स्थिति विवरण
Status Report
केवल सरकारी प्रयोग के लिए
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दिसम्बर, 2019
December, 2019

पर्यावरण सुरक्षा उपाय
Environment Safeguard Measures
सरदार सरोवर परियोजना
Sardar Sarovar Project

नर्मदा नियंत्रण प्राधिकरण
NARMADA CONTROL AUTHORITY
इन्दौर
Indore

दिसम्बर, 2019
December, 2019

गंगा कनखले पुण्या, कुरुक्षेत्रे सरस्वती
ग्रामे वा यदि वारण्ये, पुण्या सर्वत्र नर्मदा

गंगा कनखल में और सरस्वती कुरुक्षेत्र में पवित्र है
किन्तु गांव हो या वन नर्मदा हर जगह पुण्य प्रदायिका महासरिता है

Only when the incorporation of environmental aspects in the project planning was made a part and parcel of all river valley projects would there be hope to protect and preserve "our natural environment and fulfill the objective of rapid economic development on the sustained basis why safeguarding the natural resources including the air, water, land, flora and fauna for the benefit of present and future generations".

- Excerpt from Judgement by The Hon'ble Supreme Court of India
on Narmada Bachao Andolan v/s Union of India
Writ Petition (C) No 319 of 1994
18th October 2010

Foreword

Sardar Sarovar Project is an iconic Project, not only in terms of many engineering marvels but also from the view of rehabilitation and environmental safeguard measures. With its unique features and unparalleled dimensions, the Project has occupied a remarkable position in the World Atlas of water resources development. Apart from its multiple benefits in terms of water, energy and food security, and thereby sustainable development, the Project has overcome many engineering and technological challenges during its journey from concept to its present stage, making it a Temple of Modern India in true sense.

The Hon'ble Supreme Court in its Order dated 18'th October, 2000 in Original Application No.319 of 1994, Narmada Bachao Andolan v/s Union of India & Others observed that two conditions have been kept in mind (i) on the completion of Project at the earliest (ii) ensuring compliance with conditions on which clearance of the Project was given including completion of relief & rehabilitation work and taking of ameliorative and compensatory measures for environment protection in compliance with the scheme felt by the Government whereby protecting rights under Article-21 of the Constitution. Further while according environment clearance for Sardar Sarovar Project, the then Ministry of Environment & Forest, Govt. of India had stipulated that;

(i) Narmada Control Authority will ensure that environment safeguard measures planned & implemented pari-passu with progress of work on Projects
(ii) The detailed survey will be carried out as per the proposed plan and details made available to the department
(iii) The catchment treatment programme and rehabilitation plans so drawn has to be completed ahead of reservoir filling
(iv) The department should be kept informed of progress on various works periodically.

In compliance, Narmada Control Authority was expanded and its terms of reference were implied and following two important Sub-Groups were set up viz., (a) Environment Sub-Group chaired by Union Secretary, Ministry of Social Justice & Empowerment to oversee rehabilitation & resettlement of project affected families, (b) Environment Sub-group chaired by Union Secretary of Ministry of Environment, Forest & Climate Change to oversee the planning and implementation of environment safeguard measures, periodic progress on various works were appraised / reviewed through periodic meetings of the above two Sub-Groups.

This report compiles environment safeguard measures planned & implemented by the party States of Gujarat, Madhya Pradesh, Maharashtra and Rajasthan with regard to

environment safeguard measures undertaken towards ameliorative & compensatory measures for environment protection in compliance with the scheme framed by the Government thereby protecting the rights under Article 21 of the Constitution. NCA Secretariat first compiled the environment safeguard measures as provided by the party State Governments and circulated draft Status Reports vide its letter No. NCA/Env/Report 2019/667, dated 11.11.2019 inviting comments within twenty-one days of circulation from amongst the party State Governments, Members & Invitees of Environment Sub-Group of NCA. No comment has been received so far, vindicating the Report.

As such, the report is finalized and hereby published for reference & record.

Place : Indore (MP)
Date : December 2019

(Dr. M.K. Sinha)
Executive member

Executive Summary

The Narmada Control Authority (NCA) has been setup under the final orders and decision of the Narmada Water Disputes Tribunal (NWDT) as a machinery for implementation of its directions and decision. The authority started functioning from 20th December, 1980.

The authority is a body corporate with representatives of the four States of Madhya Pradesh, Gujarat, Maharashtra, Rajasthan and representatives of Government of India. The authority is funded in equal proportions by all the four states. Secretary (Water Resources), Government of India is the ex-officio Chairman of the Authority, whereas the routine administration is the responsibility of Executive Member of the Authority. NCA presently has six subgroups. The Narmada Control Authority has its headquarters at Indore.

The Ministry of Environment and Forest, after taking into account all relevant facts, accorded environmental clearance to the Indira (Narmada) Sagar Project in Madhya Pradesh and the Sardar Sarovar Project (SSP) in Gujarat vide MoE&F O.M. No. 3-87-80-IA dated 24th June, 1987. Later the investment clearance was granted by Planning Commission in October, 1988 for Rs. 6406.04 crore at 1986-87 price level vide their letter No. 2 (194)/88-ICB dated 5th October 1988. The MOEF granted clearance subject to conditions that the NCA will ensure that environmental safeguard measures are planned and implemented pari-passu with progress of works on project. This report contains up-to-date status report on Environmental Management aspects of Sardar Sarovar Project. The first chapter is dedicated to the overview of environmental management pertaining to Sardar Sarovar Project. Chapter Two to Eight describe the current progress on different parameters of environmental management, namely a) Catchment Area Treatment, b) Compensatory Plantations, c) Command Area Development, d) Flora, Fauna, Wildlife & Carrying Capacity, e) Seismicity & Rim Stability, f) Health Aspects and g) Archaeology & Anthropology.

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List of Abbreviations

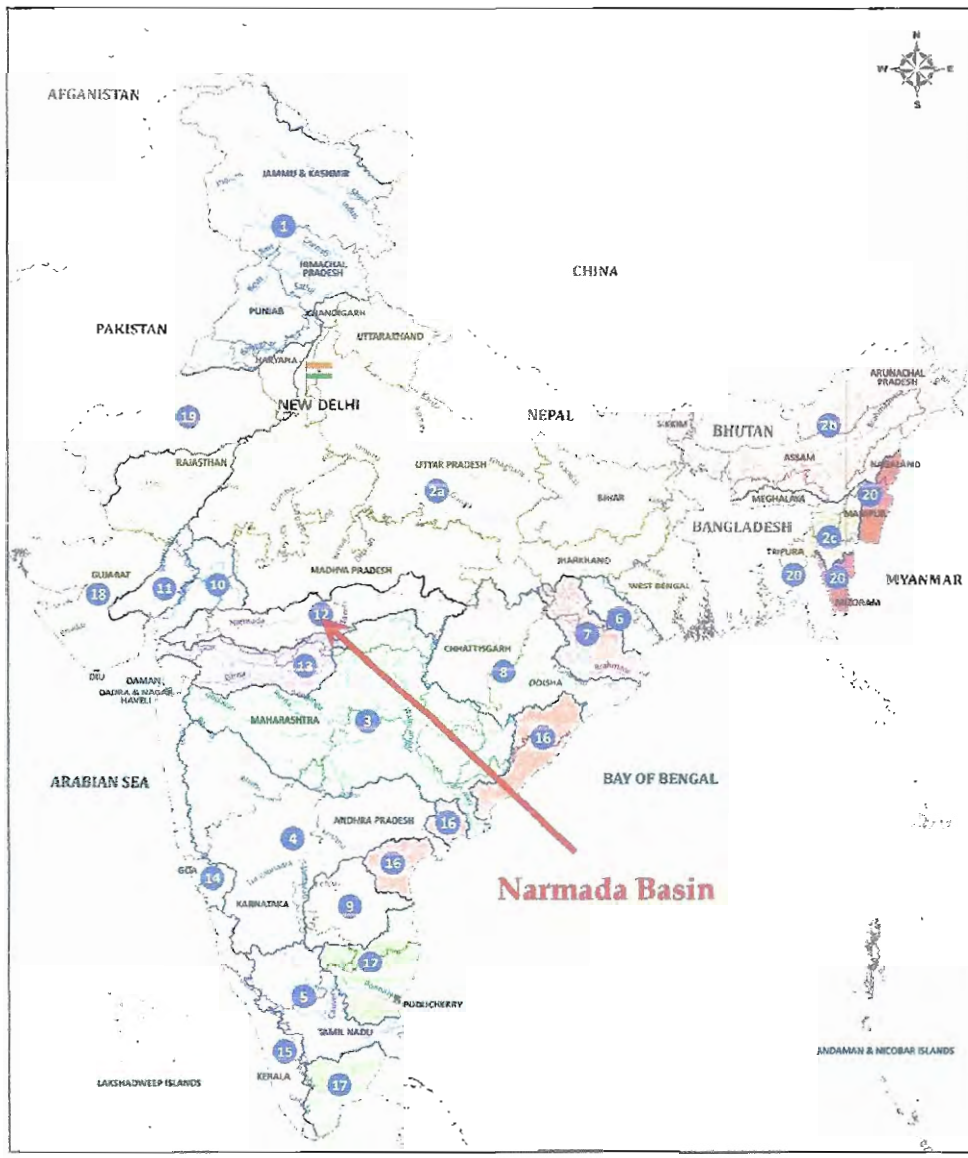
AIS&LUS	All India Soil & Land Use Survey
ASI	Archaeological Survey of India
BCM	Billion Cubic Meter
CAD	Command Area Development
CAF	Compensatory Afforestation
CAT	Catchment Area Treatment
CHPH	Canal Head Power House
CIFRI	Central Inland Fisheries Research Institute
CSR&TI	Central Soil Research and Training Institute
CSWCRTI	Central Soil & Water Conservation Research & Training Institute, Dehradun
CWPRS	Central Water and Power Research Station
DMO	District Malaria Organisation
DoWR,RD&GR	Department of Water Resources, River Development and Ganga Rejuvenation
EIA	Environmental Impact Assessment
FCC	False Colour Composite
FRL	Full Reservoir Level
FSI	Forest Survey of India
FSL	Full Supply Level
GoG	Government of Gujarat
GoI	Government of India
GoM	Government of Maharashtra
GoMP	Government of Madhya Pradesh
GoR	Government of Rajasthan
GSI	Geological Survey of India
ISP	Indira Sagar Project
LRK	Little Rann of Kutch
MAF	Million Acre Feet

MCE	Maximum Considered Earthquake
MCM	Million Cubic Meters
MoEF	Ministry of Environment and Forest
MoEF&CC	Ministry of Environment, Forest and Climate Change
MoJS	Ministry of Jal Shakti
MoWR	Ministry of Water Resources
MoWR,RD&GR	Ministry of Water Resources, River Development and Ganga Rejuvenation
MRC	Malaria Research Centre
MSU	Maharaja Sayajirao University
MW	Mega Watts
MWL	Maximum Water Level
NCA	Narmada Control Authority
NGT	National Green Tribunal
NMC	Narmada Main Canal
NWDT	Narmada Water Dispute Tribunal
PAF	Project Affected Family
PHO	Preventive Health Organisation
RBPH	River Bed Power House
RIS	Reservoir Induced Seismicity
RVP	River Valley Project
SCR	Stable Continental Region
SDA&M	State Department of Archaeology & Museum
SFRI	State Forest Research Institute
SSP	Sardar Sarovar Project
VSA	Village Service Area
WCR&TI	Water Conservation, Research & Training Institute
WHO	World Health Organization

Chapter 1 Environment Management

River Basins of India

The rivers of India play an important role in the lives of the people. They provide water, cheap electricity and the livelihood for a large number of people all over the country. There are 20 river basins/draining areas, large and small, in India. The Ganga basin is the largest. Narmada River is the fifth largest river and is also the largest west flowing river.



Source: pmfias.com

Fig. 1. Basin Map of India

Narmada Basin

Narmada is the fifth largest river of India. It is also the largest west flowing, least polluted river. Its 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 MCM (33.21 MAF). Its catchment area is about 98,000 Sq. Km, which is spread to the States of Madhya Pradesh, Maharashtra and Gujarat.

