segment, upto the outlet in that particular segment.
2. This project may be executed as per the approved outlay from year to year.

Yours faithfully,

Sd/

(**B.N. NAVALAWALA**)

Deputy Adviser (I&CAD)

for Secretary, Planning Commission

Copy to :

- 1) Secretary to Chief Minister,
Government of Gujarat, Gandhinagar.
- 2) Chairman, Sardar Sarovar Narmada Nigam Ltd.,
Gandhinagar.

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- 3) Secretary, Narmada Development Department / Finance Department,
Government of Gujarat, Gandhinagar.
- 4) Secretary, Irrigation Department, Government of Maharashtra / Madhya
Pradesh / Rajasthan, Bombay/Bhopal/Jaipur.
- 5) Ministry of Water Resources, Shram Shakti Bhawan, New Delhi.
Secretary
Commissioner (PP)
Financial Adviser
Commissioner (Project) / Commissioner (India) / Commissioner (Floods),
Joint Commissioner (P)
Deputy Secretary
Budget Section.
- 6) Secretary, Ministry of Environment & Forests,
Paryavaran Bhawan, C.G.O. Complex, Lodi Road, New Delhi.
- 7) Central Water Commission, Sewa Bhawan, R.K. Puram, New Delhi
Chairman
Member (P&P)
Chief Engineer (PAO)
Director (PAO)
- 8) Chairman, Central Electricity Authority, Sewa Bhawan, R.K. Puram, New
Delhi.
- 9) Ministry of Finance, Department of Expenditure (Plan Finance Division)
North Block, New Delhi
(Joint Secretary (PF/Director (PF)
- 10) Executive Member, Narmada Control Authority, Palika Bhawan, Sector-
13, R.K. Puram, New Delhi.
- 11) Planning Commission
PS to Deputy Chairman
Secretary / Special Secretary
Adviser (I&CAD)/(P&E) / (Agri)
Joint Secretary (SP)
Library
Information Officer
All Officers of I&CAD Division
Guard File

DIRECTION FROM SECRETARY, MOE&F (04-02-1988)

GOVT. OF INDIA, MINISTRY OF ENVIRONMENT & FORESTS

Copy of D.O. letter No.3/87/80/HCT/Env.5/IA dated February 4, 1988 from Shri T.N. Seshan, Secretary to the Govt. of India, Ministry of Environment and Forests, Paryavaran Bhawan, Lodi Road, New Delhi addressed to Shri Naresh Chandra, Secretary to the Govt. of India, Ministry of Water Resources, New Delhi.

You may kindly recall that in the last meeting of the NCA, it was considered desirable that to facilitate basic environmental data collection and preparation of needed Action Plans a framework may be worked out to be followed uniformly by all the four States. Accordingly, on each of the major environmental aspects for which necessary action plans have to be prepared, details worked out are enclosed. You may like to convey these details to the concerned Chief Secretaries for necessary follow-up action.

1] **CATCHMENT AREA TREATMENT**

Catchment Area Treatment should cover both submergence area as well as free draining catchment. The important parameters under both these heads are given below :

SUBMERGENCE AREA

Extent, land use, population affected, socio-economic profile of affected population, inter-linkages with outer population, special characteristics, flora and fauna – endangered, rare, habitat sufficiency, seismic status, geological features, ground water status, geomorphological aspects.

FREE DRAINING CATCHMENT AREA

Land use, extent of degradation, erodability, precipitation pattern, cloud bursts, land slides, biotic pressures, siltation load, other existing and proposed activities.

CATCHMENT AREA TREATMENT PLAN

- 1) Criteria adopted for identifying degraded and vulnerable areas;
- 2) Map showing critically degraded area requiring engineering and biological treatment on the basis of a recent field survey;
- 3) Details of the engineering and biological measures proposed to be carried out as a time bound programme;
- 4) Arrangements made to mobilize :
 - # Technical manpower to carry out the soil conservation and rehabilitation schemes;
 - # Planning material either through creation of special nursery or through purchases from Forest Department etc.
- 5) Geomorphological studies of the reservoir periphery.