Pic 1. Amarkantak: Origin of Narmada River

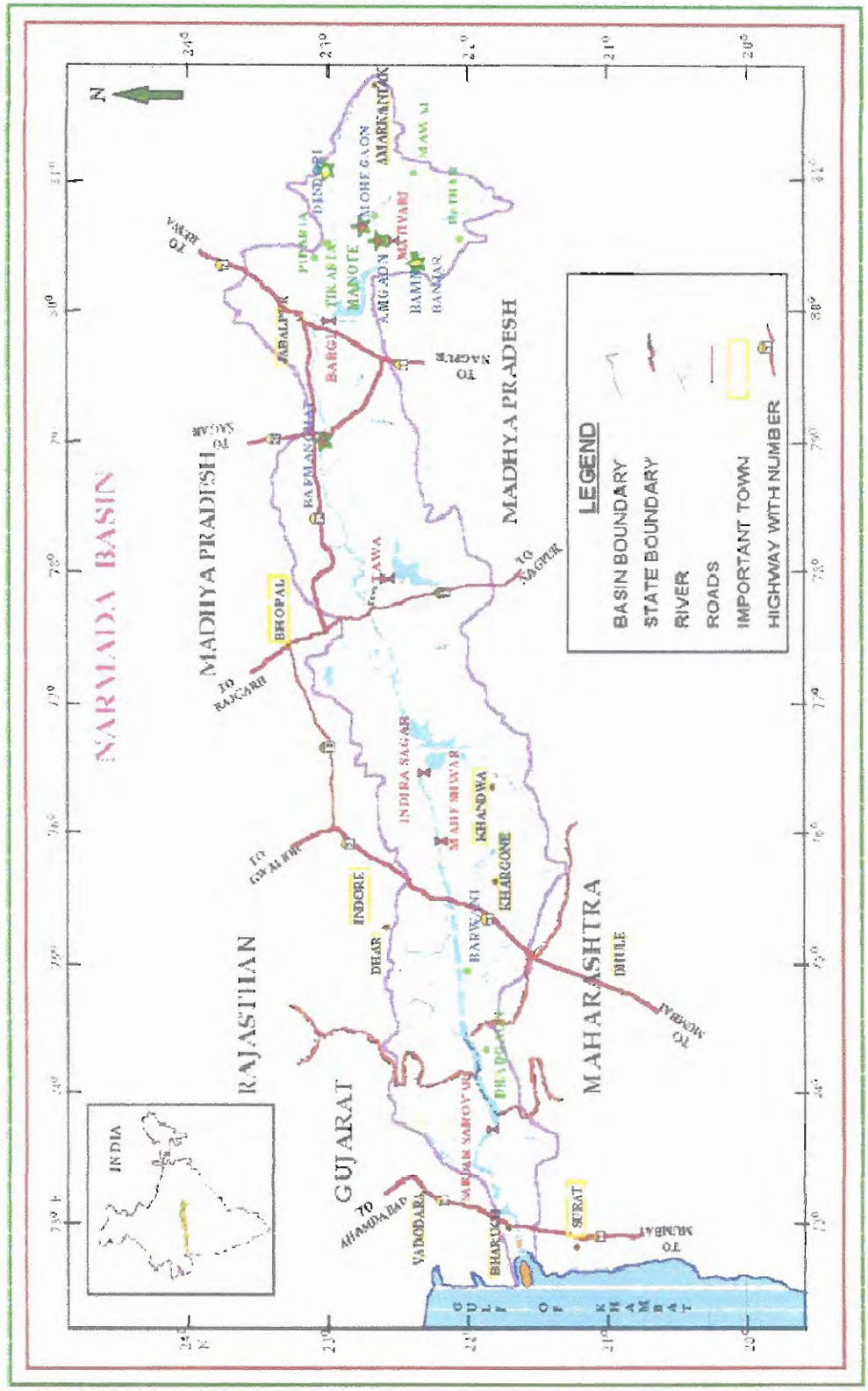
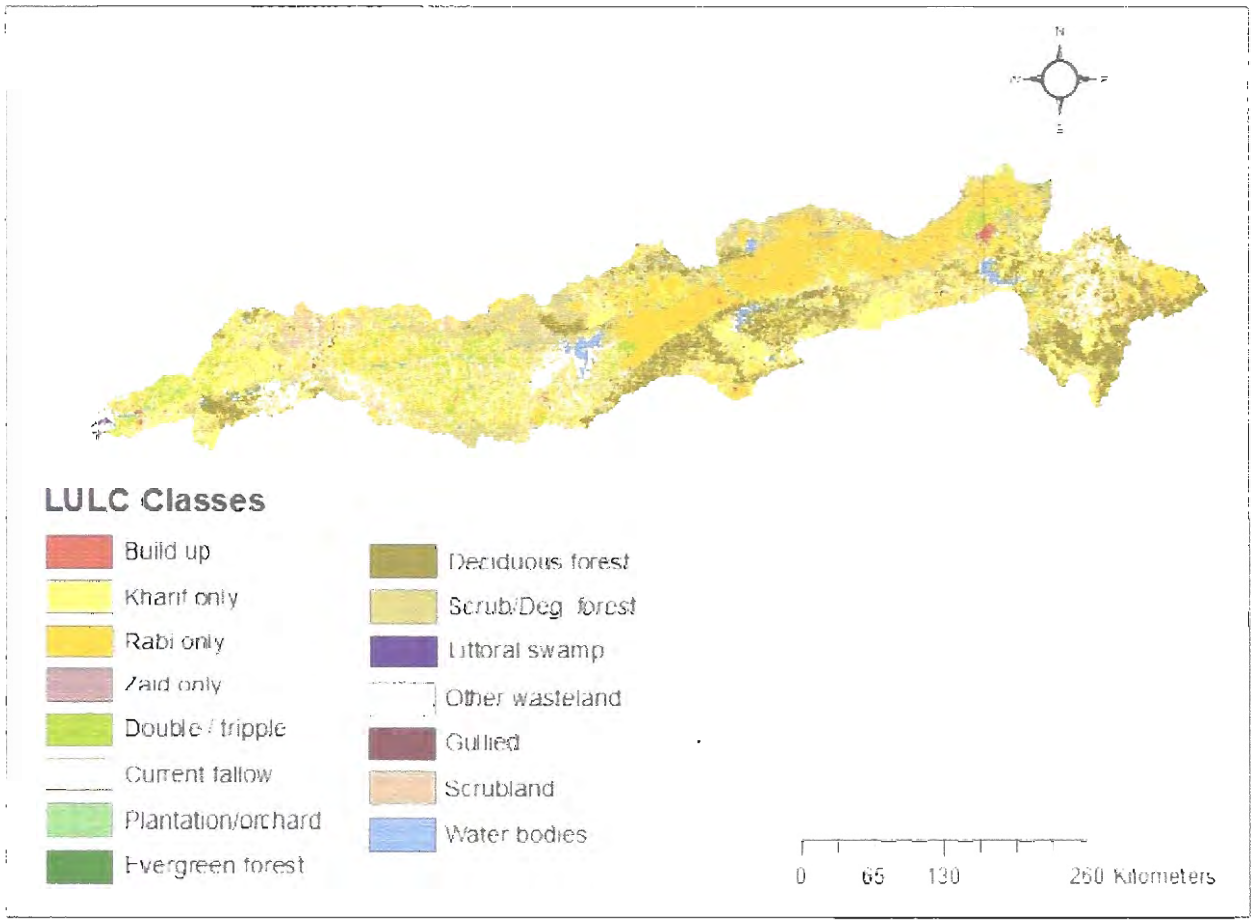


Fig. 2. Basin Map of Narmada River

Characteristics of Narmada Basin

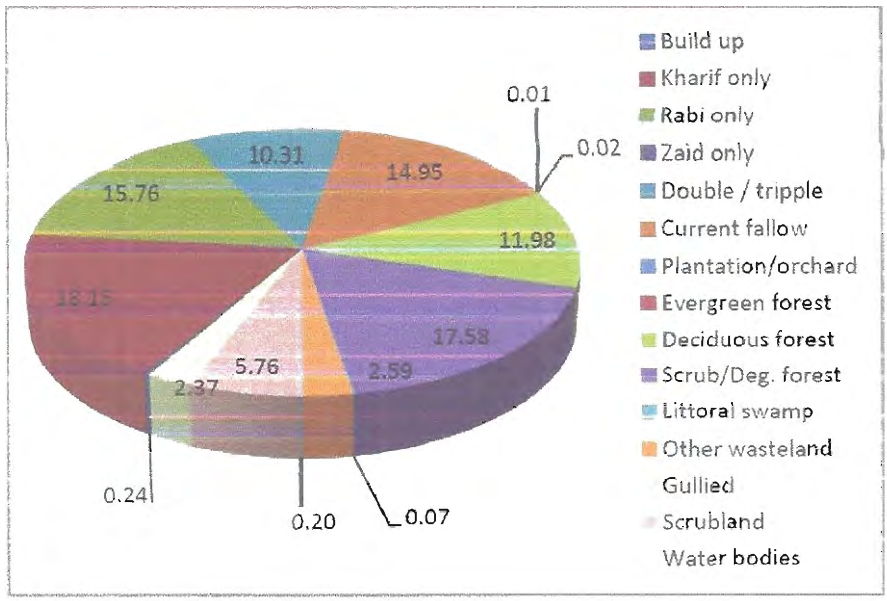
Land Use and Land Cover

The Land Use and Land Cover (LULC) map and distribution chart of Narmada basin for year 2004-05 is shown in following figure. The LULC analysis indicates that Kharif (18.15%), Rabi (15.76%), fallow (14.95%), Double/Triple crop (10.31%), deciduous forest (11.98%) and scrub/degraded forest (17.58%) are the major classes in Narmada basin.



Source: Reassessment of Water Availability in India using Space Inputs, BPMO, CWC, 2019

Fig. 3. LULC map of Narmada basin (2004-05)

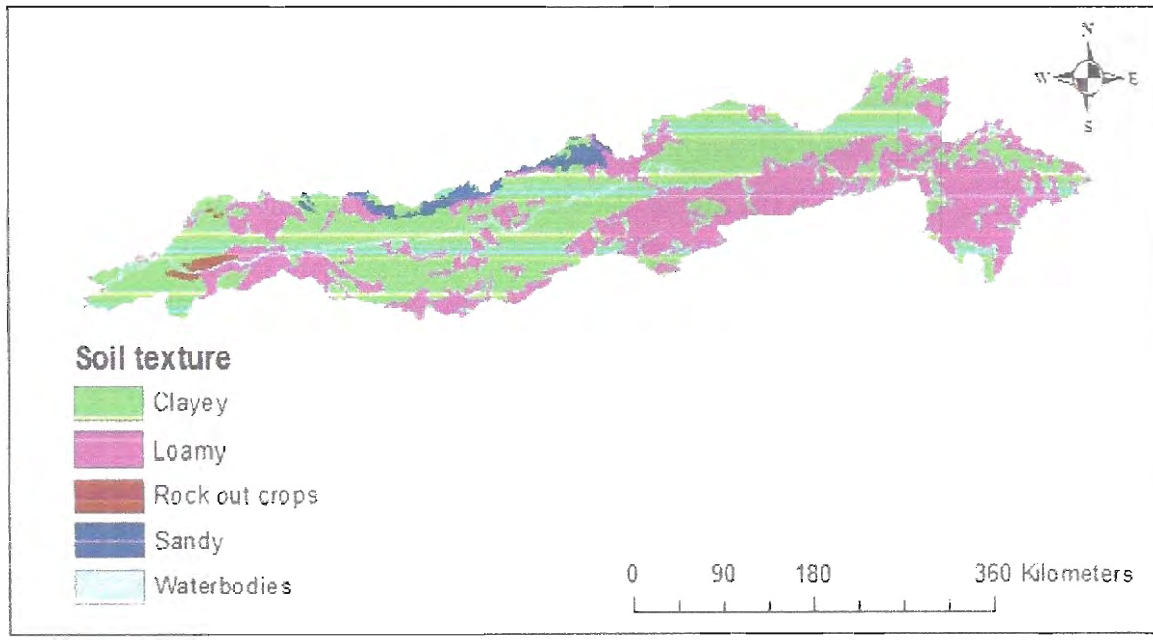


Source: Reassessment of Water Availability in India using Space Inputs, BPMO, CWC, 2019

Chart 1. Distribution of LULC in Narmada basin (2004-05)

Soil Texture

The main soil types found in the basin are clayey, loamy, sandy and rocky outcrop. Following figure shows various categories of soil in the basin.

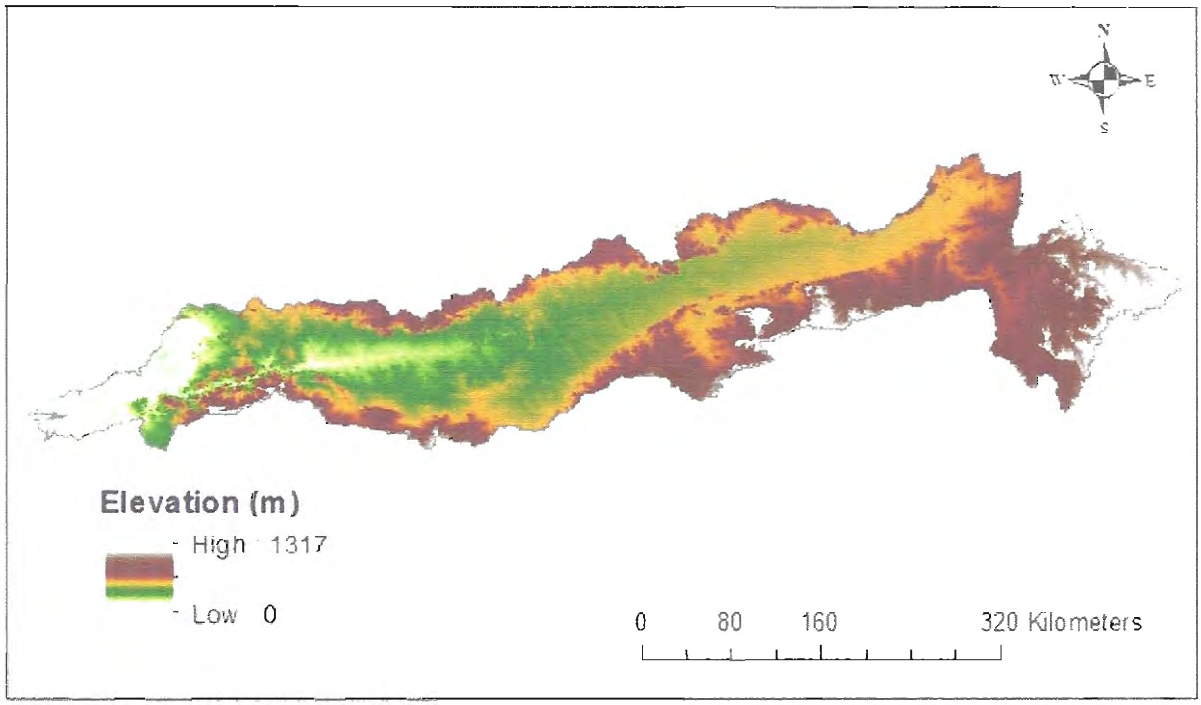


Source: Reassessment of Water Availability in India using Space Inputs, BPMO, CWC, 2019

Fig. 4. Soil texture map of Narmada basin

Topography

The topography of the basin mainly consists of forest areas and plateau. The upper regions of the basin are mostly hilly and forested. The lower region of the basin is deltaic plains. The elevation values ranges from a minimum of 0 m to a maximum of 1,317 m. Following figure shows Shuttle Radar Topographic Mission (SRTM) Digital Elevation Model (DEM) map of the basin.

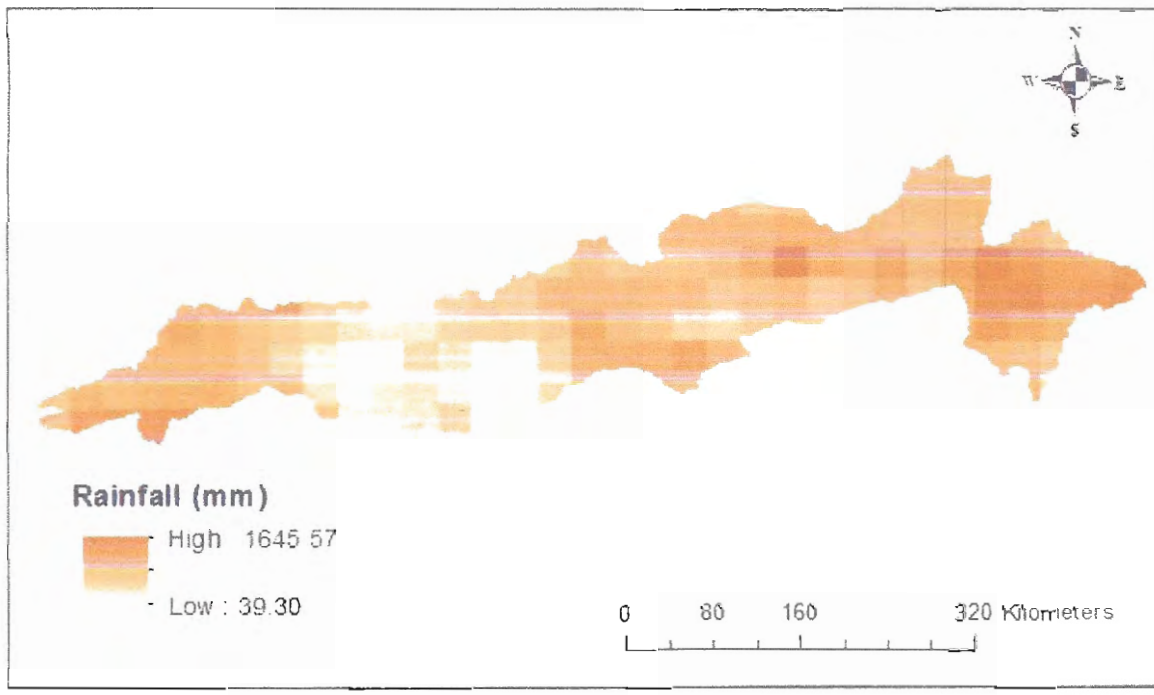


Source: Reassessment of Water Availability in India using Space Inputs, BPMO, CWC, 2019

Fig. 5. SRTM digital elevation map (DEM) of Narmada basin

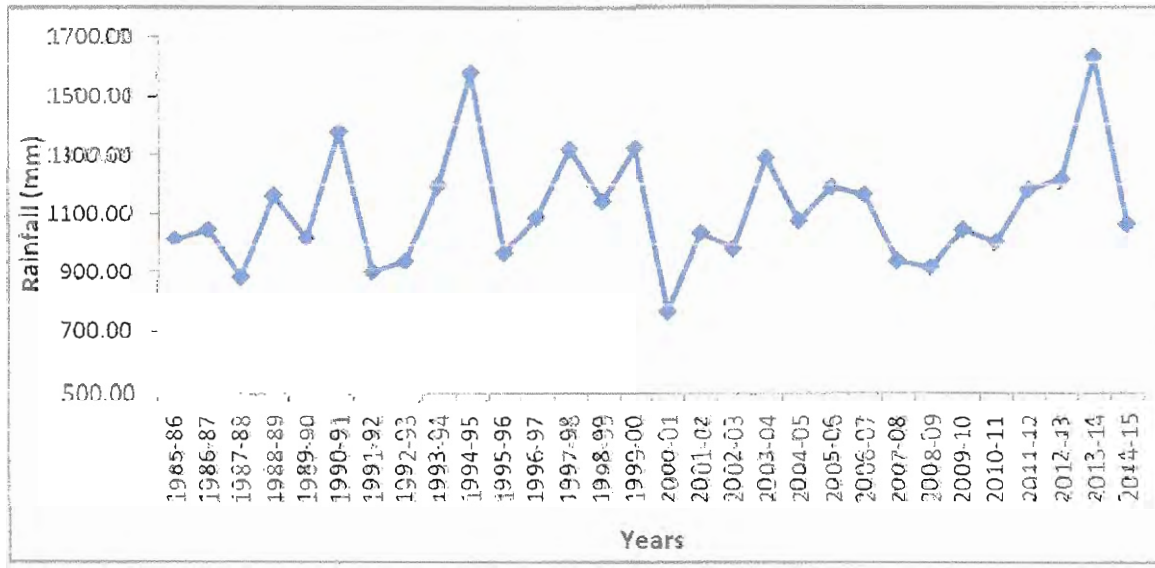
Rainfall Grids

The gridded annual rainfall map for year 2004-05 and the annual variations in the annual rainfall during 1985-86 to 2014-15 are shown in following figures. Annual rainfall of the basin varies from 762 mm to 1,630 mm.



Source: Reassessment of Water Availability in India using Space Inputs, BPMO, CWC, 2019

Fig. 6. Gridded rainfall of Narmada basin (2004-05)

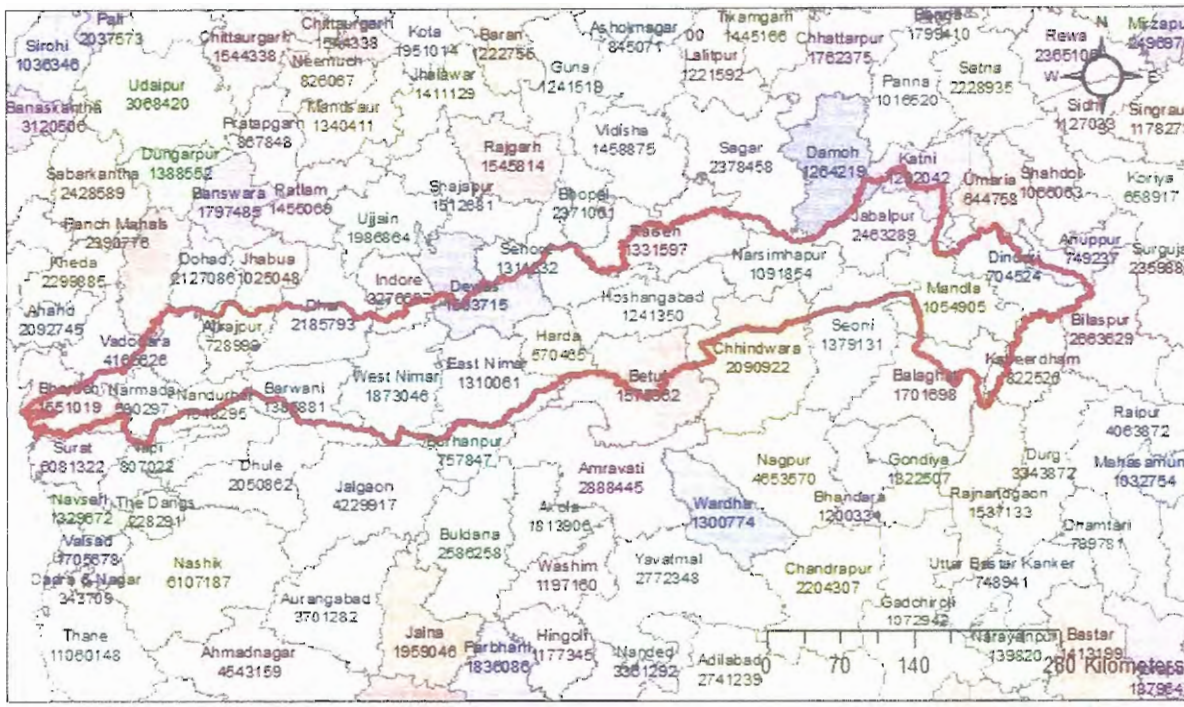


Source: Reassessment of Water Availability in India using Space Inputs, BPMO, CWC, 2019

Chart 2. Annual rainfall in Narmada basin (1985-86 to 2014-15)

Extent of Narmada Basin

Following figure shows the District boundaries in Narmada basin



Source: Reassessment of Water Availability in India using Space Inputs, BPMO, CWC, 2019

Fig. 7. District boundaries in Narmada basin

Master Plan for the Development of Narmada River Basin

In 1965, Government of India appointed a committee to develop a master plan for the Narmada Basin. The committee's recommendations were not accepted by the riparian states. 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. Its deliberations continued until 1979. The Tribunal considered the Sardar Sarovar Project and the Narmada Sagar Project together using the best available hydrological, engineering, and other evidence and passed the order which was notified in Gazette on December 12th, 1979.

Some Major Water Resources Projects on Narmada River

Bargi Dam

Rani Avanti Bai Sagar Dam (Bargi) was completed in June, 1988. A composite 69.8 meter high concrete dam and earthen flanks on main Narmada river near Bargi village of Jabalpur district. The culturable command area (CCA) of this projects is ~2.45 lakh

ha. This project generates 90 MW (2x45 MW) hydro power from River Bed Power House and 10 MW (2x5 MW) from Canal Bed Power House.

Indira Sagar Dam

The Indira Sagar Project (ISP) in Madhya Pradesh, upstream of Sardar Sarovar Dam, is a multipurpose project and comprises a 92 m high, 653 m long concrete gravity dam with a live storage capacity of 9750 MCM (7.9 MAF). A 248.65 km long flow canal with a head discharge of 160 cumec has been proposed to provide annual irrigation of 1.69 lakh ha and 74 MCM (0.06 MAF) drinking water to rural areas of Khandwa district. Hydro power generation from the dam is envisaged through a subsurface Power House with an installed capacity of 1000 MW (8 Units of 125 MW each) on the right flank of the dam. The project will also provide regulated releases of 10,015 MCM (8.12 MAF) to SSP, Ex-Maheshwar Dam, after generation of power at downstream projects viz. Omkareshwar and Maheshwar in Madhya Pradesh. The project was accorded investment clearance by the Planning Commission in September, 1989 for Rs.1993.67 crore at 1988-89 price level. The Govt. of Madhya Pradesh (GoMP) has accorded revised administrative approval at an estimated cost of Rs.2167.67 crore including cost of environmental safeguard measures being undertaken in the project area.

Omkareshwar Dam

The Omkareshwar multipurpose Project is situated 40 Km downstream of Indira Sagar Project in Madhya Pradesh. It envisages construction of 73 m high & 949 m long concrete dam across river Narmada near village Mandhata in Khandwa district of Madhya Pradesh and is planned to irrigate 2.833 lakh ha in culturable command area of 1.468 lakh ha annually and to generate power with an installed capacity of 520 MW (8x65 MW). Omkareshwar Project has been taken over by NHDC as a joint venture of GoMP & NHPC. The works of Unit-II (Canals) is with Govt. of Madhya Pradesh. After taking over of the Unit-I and Unit-III of the project by NHDC, the cost estimate has been revised and cleared by CEA for an amount of Rs.2224.73 crore at November, 2002 price level and the revised cost of Unit-II (Canals) of Omkareshwar Project is estimated Rs. 2175.59 crore at July-2007 price level.

Maheshwar Dam

The Maheshwar Hydel Project located about 40 Km downstream of Omkareshwar multipurpose project on main Narmada near Mandleshwar town in Khargone district of Madhya Pradesh envisages construction of 35 m high and 1047.5 m long Concrete Dam & Spillway with embankment of 1554 m and 492 m lengths respectively on left and right flank and a surface power house with a total installed capacity of 400 MW (10x40MW) on the right bank. After obtaining statutory clearance from the Ministry of Environment and Forests in January, 1994 and Techno-Economic Clearance of CEA, the

project has been awarded to Shree Maheshwar Hydel Power Corporation Limited (SMHPCL) for which power purchase agreement was signed by MPEB in November, 1994. The cost estimate of the project was revised from Rs. 465.63 crore to Rs. 1569 crore in December, 1996. The complete project cost based on the appraisal carried out at 2006 price level has been projected as Rs. 2760 crore.

Sardar Sarovar Dam

The Sardar Sarovar Project (SSP), a multi-purpose project involving Irrigation, Hydro Power and Drinking water benefits, is being executed as a joint venture of the four States of Gujarat, Madhya Pradesh, Maharashtra and Rajasthan. The project comprises a 1210 m long and 163 m high concrete gravity dam across the river Narmada in Gujarat with a live storage of 5800 MCM (4.73 MAF) water and 458.318 kms long concrete lined Narmada Main Canal (NMC) with a head discharge of 1133.55 cumec to irrigate 18.45 lakh ha annually in Gujarat and convey Rajasthan's share of 616 MCM (0.5 MAF) to irrigate 2.46 lakh ha of CCA in Barmer and Jalore districts of Rajasthan. The project envisages power generation through a River Bed Power House (RBPH) with an installed capacity of 1200 MW (6 x 200 MW) and a Canal Head Power House (CHPH) with an installed capacity of 250 MW (5 x 50 MW).

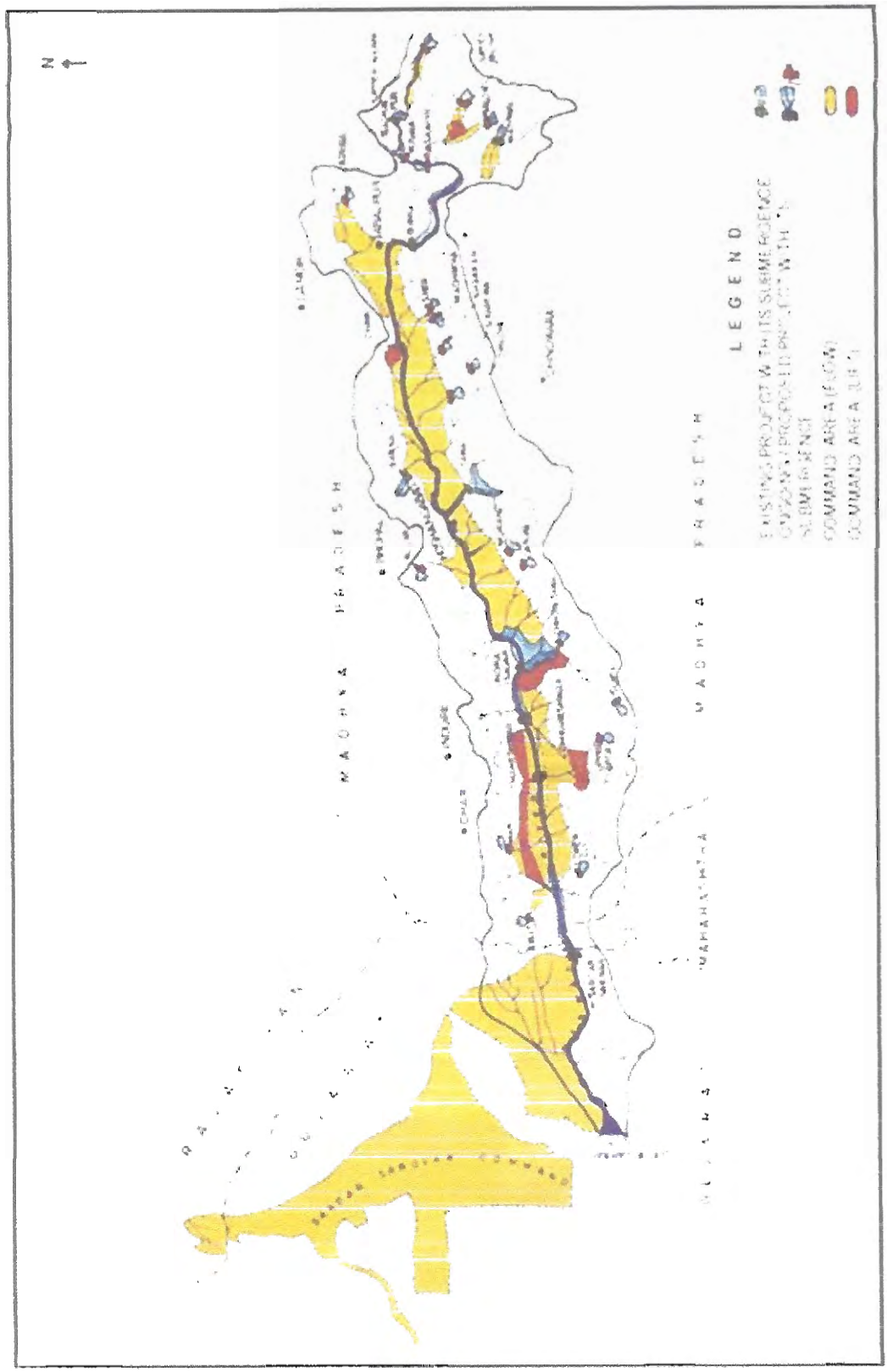


Fig. 8. Ongoing and Proposed Major Projects in Narmada Basin

Narmada Water Disputes Tribunal Award

In its 1979 award, the Narmada Water Disputes Tribunal made many of the most fundamental decisions about the Projects. These included the dam location, regulation of flows, reservoir levels etc. There are points in the Tribunal award that bear on the environmental aspects of Sardar Sarovar Project which are summarized below:

- The utilizable quantum of Narmada waters at the Sardar Sarovar dam site is specified at 28 MAF on the basis of 75% dependability.
- Apportionment is to be 18.25 MAF for Madhya Pradesh, Gujarat 9,00 MAF, Rajasthan 0.50 MAF, and Maharashtra 0.25 or in that ratio.
- The canal and dam water levels are fixed. Madhya Pradesh is to provide regulated releases of water from the Narmada Sagar Project to the Sardar Sarovar Project.
- The multi-purpose character of the project, including hydroelectric power, is affirmed.
- The apportionment /sharing of water are subject to review after 45 years.