2] COMPENSATORY AFFORESTATION

- 1) Map of the areas identified for afforestation;
- 2) Land capability survey of the identified areas;
- 3) Availability of surface and ground waters;
- 4) Species identified and the nursery creation programmes;
- 5) Phased Action Plan for compensatory afforestation;
- 6) Public participation details;
- 7) Details of after-care and monitoring.

3] REHABILITATION AND MASTER PLAN

- 1) enumeration of affected population including those whose land is submerged but houses are not as well as the landless workers;
- 2) Socio-economic studies and profile of the affected population;
- 3) Details of the rehabilitation sites along with the land capability surveys and availability of water at the selected sites;
- 4) Map of rehabilitation colonies and type, designs of the houses proposed;
- 5) Details of the occupational training programme proposed for the oustees;
- 6) Measures needed to make the identified land fit for agriculture and rehabilitation along with a phased Action Plan.

4] COMMAND AREA DEVELOPMENT

Command area involves both the management of plant as well as human aspects. The details have to be collected on the following:

LAND MANAGEMENT

Existing land use, irrigation status, cropping pattern, water availability- surface and ground; natural drainage pattern, induced drainage, yield, permeability, precipitation distribution, salinity and alkalinity problems, soil profile, land capability.

HUMAN MANAGEMENT

Cropping pattern, rationale and controlled water use; training for skills upgradation; package of irrigation water, seeds, fertilisers, insecticides, pesticides with controls; surface and subsurface drainage.

COMMAND AREA DEVELOPMENT PLAN

- 1) Land capability survey of the area which are proposed to be brought under irrigation along with the soil profiles;
- 2) Identification of the areas prone for water logging and salinity;
- 3) Details of the drainage works proposed in the command and the norms based on which these details have been planned;
- 4) On-farm development works proposed and the assistance proposed to be given to the farmers to ensure conjunctive use of water;
- 5) Details of the present and proposed cropping pattern;
- 6) Steps proposed to prevent contamination of ground and surface water due to fertilisers, pesticides, runoff.

5] FLORA AND FAUNA

FLORA

Rare and endangered species, gene-pool reserve.

FAUNA

Rare and endangered species, migratory species, migration route, breeding habitat, sanctuary, national park.

Accordingly, the rehabilitation of Flora and Fauna Action Plans would cover the following :

- 1) Survey of flora and fauna in the region going to be affected
- 2) Gene-pool, if any, likely to be affected;
- 3) Details of wildlife habitats in the region;

- 4) Measures proposed to rehabilitate endangered species of flora and fauna, if any;
- 5) Assessment of the carrying capacity of the neighbouring areas wherein the wildlife would disperse if the scheme is implemented;
- 6) Plan for rehabilitation of endangered Flora and Fauna.

6] HEALTH ASPECTS

- 1) present status of the water-borne disease in the areas;
- 2) Present status of the health delivery system;
- 3) Screening arrangements proposed for the work force;
- 4) Preventive measures proposed to control the incidence of water-borne diseases;
- 5) Reinforcement proposed to the existing health delivery system.

7] MONUMENTS AND CULTURAL ASPECTS

- 1) Cataloging of monuments and sites considered important from religious, historical and cultural angles;
- 2) Plan for rehabilitation of monuments wherever necessary

ENVIRONMENT SUB-GROUP

1.	Secretary to the Govt. of India, Ministry of Environment & Forests	Chairman	<p>i) To work out the environmental safeguard measures to be planned and implemented for the entire Narmada Basin so that environmental safeguard measures are executed and remain fully in consonance with the clearance accorded to the Narmada Sagar and Sardar Sarovar Projects.</p> <p>ii) To determine the terms of reference of required surveys and studies necessary for implementation of environmental safeguard measures inclusive of data base required, the methods by which the data base is to be prepared and also to identify the institutions/ individuals to undertake the preparation of such documents</p> <p>iii) To get prepared for clearance by the Ministries and NCA, the Action Plans with regard to all environmental safeguard measures and the assessment criteria thereof.</p> <p>iv) To devise a suitable monitoring and evaluation mechanism so that the action plans are effectively implemented in consonance with stipulations at the time of clearance of the projects.</p> <p>v) To assess the necessary organisation with management capability being set up for adequate implementation of environmental safeguard measures.</p> <p>vi) To undertake all measures necessary to assist Narmada Control Authority in the planning and implementation of environmental safeguard measures.</p>
2.	Executive Member, NCA	Member	
3.	Vice-Chairman, NVDA GOMP	Member	
4.	Secretary (Env.), GOM	Member	
5.	Secretary (R&R), Narmada Development Depts. GOG	Member	
6.	Secretary, Env. Deptt. GOR	Member	
7.	Commissioner (PP), MOWR	Member	
8.	Dy. Director General, ICAR	Member	
9.	Dy. Inspector General, MOE&F	Member	
10.	Director, Wildlife Institute, Dehradun	Member	
11.	Dr. .S. Ramaseshan, Professor, Indian Institute of Technology, Kanpur	Member	
12.	Director General, Anthropological Survey of India	Member	
13.	Dr. Shekhar Singh, Faculty Member, IIPA, New Delhi	Member	
14.	Dr.R.K. Katti, Professor (Retd.), Indian Institute of Technology, Mumbai.	Member	
15.	Director General, Archaeological Survey of India	Member	
16.	Director General, ICMR	Member	
17.	Expert of Flora	Member	
18.	Member (E&R), NCA	Member Secretary	