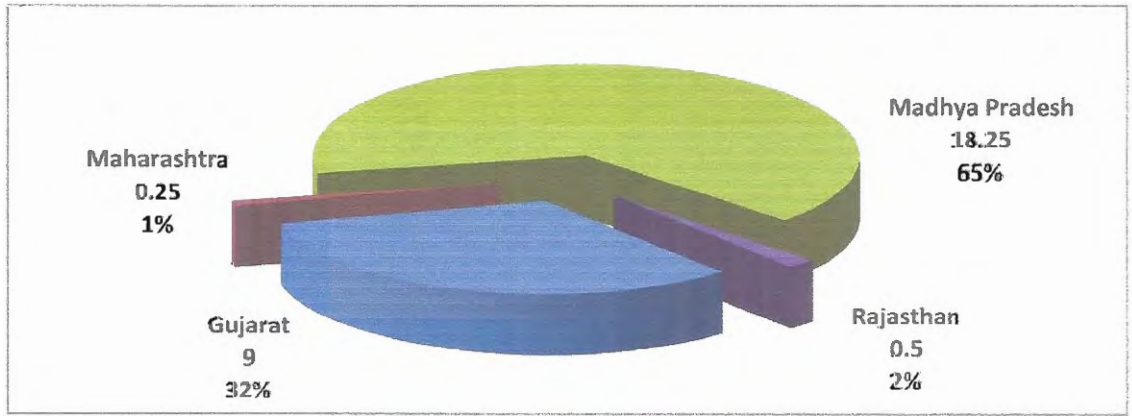


Chart 3. State's share of water (in MAF & percentage)

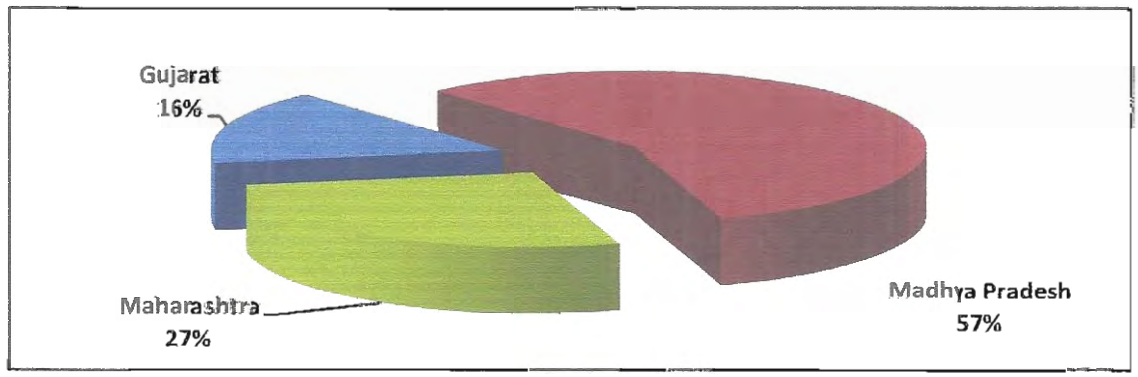


Chart 4. State's share of Power (in percentage) from Sardar Sarovar Power Complex

Table 1. Levels of SSP, ISP and NMC fixed under NWDT Award

Particular	Level (m)	Level (feet)
Sardar Sarovar Dam FRL	138.68	455
Sardar Sarovar Dam MWL	140.21	460
Indira Sagar Dam FRL	262.13	860
Narmada Main Canal FSL	91.44	300

Key Directives by NWDT on Environment & Rehabilitation

NWDT has covered the issues of Environment & Rehabilitation in its final order. Such issues along with relevant clauses of NWDT Award are detailed below:

Fisheries Development Clause- XI (sub-clause-V)

- V(7) "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(8) "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".

Archaeology & Anthropology

- Monitoring of the protection shifting/relocation/excavation of the monuments and mounds of archaeological significance being affected by the submergence of Sardar Sarovar, Narmada Sagar, (NWDT clause XI-sub-clause III (IV).

Downstream Environment

- Studies related to downstream scenario for estimating impacts of project activities (NWDT clause IX (vii) related to indenting of water for downstream by Gujarat.

Rehabilitation

- Clause XI (sub clause I to VI) deals with the provision for rehabilitation of oustees (PAFs) from submergence area of Sardar Sarovar Project who are likely to be resettled in Gujarat or in their home states.

Environmental Clearance by Government of India

It is recognized 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 Jal Shakti (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.

History of Environment Clearance for Sardar Sarovar Project

Effective 1985, the catchment area treatment plans to form a part of project report for seeking clearances from the Central Government. In case of Sardar Sarovar Project, being a major inter-state project the extent of area to be treated, the head upto which costs of treatment could be charged and the manner in which these costs could be shared was to be worked out. These issues mainly remained unresolved for a long time for various reasons.

Following the decision of committee of secretariat, to study the status of degradation in catchment of Narmada river basin, The Ministry of Agriculture on advice from Planning Commission appointed in September 1984 a committee under the chairmanship of Dr ML Deewan. The report submitted during August 1985 revealed that about 33% of the entire freely dining area of Narmada basin was degraded and required treatment at an estimated cost of Rs. 580 crores in 10 years time. For delineating degraded areas in catchment the committee suggested detailed prioritization survey of the catchment. The directives of the Committee of the Secretaries from Planning Commission was that catchment area treatment has to be an integral part of the River Valley Project development. It was also directed that catchment area treatment should be the responsibility of concerned department coordinated by the State Governments.

For the Sardar Sarovar and Indira Sagar projects, the plans for CAT and CAD needed for grant of clearance were not in place, hence the issue was referred to the Honorable PM during December 1986 with the recommendation that the subject to specific conditionality, projects may be given clearance from environmental angle as a special case. Issues brought out by the MoEF were considered by the PMO and after due

consideration and modification in the conditionalities suggested by the MoEF, during the meeting chaired by the then PM Shri Rajiv Gandhi, the projects were approved for a clearance on 13th April 1987. After needed steps were taken by all the concerned to ensure implementation of the conditions agree to on 13th April 1987, a formal order of clearance was issued by the MoEF on 24th June 1987.

Amongst others, one of the conditions was that the plants for treating of the degraded catchment would be drawn up and implemented ahead of Reservoir filling and that the detailed survey for preparation of plan would be completed within two to three years time. The order of clearance of 1987 and 1988, read with the status not presented to the PMO during 1986 and also circulated thereafter by the Ministry of Environment and Forest during 1988 spell doubt that degraded catchment within the entire free draining area of the projects shall be treated Pari passu with construction works on the projects.

Works on the preparation of CAT plans started soon thereafter. On the request of NCA and party States, AISLUSO took up the delineation of degraded areas of Narmada river catchment and submitted its report during April 1991.

Since the area to be treated was large, discussion started regarding the extent of area and the cost of its treatment. MoWR suggested that water resources project should not be unduly burdened with CAT fox and that such works should be done under National programs/schemes. MoEF insisted treatment of critically degraded sub-watershed in the entire free draining catchment of the projects as precondition of the clearance order of June 1987. On the advice of MoEF, MoWR requested Committee of Secretaries to deliberate on the issue.

The committee advised on the extent and chargeability of catchment area treatment for water resources projects. MoWR issued guidelines in July 1992 that for the SSP and ISP the project would bear the costs of treatment of all critically degraded sub-watersheds raining directly into the reservoir. These watersheds were identified amongst those classified as either very high or high priority categories by the AISLUSO. The project would also be responsible for the treatment of those areas of the catchment which are directly damaged by the project activities. In addition, plants are required to be prepared for the treatment of the balance of critically degraded sub-watersheds but the cost of this will be met from other ongoing schemes and in a time frame to be determined by the MoEF the at the time of clearance.

Role of Narmada Control Authority

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 its 12th meeting held in 1983 and sought more information & data on certain parameters of Environmental impact & management which 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 and data were considered and the Sardar Sarovar in Gujarat was formally cleared from environmental angle on 24th June 1987 by the Ministry of Environment & Forests, Government of India. 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.

Following the recommendations of the Ministry of Environment & Forest, the scope of the Narmada Control Authority was enlarged on 3th June 1987 through amendment brought out by MoWR through gazette notification. The functions of NCA were modified to include major functions of coordination & direction of the implementation of all the projects including the environmental protection measures to ensure the faithful compliance of the conditions attached by GOI while granting clearance to these projects. The NCA, originally as envisioned by the NWDT, consisted of 7 nos. of high ranking Engineers as Members, was expanded and made Multidisciplinary by inducting Union Secretaries of the Ministries of Environment & Forests, Social Justice and Empowerment, Ministry of Power, Ministry of Tribal Welfare as Ex-officio Members. In addition, Chief Secretaries of the States of Gujarat, Madhya Pradesh, Maharashtra and Rajasthan were also inducted as Members. One Full Time Member of the discipline Environment & Rehabilitation was added to the existing Full Time Members of the discipline Civil and Power Engineering. The Union Secretary of the Ministry of Water Resources was inducted as Ex-officio Chairman of the NCA.

Permission for diversion of the forestland was also subsequently accorded by the MOEF during October, 1987. The Investment Clearance for the Sardar Sarovar Project was received from the Planning Commission on 05th October 1988 at a cost of Rs.6406.06 crores thus paving the way for implementation of this project. 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.

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

- The Narmada Control Authority would ensure that the environmental safeguard measures are planned and implemented pari-passu with the progress of the work on the project
- 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

Forest Clearance for SSP

In September 1987, under the Forest (Conservation) Act, 1980 the Central government gave approval for the diversion of over 13,386 hectares of forest land for the Sardar Sarovar Project. This approval was subject to eleven conditions in all three states, of which the following four conditions are of special relevance:

- 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 forest lands in addition to the afforestation of equivalent non-forest land, and a scheme for this would be submitted
- Catchment area treatment plan will be prepared by November 30, 1987, failing which a central government team would be appointed at the cost of the project.

Investment Clearance for Sardar Sarovar Project

The original investment clearance was given for Sardar Sarovar Project in 1988. Due to inflation, price escalations, and other factors, the cost of the Project was revised multiple times. The history of cost revisions of Sardar Sarovar Project is as follows:

- The Planning Commission, Government of India approved investment for an estimated cost of Rs. 6,406.06 crores for SSP in Gujarat vide their letter dated 05th October 1988 at 1986-87 price levels.
- The cost of Sardar Sarovar Project was then revised to 13,180.62 crore at 1991-92 price level.
- The same was then revised to Rs. 39,240.45 crores at 2008-09 price levels on 20th May 2010.
- Final cost of Sardar Sarovar Project is Rs. 54,772.94 crores at 2014-15 price levels which was approved on 08th July 2016 by the Advisory Committee of MoWR in the 129th Meeting.

The Planning Commission of the Government of India granted the investment clearance to the Sardar Sarovar Project subject to seven conditions that bear on the environment as well as resettlement and rehabilitation.

- 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 benefits do, in fact, start accruing from the financial investment

Environment Sub-Group of NCA

The Hon'ble Supreme Court of India in its judgment dated 18th October 2000, in respect of Writ Petition no 345/94 filed by Narmada Bachao Andolan, gave due importance to environmental safeguard measures to be taken up. In this judgment, Hon'ble Supreme Court of India has mentioned that "Only when the incorporation of environmental aspects in the project planning was made a part and parcel of all river valley projects would there be hope to protect and preserve "our natural environment and fulfill the objective of rapid economic development on the sustained basis why safeguarding the natural resources including the air, water, land, flora and fauna for the benefit of present and future generations"".

The environment management has been a part of Sardar Sarovar Project since its inception. NCA had constituted among others, a sub-group namely Environment Sub-group under the Chairmanship of Secretary, MoEF, GoI. Member (E&R), NCA is Member Secretary to this Sub-group. The 51st Meeting of the Subgroup was held on 21st August, 2019.

Functions of the Environment Sub-Group

- 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 Indira Sagar and Sardar Sarovar Projects.
- 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.

- 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.
- 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.
- To assess the necessary organization with management capability being set up for adequate implementation of environmental safeguard measures.
- To undertake, all measures necessary to assist Narmada Control Authority in the planning and implementation of environmental safeguard measures.

Environment wing of the NCA

The Environment & Rehabilitation (E&R) wing of NCA is headed by Member (E&R), NCA, Indore. The organizational structure of the Environment Unit of the E&R wing is as follows:

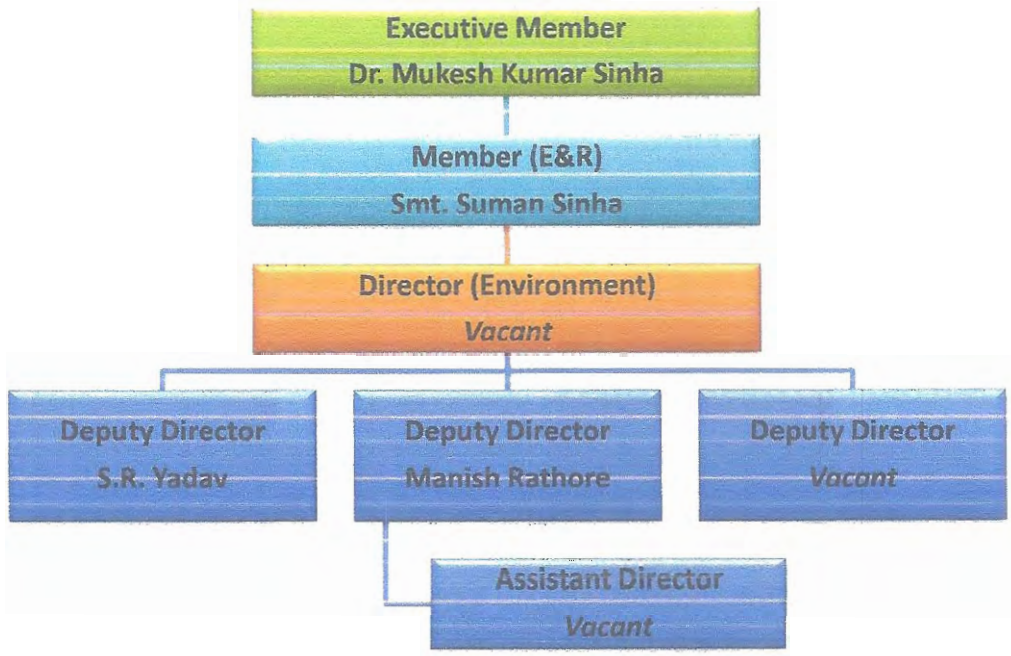


Chart 5. The organizational structure of the Environment Unit of the E&R wing

Important Sub-Groups and Sub-Committees on Environment

- Committee on Command Area Development. This committee is chaired by the Executive Member, NCA

- Environment Committee headed by the Member (E&R), NCA. This Committee visits the impacted areas in all the three states from time to time for assessing compliance and submits its reports to the sub-group and necessary recommendations are forwarded to concerned State Governments for compliance.
- High level expert group on fisheries development and conservation in Sardar Sarovar reservoir. This is chaired by the Joint Secretary, Ministry of Agriculture.
- Committee on flora and fauna aspect of Sardar Sarovar and Indira Sagar Project. This committee is chaired by Member (E&R), NCA
- Committee on archaeological and anthropological aspects. This committee is chaired by Member (E&R), NCA
- Committee on Health aspects. This committee is chaired by Member (E&R), NCA

There are four high level expert multi disciplinary groups directing, coordinating and monitoring various studies commissioned by Government of Gujarat for the vast command area of SSP formed in pursuance of the directives of the Environment Sub-group for initiating such studies. Director (Environment) is a member of the committee. Meeting of the expert group are convened by Narmada Planning Group (NPG) from time to time to discuss the progress/interim reports of the studies commissioned by the Government of Gujarat.

The Government of M.P. had constituted Wild Life Committee to review the environmental issues related with the SSP and ISP including studies, action plans and implementations.

The Sardar Sarovar Project

The Sardar Sarovar Project in Gujarat is the terminal project on the river Narmada. The Salient features of the Project are given below:

Salient Features

Location	Near village Navagam, Dist. Narmada
Height	163.00 m
Length	1,210.00 m
Gross storage	9.5 BCM (7.70 MAF)
Live storage	5.8 BCM (4.73 MAF)
Annual irrigation	19.80 lakh ha.
Installed capacity	1,450 MW (1200 MW RBPH + 250 MW CHPH)

Cost of Project (Estimated)	Rs. 6,406.06 crore (at 1986-87 price levels)
	Rs. 13,180.62 crore (at 1991-92 price levels)
	Rs. 39,240.45 crore (at 2008-09 price levels)
	Rs. 54,772.94 crore (at 2014-15 price levels)

Benefits

Irrigation	Gujarat 18.45 lakh ha
	Rajasthan 2.46 lakh ha
	Maharashtra 0.375 lakh ha (by lift)
Hydropower	RBPH 1200 MW
	CHPH 250 MW
	Total 1450 MW
Flood control	210 villages and Bharuch city 750,000 population
	Peak reduction in flood due to moderation effect

The Project

The height of the dam, the supply level of the canal and other levels of the Sardar Sarovar and Indira Sagar projects were fixed by the Award of the Tribunal. Thus submergence of the land, displacement of the people and related impacts also got fixed. Once it was determined that no environmental concern is serious enough to threaten the viability of the project what remained to be done was to identify the source of impacts and the impacts, their evaluation, quantification and assessment with an objective of devising mitigatory measures. In the following chapters the salient features of the twin projects have been briefly presented and the current status of the survey studies and implementation on the suggested parameters is briefly appraised. While resettlement & rehabilitation is dealt with separately other issues have been discussed in this report.

Additional benefits from the proposed project

- Drinking water supply to 135 urban centers and 8215 villages and Water supply for industries in Gujarat and drinking water supply to 518 villages of Jalore District & 589 villages of Barmer District of Rajasthan.
- A special allocation of 0.86 MAF of water has been made to provide drinking water to 173 urban centers and 9490 villages within and out-side command in Gujarat for present population of 28 million and prospective population of over 40 million by the year 2021.

- All the villages and urban centers of arid region of Saurashtra and Kutch and all "no source" villages and the villages affected by salinity and fluoride in North Gujarat will be benefited.
- Water supply requirement of several industries will also be met from the project giving a boost to all-round production
- Wild life sanctuaries development and Fisheries development in command areas of Sardar Sarovar Project will enable better preservation of flora and fauna.

Source of Impacts: the submergence

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

Table 2. Areas coming under submergence in Maharashtra, MP & Gujarat

State	Culturable land (ha)	Forest land (ha)	Land under other uses (ha)	Total land (ha)	Affected number of villages
Madhya Pradesh	7,883	2,731	10,208	20,822	192
Maharashtra	1,519	6,488	1,592	9,599	33
Gujarat	1,877	4,166	1,069	7,112	19
Total	11,279	13,385	12,869	37,533	244

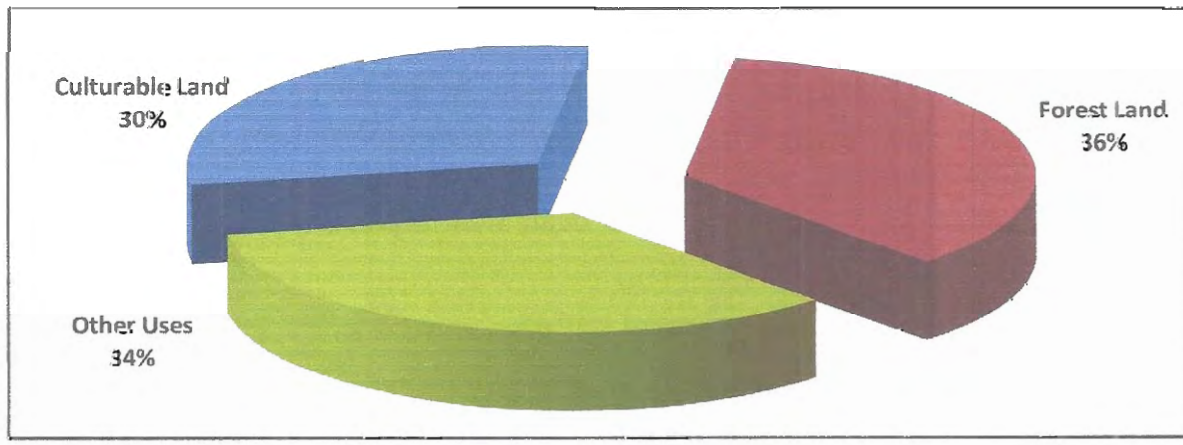
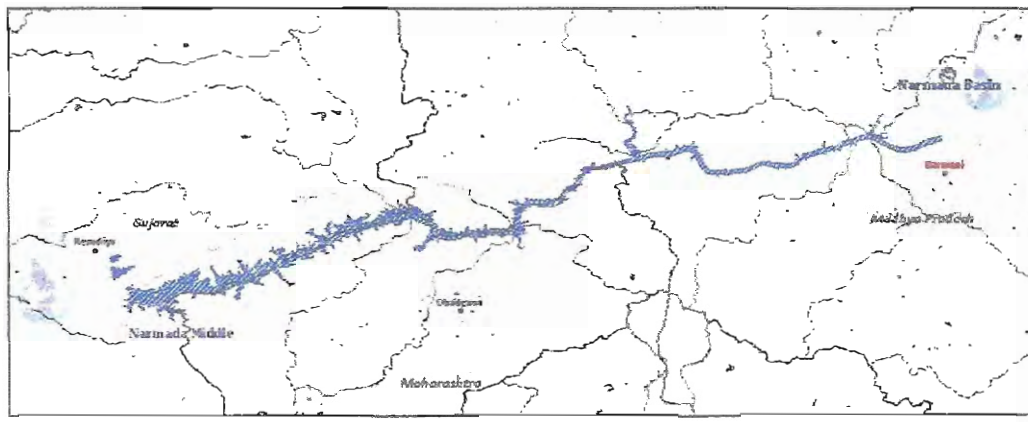


Chart 6. Land use pattern of land under submergence



Source: India-WRIS

Fig. 9. Map shows linear shape of the reservoir impacting lands of a narrow valley in the State of Gujarat, Maharashtra & Madhya Pradesh

Source: sardarsarovardam.org

Pic 2. View from upstream side of Sardar Sarovar Project)

Source: sardarsarovardam.org

Pic 3. View from downstream side of Sardar Sarovar Project

Pic 4. View of Sardar Sarovar Project with open spillway gates

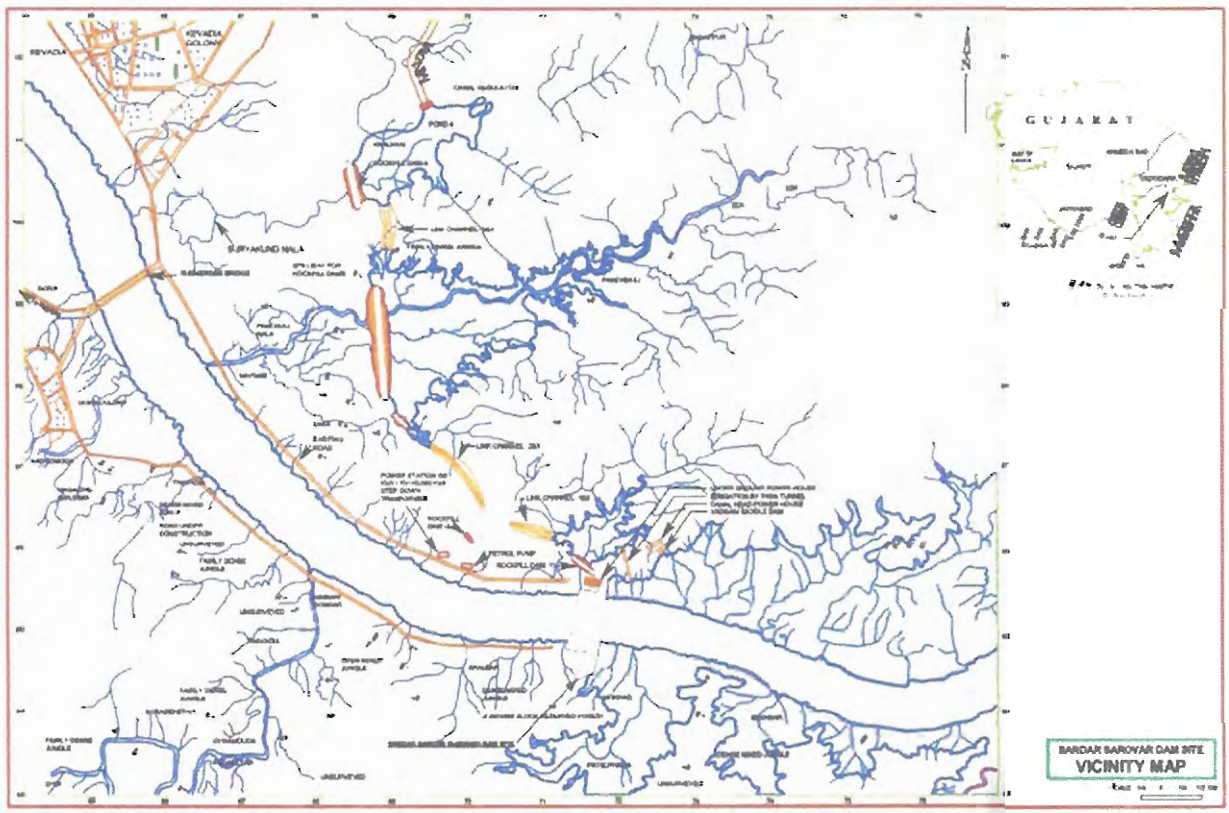


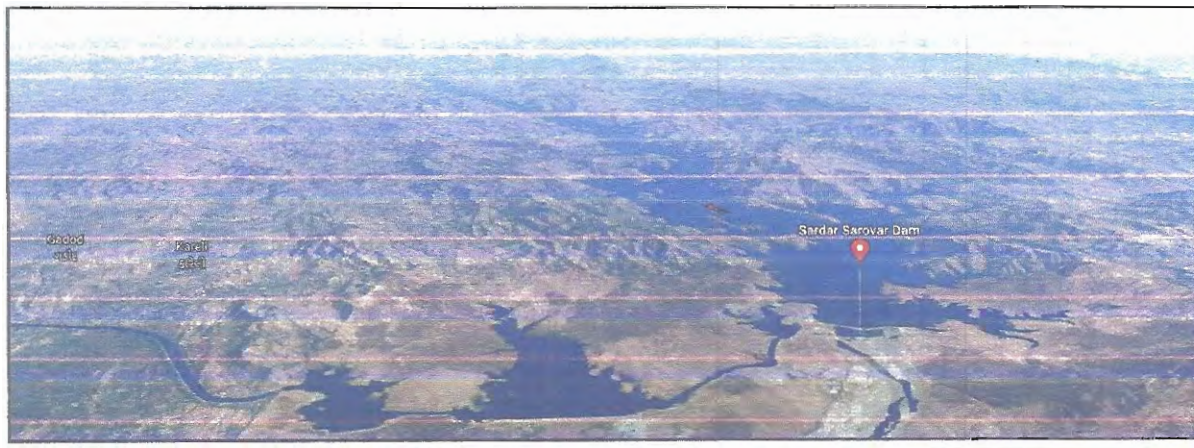
Fig. 10. Vicinity Map of Sardar Sarovar Project

Development and Current Status of the Management of SSP Environment

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

- Resettlement & Rehabilitation (separately dealt)

- Catchment Area Treatment
- Compensatory Afforestation
- Command Area Development
- Flora Fauna & Carrying Capacity of Surrounding area
- Seismicity
- Health
- Archaeology & Anthropological aspects



Source: Google Maps

Fig. 11. Bird's eye view of Sardar Sarovar Project

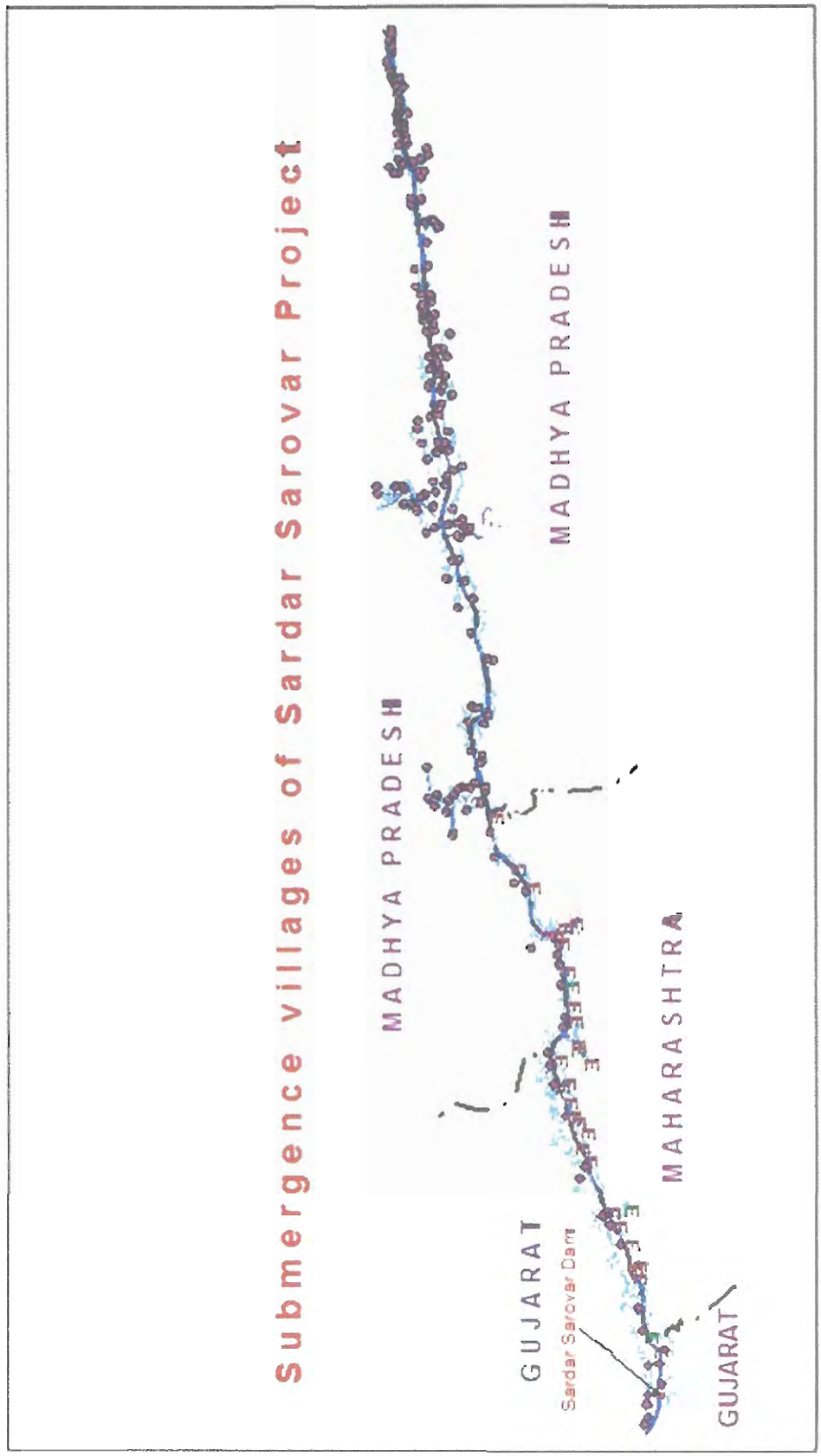


Fig. 12. Submergence villages of Sardar Sarovar Project

Chapter 2 Phased Catchment Area Treatment

Introduction

The study of erosion and sediment yield from catchment is of utmost importance as the deposition of sediment in reservoir reduces its capacity, thus affecting the water available for the designated use. The eroded sediment from catchment when deposited on streambeds and banks causes braiding of river reach. The removal of top fertile soil from catchment adversely affects the agricultural production and silt laden water affect the turbine blades thereby affect the hydro power production.

The lack of proper vegetal cover is a factor, which causes degradation and thereby results in severe run off/soil erosion, resulting in premature siltation of the reservoir. Thus, a well-designed Catchment Area Treatment (CAT) Plan is essential to ameliorate the above including process of soil erosion. The catchment area treatment involves the understanding of the erosion characteristics of the terrain and identifying/ suggesting remedial measures to reduce the erosion rate. For this reason, the catchment area responsible for directly draining rivers, streams, tributaries, etc. are treated and the cost is included in the project cost.