Details of Meetings

Year (Financial)	No.	Meeting	Date	Venue	Chairman
1987-88	2	I	27.11.87	Paryavaran Bhawan, New Delhi	Shri T.N. Seshan
		II	05.01.88	Paryavaran Bhawan, New Delhi	Shri T.N. Seshan
1988-89	3	III	19.07.88	Paryavaran Bhawan, New Delhi	Shri K.P.Geetakrishnan
		IV	18.11.88	Paryavaran Bhawan, New Delhi	Shri K.P.Geetakrishnan
		V	07.03.89	Paryavaran Bhawan, New Delhi	Shri K.P.Geetakrishnan
1989-90	2	VI	07.08.89	Paryavaran Bhawan, New Delhi	Shri Mahesh Prasad
		VII	19.12.89	Paryavaran Bhawan, New Delhi	Shri Mahesh Prasad
1990-91	3	VIII	14.05.90	Paryavaran Bhawan, New Delhi	Shri Mahesh Prasad
		IX	07.09.90	Paryavaran Bhawan, New Delhi	Shri Mahesh Prasad
		X	31.01.91	Paryavaran Bhawan, New Delhi	Shri R. Rajamani
1991-92	4	XI	01.05.91	Paryavaran Bhawan, New Delhi	Shri R. Rajamani
		XII	10.09.91	Paryavaran Bhawan, New Delhi	Shri R. Rajamani
		XIII	29.11.91	Kevadia Colony, Gujarat	Shri R. Rajamani
		XIV	25.02.92	Paryavaran Bhawan, New Delhi	Shri R. Rajamani
1992-93	3	XV	19.08.92	Paryavaran Bhawan, New Delhi	Shri R. Rajamani
		XVI	09.11.92	Paryavaran Bhawan, New Delhi	Shri R. Rajamani
		XVII	16.03.93	Paryavaran Bhawan, New Delhi	Shri R. Rajamani
1993-94	4	XVIII	28.05.93	Paryavaran Bhawan, New Delhi	Shri R. Rajamani
		XIX	28.07.93	Paryavaran Bhawan, New Delhi	Shri R. Rajamani
		XX	03.11.93	Hotel Taj Malwa, NCA, Indore	Shri R. Rajamani
		XXI	07.12.93	Paryavaran Bhawan, New Delhi	Shri R. Rajamani

1994-95	3	XXII	03.05.94	Paryavaran Bhawan, New Delhi	Shri R. Rajamani
		XXIII	29.11.94	Paryavaran Bhawan, New Delhi	Shri N.R. Krishnan
		XXIV	10.03.95	Paryavaran Bhawan, New Delhi	Shri N.R. Krishnan
1995-96	3	XXV	11.07.95	Paryavaran Bhawan, New Delhi	Shri N.R. Krishnan
		XXVI	12.10.95	Paryavaran Bhawan, New Delhi	Shri N.R. Krishnan
		XXVII	18.12.95	Paryavaran Bhawan, New Delhi	Shri N.R. Krishnan
1996-97	3	XXVIII	14.05.96	Paryavaran Bhawan, New Delhi	Shri N.R. Krishnan
		XXIX	15.11.96	Paryavaran Bhawan, New Delhi	Shri T.K.A. Nair
		XXX	28.01.97	Paryavaran Bhawan, New Delhi	Shri T.K.A. Nair
1997-98	1	XXXI	31.01.98	Paryavaran Bhawan, New Delhi	Shri Vishwanath Anand
1998-99	1	XXXII	14.10.98	Paryavaran Bhawan, New Delhi	Shri Vishwanath Anand
1999-00	1	XXXIII	28.9.99	Paryavaran Bhawan, New Delhi	Shri Vishwanath Anand