Following the directives of the Planning Commission for including requirement of a catchment area treatment and command area development plan while granting clearance from environmental angle, based on the report of Inter-Departmental Committee on Soil Conservation and Afforestation, (the Deewan Committee Report), 1985, the MOEF considered and granted clearance in 1987 with two key conditions related to catchment area treatment attached as follows:

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

Methods of Catchment Area Treatment

Afforestation

The trees and vegetation cover play an important role in the conservation of soil and ecology, as a vegetated patch of land will lead to lesser silt yield. When there is rainfall, the trees and vegetation acts as a barrier to the water flow and reduces the flow velocity. This reduces soil erosion. Due to the obstruction, velocity reduces and water percolates instead of flowing down. This allows infiltration of water into the soil.

Nala Bund

Nala bunds are embankments constructed across nalas for checking velocity of runoff, increasing water percolation and improving soil moisture regime.

Loose Boulder Structure

In this method, loose boulders are placed across natural nala and drains, creating obstruction in the flow of water. This is easy to construct and requires less manpower. This reduces the velocity of flow and promotes infiltration of water in soil.

Gully Control

In gully control method of catchment area treatment, the erosive water flow velocities are reduced by flattening out the steep gradient of the gully. This is achieved by constructing a series of check which transform the longitudinal gradient into a series of steps with low risers and long flat treads. This reduces the velocity of flow and promotes infiltration of water in soil.

Check dams

By creating check dams along natural drains, the water flow velocities are reduced. Also this creates small water ponds which promote infiltration. Additionally, the silt which is carried by the stream is deposited in those check dams and thus does not reach the main river.

Contour Bunding

Contour bunding is one of the simplest methods of soil and water conservation. It plays an important role in soil and water conservation in the field with medium slope. Contour bonding helps in soil and water conservation. When there is rainfall, contour bund acts as a barrier to the water flow and checks the velocity. This reduces chances of soil erosion. When water starts flowing along the fields, bund becomes obstruction for it. Due to the obstruction, velocity reduces and water percolates behind the bunds. This allows infiltration of water into the soil.

Pic 5. View of submergence area in Maharashtra

Studies

In pursuance, surveys and studies have been done during 1989-91 by the All India Soil & Land Use Survey, organization (AIS&LUS), New Delhi to aid the development of a management plan for CAT in the Sardar Sarovar catchment.

According to the above studies, the total catchment area of Sardar Sarovar Project below Indira Sagar Dam is 24,42,440 ha. Out of this 6,82,769 ha area spread to 500 sub-watersheds having silt yield index 1,200 and above was identified as critically degraded. The critically degraded sub-watersheds delineated by AIS&LUS (excluding directly draining sub watersheds) are shown in the map below:

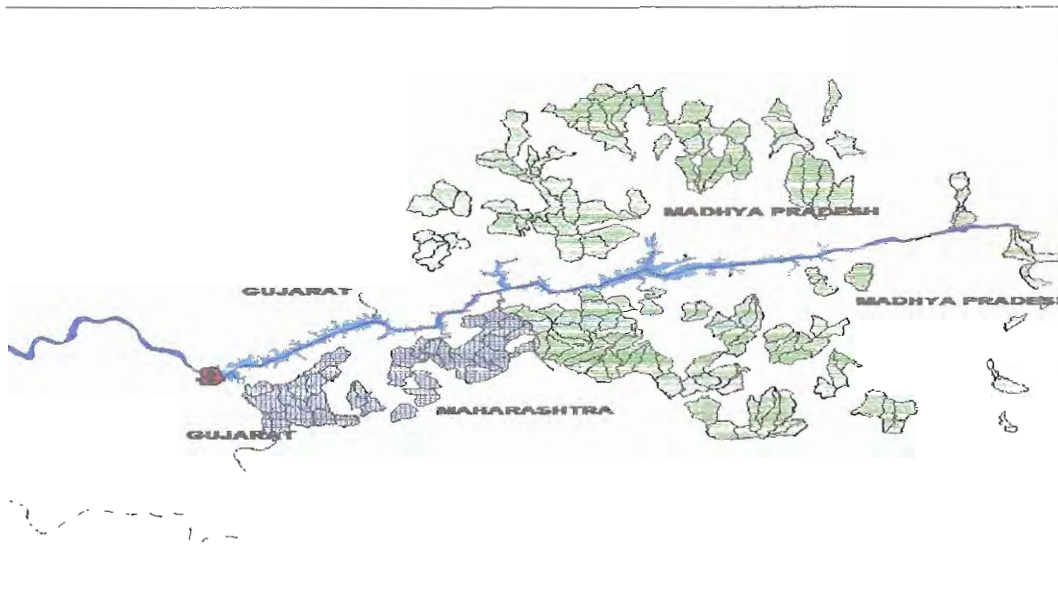


Fig. 13. Map showing the critically degraded sub-watersheds delineated by AIS&LUS (excluding directly draining sub watersheds)

Out of total SSP catchment, about 27.96% was found to be critically degraded and was required to be treated by the project authorities pari-passu with the construction works ahead of the reservoir filling. This was close to the estimation of Deewan Committee (1985) which estimated it to be 33%. Since the area requiring treatment was large, project authorities were of the opinion that such large areas should not be loaded on the water resources project. Since this opinion was at variance with the conditions contained in the order of clearance, the issue was referred to the Government of India. This issue was finally resolved by the Government of India by issuing a directive in July 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. These watersheds were to be identified amongst those classified as either very high or high-priority categories by the All India Soil & Land Use Survey (AIS&LUS).

- The project authority would also be responsible for the treatment of those areas of the catchment, which are directly damaged by the project activities.
- The plans are required to be prepared for the treatment of the balance of the critically degraded sub-watersheds but the cost of this will be met from other ongoing schemes and in a timeframe to be determined in consultation with the Ministry of Environment & Forests.

However the issue remained unresolved, Narmada Valley Development Authority expressed the view that in accordance with the order of clearance issued by MoEF in 1987, in addition to the critically degraded sub watersheds in the entire free draining catchment, downstream of Maheshwar project, the cost of treating upstream projects like Indira Sagar should also be chargeable to Sardar Sarovar project.

On a reference received from RC, NCA / NCA the issue was discussed in especially convene a meeting by the chairman of the Environmental Sub-group on 9th July 2007 and it was recommended that in accordance with the order of clearance, the cost of critically degraded sub-watershed in the entire freely draining catchment of Sardar Sarovar project (downstream of Maheshwar project) should be chargeable to Sardar Sarovar project.

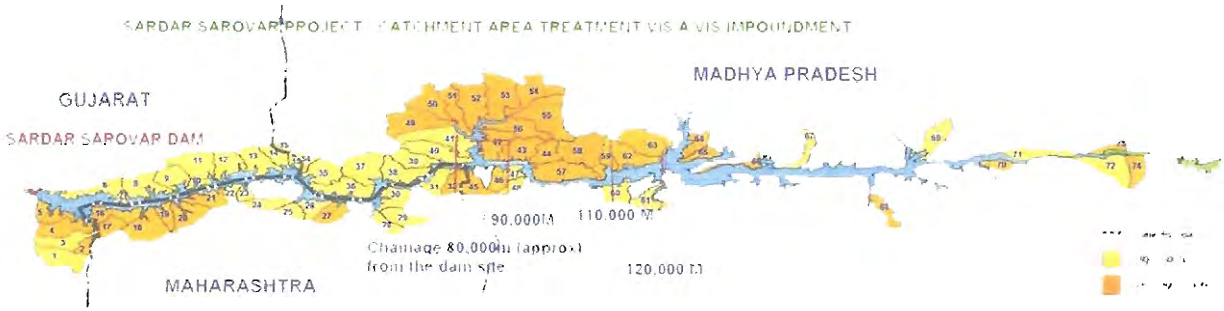


Fig. 14. Catchment area treatment (high and very high priority) vis-à-vis impoundment of SSP

Phase-I: Directly Draining Sub-watersheds

In terms of the directives of the GoI, selecting the sub-watershed identified as critically degraded on the basis of their proximity to the reservoir, project authorities prepared the plans for treating 7.34% (area of 1,79,180 ha) area out of 27.96% identified critically degraded for treatment pari-passu with the project works. Whereas, the balance area of 20.62% (5,03,589 ha) was proposed to be treated during Phase-II, as shown in the table below:

Table 3. Directly draining critically degraded sub-watersheds (in ha) originally planned to be treated under Phase-I and Phase-II

Particulars		Madhya Pradesh	Gujarat	Maharashtra	Total
Very High & High Degradability	Phase- I	1,25,725	29,157	24,298	**1,79,180**
	Phase- II	3,49,892	76,129	77,568	**5,03,589**
	Total	**4,75,617**	**1,05,286**	**1,01,866**	**6,82,769**

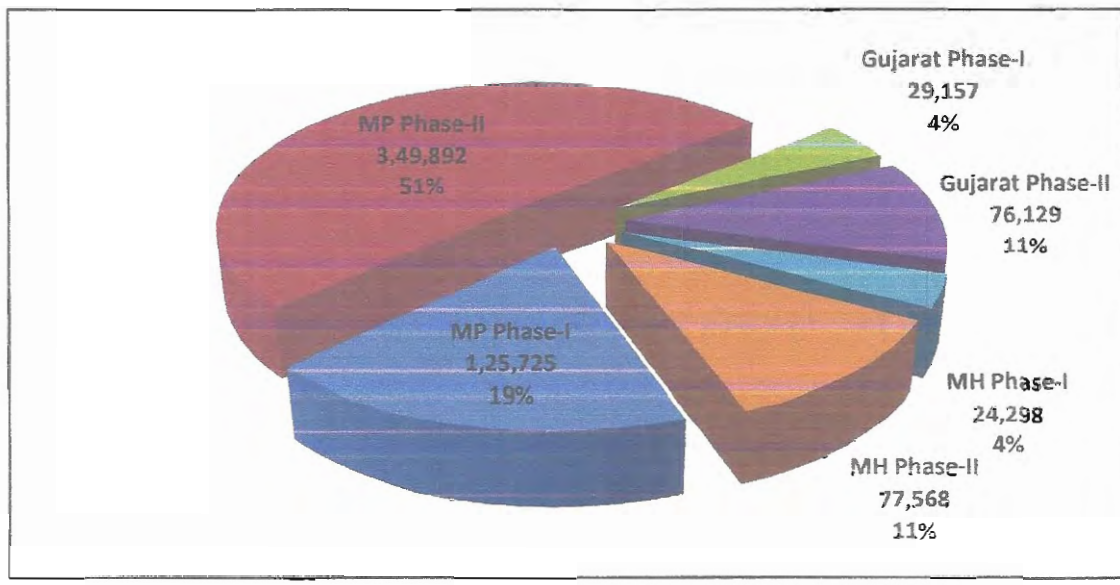


Chart 7. State-wise and phase-wise distribution of directly draining critically degraded sub-watersheds (in hectare & percentage) originally planned to be treated

Action Plans

The project authorities have submitted the Action Plans in varying stages of completeness. These plans contained information related to survey work, management

options, monitoring & phased programme of treatment besides provisions for annual budget. The sub-watersheds planned for treatment were delineated as shown below:

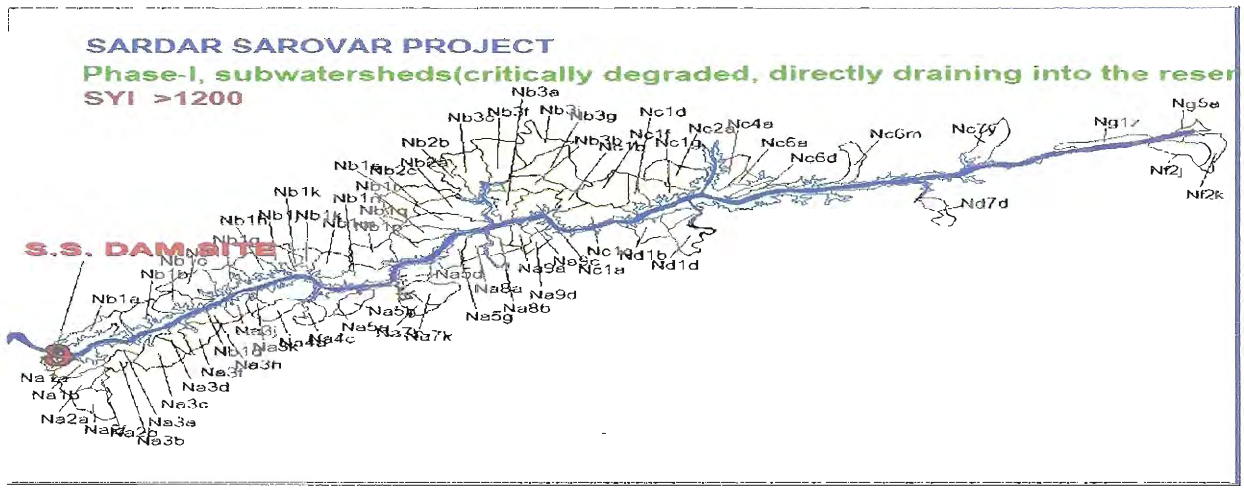


Fig. 15. Critically degraded sub-watersheds planned for treatment under Phase-I

Implementation

Project authorities have prepared the plans 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. However, out of 1,79,180 ha area planned for treatment micro-watershed, only 1,63,449 ha was identified as treatable as balance area was not available for treatment for being rocky or inaccessible. Following table shows the state-wise distribution of treatable areas (after deducting untreatable areas):

Table 4. Directly draining critically degraded sub-watersheds (in ha) under Phase-I and Phase-II which is considered treatable

Particulars		Madhya Pradesh	Gujarat	Maharashtra	Total
Very High & High Degradability	Phase– I	1,10,997	29,157	23,295	**1,63,449**
	Phase– II	2,62,165	500	43,125	**3,05,790**
	Total	**3,73,162**	**29,657**	**66,420**	**4,69,239**

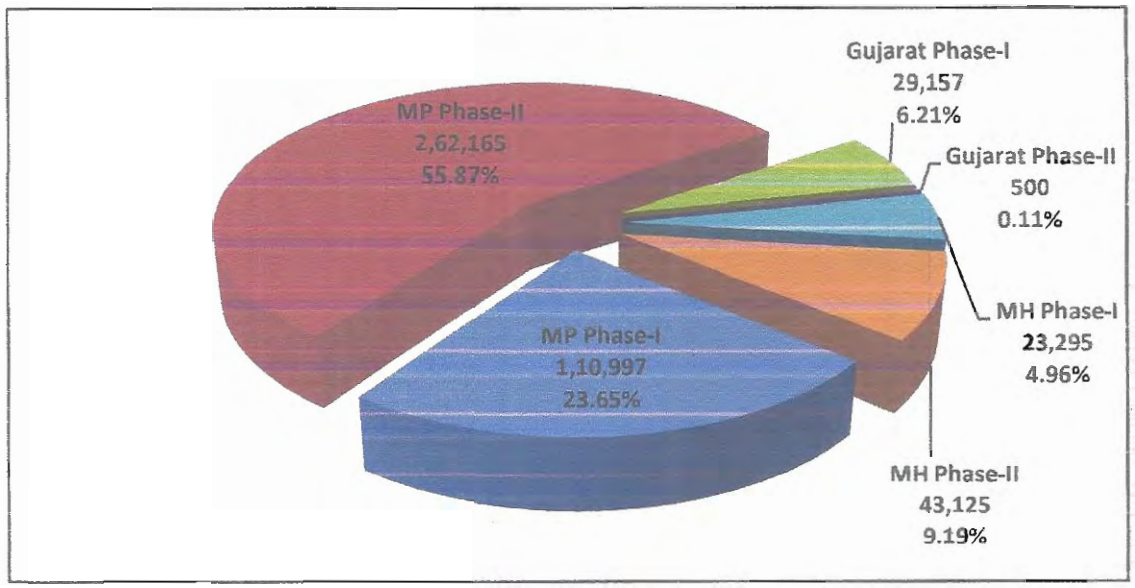


Chart 8. State-wise and phase-wise distribution of directly draining critically degraded sub-watersheds (in hectare & percentage) which is considered treatable

Current Progress

The progress of treatment work with new targets is detailed in the table below.