ENTITLEMENTS OF REHABILITATION BENEFITS AS PER NWDT AWARD AND STATE-WISE

1.	Definition of oustee	An oustee shall mean any person who, since at least one year prior to the date of publication of notification u/s 4 of the Land Acquisition Act, has been ordinarily residing or cultivating land or carrying on any trade, occupation or calling or working for gain in the area likely to be submerged permanently or temporarily.	Any person who has been ordinarily residing or carrying on any trade or vacation for his livelihood for atleast one year before the date of publication of notification u/s 4 of the Land Acquisition Act or has been cultivating land for at least three years prior to such notification in an area which is likely to come under submergence whether temporarily or permanently because of the project or is otherwise required for the Project.	Same as under NWDT Award Clause XI-1(2)	Same as under NWDT Award Clause XI-1(2)
2.	Family	A family shall include husband, wife and minor children and other persons dependent on the head of the family, e.g. widowed mother.	A family shall mean and include husband, wife and minor children and other persons dependent on the head of the family e.g. widowed mother, widowed sister, unmarried sister, unmarried daughter or old father.	Same as under NWDT Award Clause XI-1(3) (ii)	Same as under NWDT Award Clause XI-1(3) (ii)
3.	LAND ALLOTMENT				
	a) Landed Oustees	Every displaced family from whom more than 25% of its land holding is acquired shall be entitled to and be allotted irrigable land to the extent of land acquired from it subject to the prescribed ceiling in the State concerned and a minimum of 2 hectares (5 acres) per family, the irrigation facilities being provided by the State in whose territory the allotted land is situated. This land shall be transferred to the oustee family if it agrees to take it. The price charged for it would be as mutually agreed between Gujarat and the concerned State. Of the price to be paid for the land a sum equal to 50% of the	<ol style="list-style-type: none"> 1. Land equivalent to that acquired with a minimum of 2 ha and maximum of 8 ha and also Govt. assistance in providing irrigation by wells/ tubewells or any other method if land not irrigated. If irrigation is not possible, minimum 4 ha will be allotted. Development of dry land would be subsidized by the Government to the extent of 75% of the cost involved. 2. (a) For families of all SC/ST and other categories with land holding upto 2 ha. grant-in-aid would be paid to cover the gap, if any, between the amount of compensation and the cost of allotted land in full. For other owing land from 2 	<ol style="list-style-type: none"> 1. Land equivalent to that acquired with a minimum of 2 ha and maximum limited to State ceiling. Joint holders are also eligible for land equal to his share subject to a min. of 2 ha. Joint holders and major sons will be considered as co-sharer of acquired land. Irrigation facilities to be provided by the State. 2. Where agricultural land is purchased by the oustees' family through committee, the difference, if any, in price of land so purchased and the amount of compensation shall be paid as an ex-gratia. 	<ol style="list-style-type: none"> 1. Land equivalent to that acquired with a minimum of 2 ha and maximum limited to State ceiling. Joint holders are also eligible for land equal to his share subject to a minimum of 2 ha. Irrigation facility to be provided by the State. The land is allotted to the oustee free of cost. 2.

ENTITLEMENTS OF REHABILITATION BENEFITS AS PER NWDT AWARD AND STATE-WISE

		compensation payable to the oustee family for the land acquired from it will be set off as an initial installment of payment. The balance cost of the allotted land shall be recovered from the allottee in 20 yearly installments free of interest. Where land is allotted in Madhya Pradesh or Maharashtra, all recoveries for the allotted land shall be credited to Gujarat.	to 8 ha. will be eligible for an additional amount of Rs.2000/- per ha. of 50% of the difference in cost of allotted land and the compensation received. Whichever is less. (b) Oustee has two choice : I. He can opt for cash compensation for his submerged land. II. He can opt for compensation in the form of land. He will be entitled for 50% amount of compensation in cash and remaining 50% amount will be adjusted against the cost of the allotted land. Remaining cost of allotted land will be recovered in 20 yearly installments as loan due from third year. Loan will be interest free.	3. The landed oustee/ encroacher who have received compensation of land has an option to contribute 50% of his compensation as initial installment towards the cost of allotted land and rest of the amount of the cost of land to be repaid in 20 years, yearly interest free installments of contribute 100% compensation towards the cost of allotted land and the difference between the price of the allotted land and compensation would be treated as ex-gratia towards occupancy price. In other categories, i.e. landless agricultural labourer, encroacher (who has not received compensation) and their major sons are given full ex-gratia amount towards the cost of allotted land.	
	b) Encroacher oustees	No land allotment benefit provided.	a) They will be treated as landed oustees subject to two conditions. i. Encroachment must be on or before 13.4.87. ii. Allotment of agricultural land will be 1 ha. or 2 ha. Only subject to the size of encroachment coming under submergence. b) Encroachers will be entitled to get compensation for land under submergence. c)	Encroachers prior to 1 year of Notification under Sec. 4 of the Act are entitled for 2 ha. of land and compensation for the balance encroached land as ex-gratia	2 ha of land and compensation as ex-gratia payment for the balance land encroached upto 31/3/78. Later encroachers will be treated as landless and will get 1 ha. Agriculture land
	c) Landless	No provision for land allotment	No. land. All landless agricultural	2 ha of land to landless	1 ha of land if oustee

ENTITLEMENTS OF REHABILITATION BENEFITS AS PER NWDT AWARD AND STATE-WISE

	oustees		labourers and all SC/ST landless oustees will get Rs.29000 each for productive assets while other landless will get Rs.19500 accordingly.	Agricultural labourers only	moves with others. □
	d) Major sons of above all categories of oustees	<ul style="list-style-type: none"> • Every major sons will be treated as separate family • No provision for land allotment 	Major sons will be treated as separate family. They will be entitled to cash compensation according to the category to which they belong.	2 ha of land to each major sons of all category of oustees with 1/1/87 as cut-off date for major sons.	1 ha. of land to each major unmarried daughters and major sons of all category of oustees with 1/1/87 as cut-off date for major sons and unmarried daughters.
4.	House plot	Free of cost allotment of house plot to each oustee family measuring 18.29 x 27.43 m (60'x90') including major sons.	Residential developed plot of 502 Sq.m.(60'x90') in rural areas will be given free to the oustee families and their Major sons.	1. Residential plot of 502 sq.m. would be given free of charge to the oustee families and their major sons. 2. Free core houses costing Rs.45,000/-	1. Residential plot of 502 sq.m. would be given free of charge to the oustee families and their major sons and unmarried major daughters. 2. Free Mangalore tiles and bamboos.
5.	Rehabilitation Grant, Grant-in-aid, Subsidy	Resettlement/rehabilitation grant @ Rs.750/- per family inclusive of transportation charges. Grant-in-aid upto Rs.500/-	Scale of grant-in-aid for rehabilitation will be as follows : Rehabilitation Grant: All small & marginal farmers and all ST/SC farmers @ Rs.11000 each. All other farmers @ Rs.5500 each. All agricultural landless labourers & all SC/ST labourers, @ Rs. 11,000 each. All other labourers & land less families @ Rs. 5500 each. Major son of each oustee family will be treated as landless. He will be categorised amongst landless oustees as per his occupation.	Subsistence Allowance Each family will be paid subsistence allowance at Rs.15/- per day for 25 days in a month for a period of one year after resettlement. Rs. 750/- per family with an increase of 8% per year worked out with January,80 as base, as resettlement grant. Grant-in-aid upto Rs. 500/- as per NWDT Award. Rs. 5000/- to purchase productive assets and Rs. 10000/- to construct pucca house plinth. The above benefits at Sl. 2 will be given to all category of oustees & their major sons.	Subsistence Allowance Each family will be paid subsistence allowance at Rs.15/- per day for 25 days in a month for a period of one year after resettlement. Rs. 750/- per family with an increase of 8% per year worked out with January,80 as base, as resettlement grant. Grant-in-aid upto Rs. 500/- as per NWDT Award. The above benefits at Sl. 2 will be provided to all category of oustees and their major sons and unmarried major daughters.