Table 5. Overall progress of Phase-I of Catchment Area Treatment (CAT) works

Particular	Area in hectare
Area planned for treatment	1,63,449 ha
Progress	1,63,449 ha
Balance	0 ha

Table 6. State wise progress of Phase-I of Catchment Area Treatment (CAT) Works

Particular	Madhya Pradesh	Gujarat	Maharashtra	Total
Catchment area below Indira Sagar Project	22,48,600	30,230	1,63,611	24,42,441
Very high and high degraded area as identified by AIS&LUS	4,33,740	30,230	1,00,993	5,64,963
Phase-I area: Directly draining very high and high degraded area	1,15,622	29,730	24,298	1,69,650
Phase-I area: Target after deducting untreatable area on account of being rocky / steep / slope, etc.	1,10,997	29,157	23,295	1,63,449
Phase-I area Achievement	1,10,997	29,157	23,295	1,63,449
Phase-I area Status	Complete	Complete	Complete	Complete

Table 7. Year wise progress of Phase-I of Catchment Area Treatment (CAT) Works

Year	Gujarat			Maharashtra			Madhya Pradesh		
Targets	FA 27,204	NFA 1,953	Total 29,157	FA 21,122	NFA 3,176	Total 24,298	FA 51,930	NFA 73,795	Total 1,25,725
1990-91	4,528	898	5,426	0	0	0	0	0	0
1991-92	4,770	230	5,000	0	0	0	0	0	0
1992-93	6,014	336	6,350	960	0	960	0	7,122	7,122
1993-94	6,000	286	6,286	6,514	322	6,836	966	6,001	6,967
1994-95	5,730	168	5,898	6,542	2,686	9,228	4,348	5,768	10,116
1995-96	0	35	35	4,735	4	4,739	4,390	9,351	13,741
1996-97	0	0	0	450	0	450	8,158	6,357	14,515
1997-98	0	0	0	1082	0	1082	4,441	3,732	8,173
1998-99	0	0	0	0	0	0	8,583	2,331	10,914
99-2000	162	0	162	0	0	0	2,830	3,247	6,077
2000-01	-	-	-	-	-	-	3,270	6,318	9,588
2001-02	-	-	-	-	-	-	2,233	4,221	6,454
2002-03	-	-	-	-	-	-	989	5,403	6,392
2003-04	-	-	-	-	-	-	1,040	5,657	6697
Total	27,204	1,953	29,157	20,283	3,012	23,295	41,248	65,508	106,756
Work by other agency :			0			0	3,352	889	4,241
Grand Total			29,157			23,295			110,997

Government of Gujarat

As the Catchment area of Sardar Sarovar was little in Gujarat, GOG accepted the recommendations of Deewan Committee and commenced the work of treating entire catchment area in the year 1990. By the end of September' 1995 forest area of 27,042 ha

& non-forest area of 1,953 ha were treated. Treatment work is completed. Government of Gujarat however revisited this area for maintenance under a programme referred to as Phase-II programme by Government of Gujarat. Under this programme casualty replacement were carried out besides other maintenance works. Thus by the end of September 2019, a total area of 29,157 ha was treated at the cost of the project.

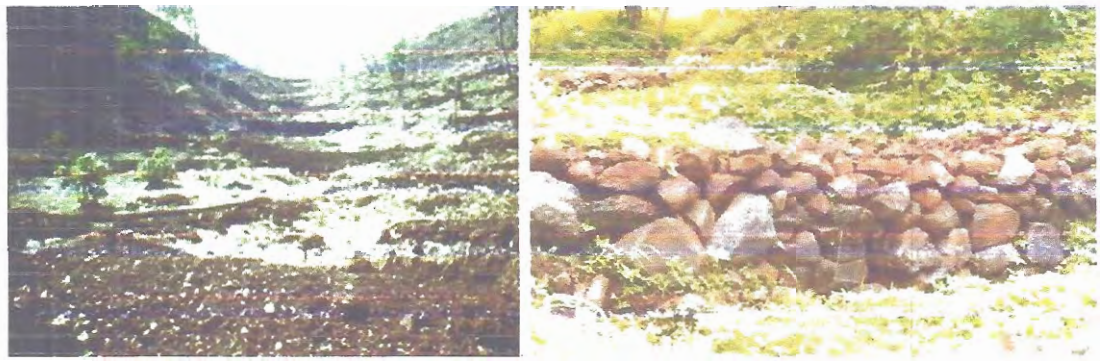


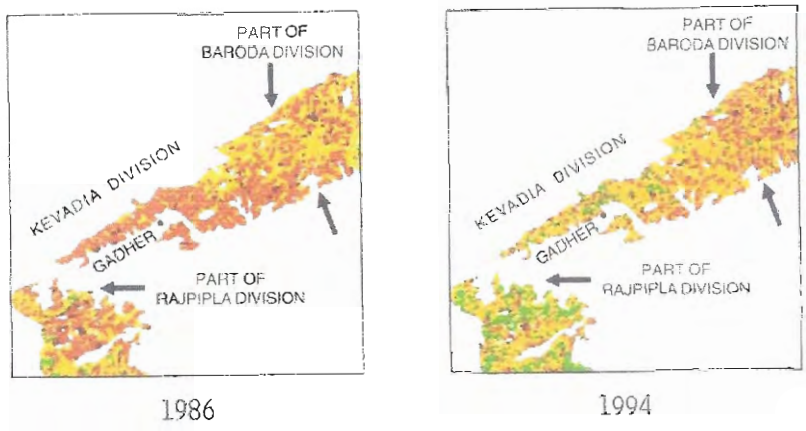
Fig. 16. Catchment Area Treatment works in Gujarat

COLOUR / CODE CLASSIFICATION

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

Source: SSP on Narmada: Meeting the Challenges of Development - SSNNL report

Fig. 17. Changes in the forest cover showing the impact of afforestation in catchment area from 1986 to 1994 in SSP catchment area – Part of Rajpipla Division



COLOUR / CODE CLASSIFICATION

Colour	Code	Class
	1.	Closed forest area
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	4.	Highly deg forest area/cultivation/grass growth

Source: SSP on Narmada: Meeting the Challenges of Development - SSNNL report

Fig. 18. Changes in the forest cover showing the impact of afforestation in catchment area from 1986 to 1994 in SSP catchment area – Kevadia and part of Rajpipla Division

Government of Maharashtra

Treatment works in Maharashtra could commence in the year 1992. Thus by the end of September 2019 an area of 23,295 ha was treated at the cost of the project against a target of 24,298 ha. The balance area of 1003 ha was not available for treatment for various reasons and thus the treatment of Phase-I areas was considered complete.

Pic 6. Catchment area treatment works in Rajasthan (Loose Boulder Structure, Water Harvesting Structure and Nala Bund)

Government of Madhya Pradesh

Treatment works in Madhya Pradesh could commence after submission of the revised work plan in 1992. By the end of March 2008 against a target of 1,08,757 ha, a total of 1,10,997 ha area (including both forest & non-forest areas) actually available was treated. This excluded treatment of 4,241 ha. area by other agencies previously. Thus an area of 1,06,756 ha was treated at the cost of the project.

Sardar Sarovar Project: Current Status

Targets and Achievements

- It was reported by Government of M.P. & Maharashtra that the balance areas were not available on account of being rocky / unproductive / under development / litigation and thus the targets of the CAT works chargeable to SSP were revised to 1,63,449 ha.
- Therefore for the available (treatable) areas in Gujarat & Maharashtra treatment works are complete.
- For the SSP as a whole, against the planned target of 179,180 ha of CAT works, an area of 1,63,449 ha was already completed and since the remaining areas in Maharashtra and M.P. are not available for CAT, this activity has been considered to be completed.

Outstanding works

- Assessment of the efficacy of the treatment works and consequential maintenance of the works till handed over to regular formations for regular upkeep & maintenance.

Assessment of the efficacy of the treatment works

To assess the success or failure of the CAT measures implemented at the cost of huge investments and for ensuring that structures were maintained and remained functional monitoring through establishment of silt studies stations / remote sensing was directed by the Sub-group. During the 40th meeting, while reviewing the progress and arrangements made for the purpose, it was directed that dedicated and focused monitoring for assessment of the CAT works should be a continuous process and arrangements made for the same should be continued.

Government of Gujarat

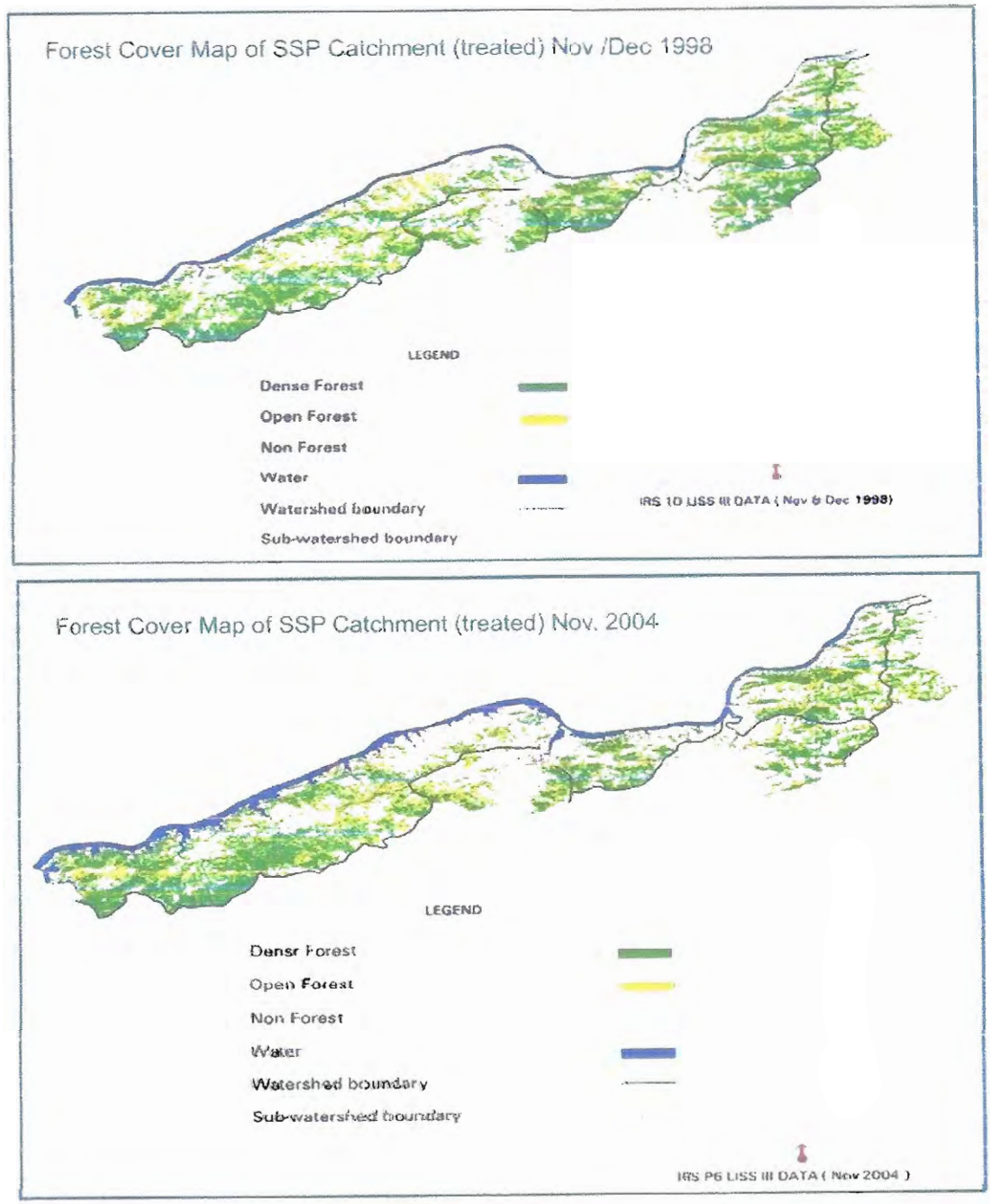
Catchment Area Treatment works was started by Government of Gujarat from 1990. However the results of analysis conducted by ISRO, Ahmedabad compared data of 1986 with that of 1994. By 1994 more than 90% of the work was completed by the GoG. Updating of this data was suggested by the Environment Sub-group. For non forest areas the work to estimate the efficacy of catchment area treatment was entrusted to CSR&TI.

Pic 7. Part view of the sub-watershed where observations for efficacy of catchment area treatment works were made

Government of Maharashtra

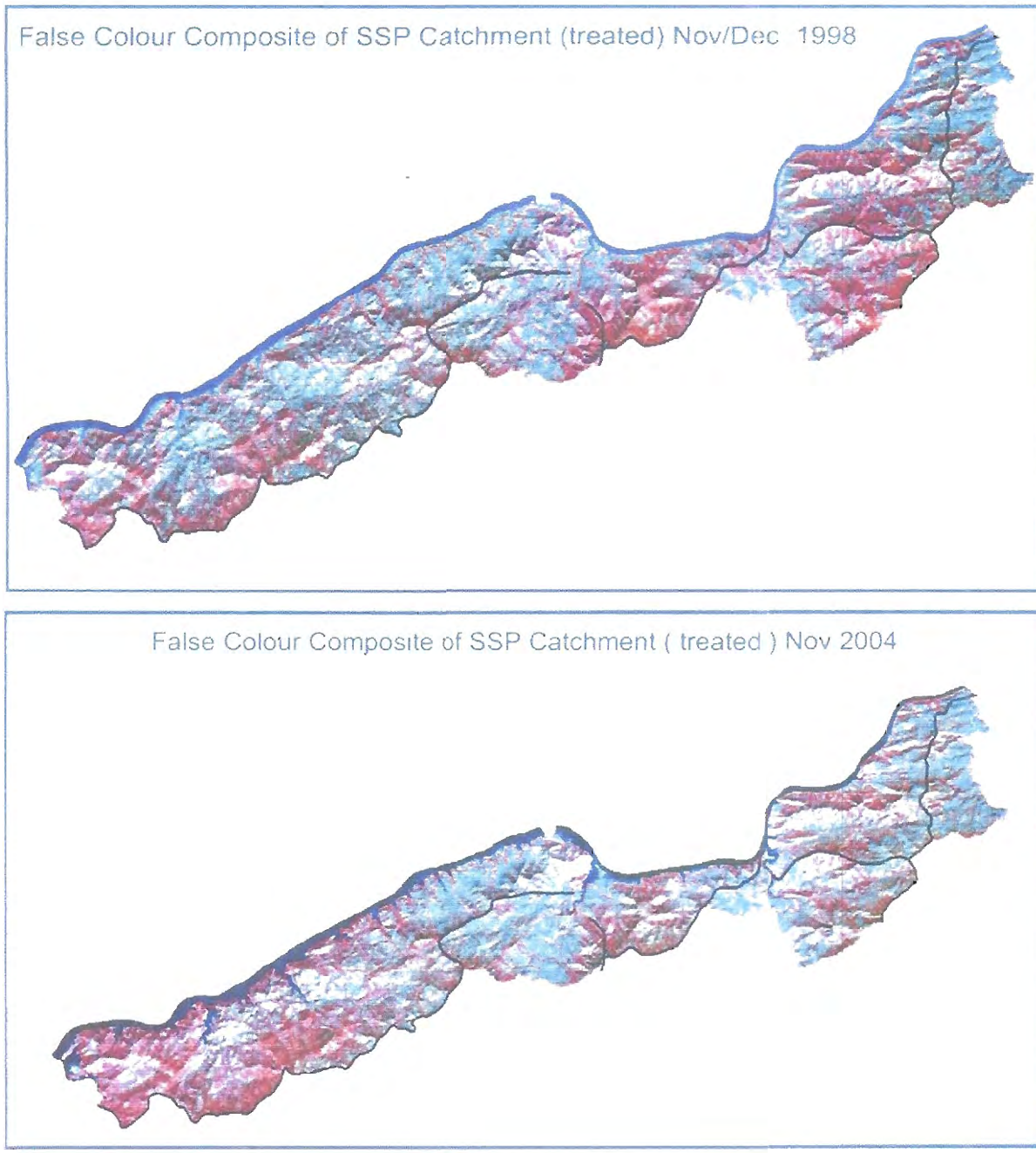
The result of the studies carried out jointly by the Maharashtra State Forest Department Dhule, for the period 1993 to 1998 indicated the increase in dense forest and decrease in blanks. Updating of this data was suggested by the Environment Sub-group. For non

forest areas GoM have addressed Central Soil Research and Training Institute for taking up assessment works for SSP catchment in Maharashtra. Two stations have been established and were expected to be in the operation from June, 2005/2006 with the help of WCR&TI located in Gujarat, a Government of India agency, at an estimated cost of Rs.16.56 lakh which includes consultancy charges of Rs.13.56 lakh.