ENTITLEMENTS OF REHABILITATION BENEFITS AS PER NWDT AWARD AND STATE-WISE

6.	Transportation Grant	Transportation charges to be met out of resettlement/ rehabilitation grant of Rs.750/-	Free transport will be provided by the project. In case this facility is not availed of, a lumpsum relocation grant will be paid.	Free transport will be provided by State Government.	Free transport will be provided by State Government
7.	Acquisition of Private land/ Houses which get isolated or physically cut-off.	Not dealt with	Would be acquired and owners treated as oustees.	Would be acquired and owners treated as oustees.	Would be acquired and owners treated as oustees.
8.	Compensation	As per Land Acquisition Act in operation at the time of acquisition	Compensation for land on the basis of price of similar land in adjacent command areas.	As per Land Acquisition Act as amended from time to time.	As per Land Acquisition Act as amended from time to time.
	(a) Land				
	(b) Houses	As per Land Acquisition Act.	Replacement value of House.	As per Land Acquisition Act.	As per Land Acquisition Act.
9.	Civic Amenities	<ol style="list-style-type: none"> One primary school (3 rooms) for every 100 families One Panchayat Ghar for every 500 families. One dispensary for every 500 families. One seed store for every 500 families. One children's park for every 500 families. One village pond for every 500 families. Drinking water well with trough for every 50 families. One tree platform for every 50 families. One religious place of worship for every 500 families. Each colony should be linked to main road by roads of appropriate standards. 	<ol style="list-style-type: none"> Drinking water well/tube-well with trough. Link and approach road and drains. Electricity Dispensary Primary School Panchayat Bhawan-cum-Community Hall. Playground/Children's Park Cattle shed Place of Worship Threshing ground Seed Store Tree Platform. Cremation & burial ground Pond, wherever feasible Social amenities for each municipal town viz. water supply, sanitary arrangements etc. Any other facility such as middle school which was existing in the affected village 	As per NWDT Award.	<ol style="list-style-type: none"> One Primary School (3 rooms) for 100 families One Panchayat Ghar for 500 families. Samaj Mandir(cultural centre) for 500 families One health dispensary for 500 families. One seed store for 500 families One children's park for 500 families. One village pond for 500 families Drinking water well with trough for 50 families. Approach and internal roads. One tree platform for every 50 families. Play ground for School (1 Acre for Primary and 2 Acre for secondary).

ENTITLEMENTS OF REHABILITATION BENEFITS AS PER NWDT AWARD AND STATE-WISE

		11. Electrification, water supply, sanitary arrangements etc.	and its improvement. 17. Ear marking of pasture land and its improvement.		12. Electricity supply. 13. Open gutters. 14. Public Latrines. 15. Open place for collection of animals. 16. Khalwadi (Threshing platform) 17. S.T. Stand 18. Grazing Land. 19. Open Place for Bazar. 20. Cremation/burial ground.
10.	Other facilities	Nil	<ol style="list-style-type: none"> Where the option of interest free loan is not availed, the family would be assisted to the extent of a grant-in-aid of Rs.1000/- per ha. per year for 2 years. Age relaxation of 2 Yrs. in Class III posts under the Govt. service. All welfare schemes being run at the site of displacement will be implemented at relocation sites also. 	<ol style="list-style-type: none"> Special schemes for rehabilitating Dungri Bhils in their marriage circles. Priority in allotment of tankbed land. A non-agriculturist family ie., Trader, Shopkeeper, Artisan, are given financial assistance upto Rs.5000/-at the new site for resettling at the new location.He is also provided floor area equal to that lost at new site for carrying out the trade. The differential price is treated as ex-gratia. Preference in employment. All ongoing welfare schemes will be implemented at relocation sites also. 	<p>Relocation would be given priority in public employment subject to meeting minimum qualifications and subject to age relaxation upto 3 years. Also attempt would be made to absorb as many oustees as possible in project works.</p> <ol style="list-style-type: none"> Priority in Class-III & IV posts. Reservation in project establishment. 50% reservation in ITI. 5% reserved for PAP's children in Class-III & IV posts in all Govt./Semi Govt. Organisations and local authority. House building advance i.Landholder-Rs.8000/- ii)Landless labourers-Rs. 4000/-

ENTITLEMENTS OF REHABILITATION BENEFITS AS PER NWDI AWARD AND STATE-WISE

					<p>5. Priority in allotment of tankbed land as per existing state policy.</p> <p>6. All ongoing welfare schemes will be implemented at relocation sites also.</p>
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REHABILITATION COMMITTEE OF NARMADA CONTROL AUTHORITY**Composition and functions**

Composition		Functions
1. Secretary to the Government of India, Ministry of Social Justice & Empowerment.	Chairman	i. To move in the submergence villages and in the area where rehabilitation is to be undertaken and directly ensure that rehabilitation is carried out. ii. To inspect the rehabilitation at intervals. iii. To submit reports after the field visit to the Hon'ble Supreme Court.
2. Member (Rehabilitation), NVDA, GOMP.	Member	
3. Executive Director, Sardar Sarovar Narmada Nigam Limited, GOG.	Member	
4. Additional Commissioner, Sardar Sarovar Project, Dhule, GOM.	Member	
5. Secretary, Sardar Sarovar Construction Advisory Committee.	Member	
6. Member (E&R), NCA.	Member Secretary	

RESETTLEMENT & REHABILITATION (R&R) SUB-GROUP**Composition and functions****List of Members**

Composition		Functions
1. Secretary to the Government of India, Ministry of Social Justice & Empowerment.	Chairman	I. To Monitor the progress of Land Acquisition in respect of submergence land of Sardar Sarovar Project and Indira (Narmada) Sagar Project (ISP).
2. Executive Member, NCA.	Member	II. To monitor the progress of implementation of the action plan of rehabilitation of Project Affected Families (PAFs) in the affected villages of SSP and ISP in concerned States.
3. Additional Chief Secretary (R&R), Narmada Development Department, GOG.	Member*	
4. Additional Chief Secretary/Vice Chairman, NVDA, GOMP.	Member	III. To review the R&R Action Plan from time to time in the light of results of the implementation.
5. Principal Secretary (Revenue & Relief), Govt. of Maharashtra, Mumbai.	Member*	
6. Principal Secretary (R), Govt. of Rajasthan.	Member	IV. To review the reports of the agencies entrusted by each of the State in respect of monitoring and evaluation of the progress in the matter of resettlement and rehabilitation.
7. Commissioner (PP), Ministry of Water Resources.	Member*	
8. Member (Reh.), NVDA, GOMP.	Member	V. To monitor and review implementation of resettlement & rehabilitation programmes <i>pari-passu</i> with the raising of the dam height, keeping in view the clearance granted to ISP and SSP from environmental angle by Government of India and Ministry of Environment and Forests (MOEF).
9. Secretary, Tribal Development, Govt. of Maharashtra, Mumbai.	Member	
10. Commissioner, Tribal Welfare Department, GOMP.	Member	VI. To coordinate States/ Agencies involved in the R&R programmes of SSP & ISP.
11. Commissioner (R) & CEO, SSPA, GOG.	Member	
12. Director, Tribal Research & Training Institute, Gujarat Vidhyapith.	Member	VII. To undertake any or all activities in the matter of resettlement & rehabilitation pertaining to SSP and ISP.
13. Joint Secretary/Dy. Secretary, Ministry of Tribal Affairs, Government of India, Shastri Bhawan, Dr. R.P.Road, New Delhi.	Member	
14. Dr. Vimal P.Shah, Head of Sociology Department, Gujarat University, Ahmedabad.	Member	
15. Shri K.R.Datye, Consulting Engineer, Mumbai.	Member	
16. Smt. Kanta Tyagi, Director, Kasturba Mahila Ashram, Niwari, Distt.Khargone (M.P.).	Member	
17. Prof. M.H.Qureshi, Jawaharlal Nehru University, New Delhi.	Member-Secretary	
18. One expert from Delhi University/Social Science Institution in Delhi (Woman Representative).		
19. Shri M.S.Billore, Former Secretary, (Irrigation), and Advisor, GOMP.		
20. The Member (E&R), NCA.		