Source: Forest Cover Change Study in Catchment of SSP in Maharashtra, FSI, Central Zone, Nagpur

Fig. 19. Change in forest cover map (true colour) of SSP catchment in Maharashtra 1998 v/s 2004showing the impact of catchment area treatment



Source: Forest Cover Change Study in Catchment of SSP in Maharashtra, FSI, Central Zone, Nagpur

Fig. 20. Change in forest cover map (FCC) of SSP catchment in Maharashtra 1998 v/s 2004showing the impact of catchment area treatment

Government of Madhya Pradesh

Government of Madhya Pradesh is making arrangements for dedicated focused monitoring for the areas treated and has addressed Forest Survey of India for its periodical reports and Central Soil and Training Research Institute for forest / non forest areas respectively.

Phase-II: Indirectly Draining Sub-watersheds

Project authorities were required to treat the balance of the critically degraded sub-watersheds. The current progress of treating Phase-II (Indirectly Draining Sub-watersheds) is shown in following table:

Table 8. Overall progress of Phase-II of Catchment Area Treatment (CAT) Works

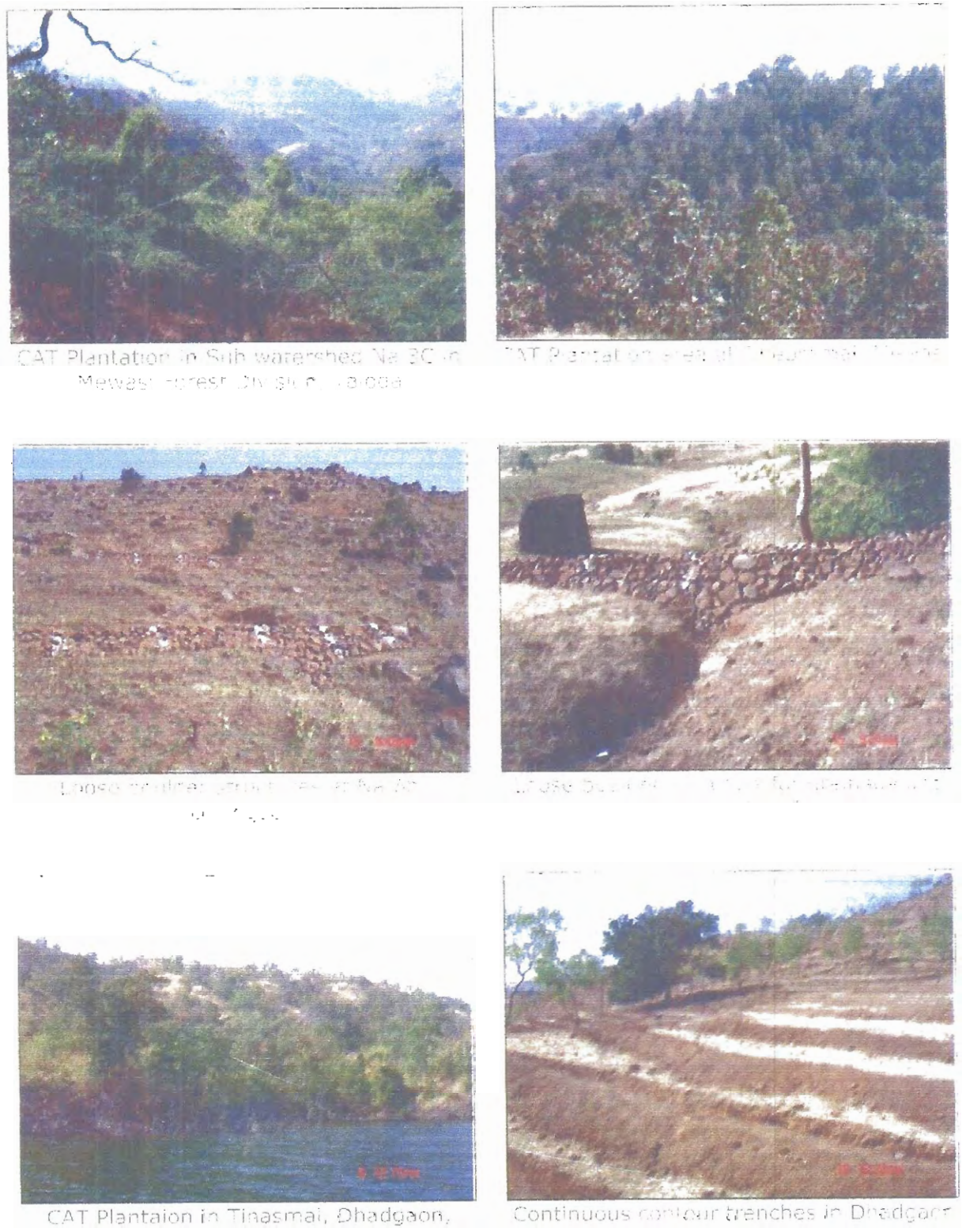
Particular	Area in hectare
Area planned for treatment	3,05,790 ha
Progress	3,05,790 ha
Balance	0 ha

Table 9. State wise progress of Phase-II of Catchment Area Treatment (CAT) Works

Particular	Madhya Pradesh	Gujarat	Maharashtra	Total
Catchment area below Indira Sagar Project	22,48,600	30,230	1,63,611	24,42,441
Very high and high degraded area as identified by AIS&LUS	4,33,740	30,230	1,00,993	5,64,963
Phase-II area: Freely draining very high and high degraded area	3,18,118	500	77,568	3,96,186
Phase-II area: Target after deducting untreatable area on account of being rocky / steep / slope, etc.	2,62,165	500	43,125	3,05,790
Phase-II area Achievement	2,62,165	500	43,125	3,05,790
Phase-II area Status	Complete	Complete	Complete	Complete

Maharashtra

Catchment area of Sardar Sarovar Project below Indira Sagar in Gujarat is 1,63,611 ha. The gross area of critically degraded sub-watersheds is 1,10,993 ha. Out of this, Government of Maharashtra had prepared plans for treating 77,568 ha area under Phase-II, as described in table above, under directly draining category at the cost of the project. Out of this, only 43,125 ha area was found treatable. Presently 43,125 ha area has been treated pari-passu with the construction of project and thus the catchment area treatment work is considered complete.

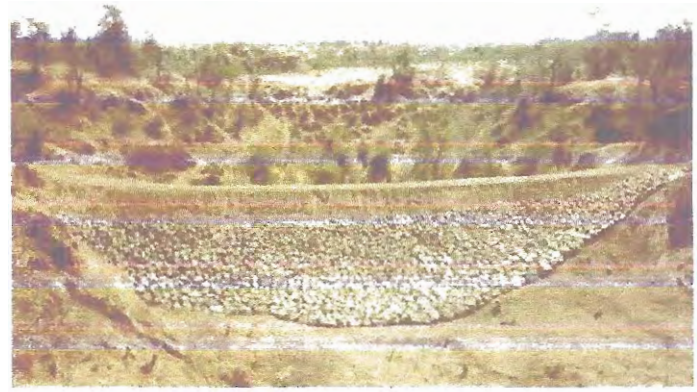


Source: Environmental Safeguard Measures in Maharashtra: A Status Report, Nov 2010

Pic 8. Some photographs of catchment area treatment works in Maharashtra

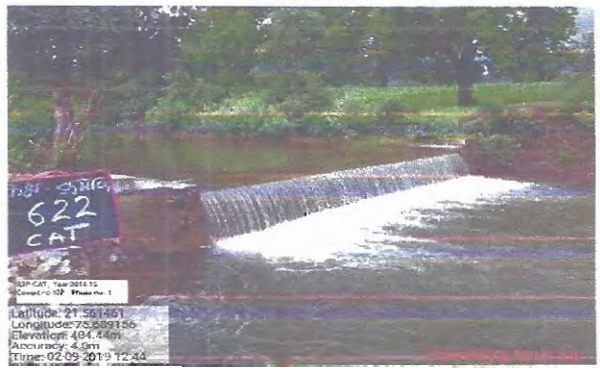
Madhya Pradesh

Catchment area of Sardar Sarovar Project below Indira Sagar in Madhya Pradesh is 22,48,600 ha. The gross area of critically degraded sub-watersheds is 4,33,740 ha. Out of this, Government of Madhya Pradesh has prepared plans for treating 3,18,118 ha area, as Phase-II, as described in table above, under directly draining category at the cost of the project. Out of this, only 2,62,165 ha area was found treatable. Presently 2,62,165 ha area has been treated pari-passu with the construction of project and thus the catchment area treatment work is considered complete.



Pic 9. Picture showing catchment area treatment works in Madhya Pradesh

Some latest pictures showing efficacy of catchment area treatment works are as follows:

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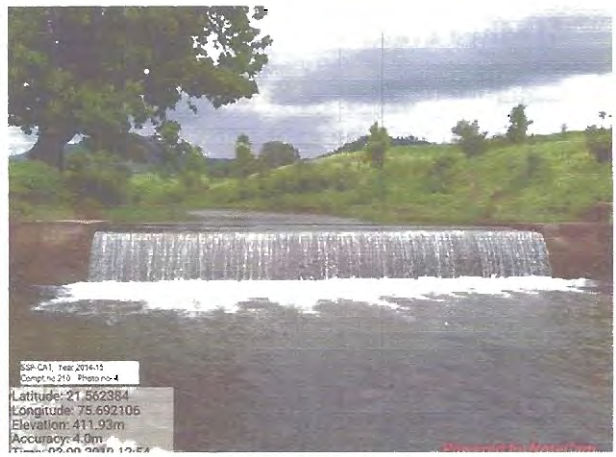
Longitude: 75.68912
Elevation: 398.99m
Accuracy: 4.0m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Longitude: 75.692106
Elevation: 411.93m
Accuracy: 4.0m


Latitude: 21.566528
Longitude: 75.67303
Elevation: 402.39m
Accuracy: 4.0m
Time: 02-09-2019 11:52


Latitude: 21.569002
Longitude: 75.721378
Elevation: 480.13m
Accuracy: 6.0m
Time: 02-09-2019 14:06
655
CAT


Latitude: 21.568108
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Elevation: 479.94m
Accuracy: 12.0m
Time: 02-09-2019 14:02
655
CAT


Latitude: 21.567654
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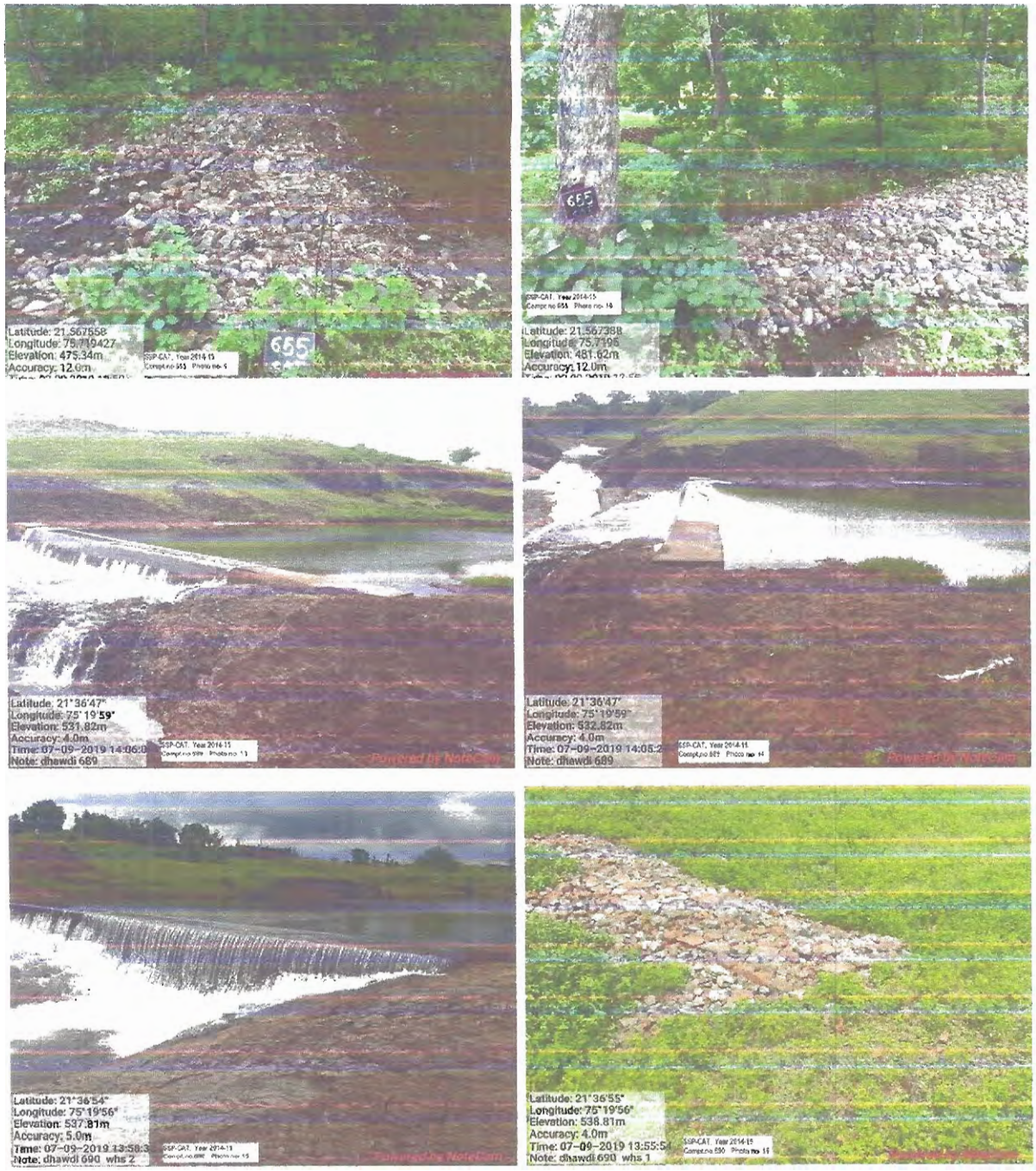


Pic 10. Latest pictures showing efficacy of catchment area treatment works in MP

Gujarat

Catchment area of Sardar Sarovar Project below Indira Sagar in Gujarat is 30,230 ha. The gross area of critically degraded sub-watersheds is 30,230 ha. Out of this, Government of Gujarat had prepared plans for treating 500 ha area under Phase-II, as described in table above, under directly draining category at the cost of the project.

Presently 500 ha area has been treated pari-passu with the construction of project and thus the catchment area treatment work is considered complete.

Following images show the GIS and satellite data for progress and efficacy of catchment area treatment works for the year 2001, 2006 and 2012.

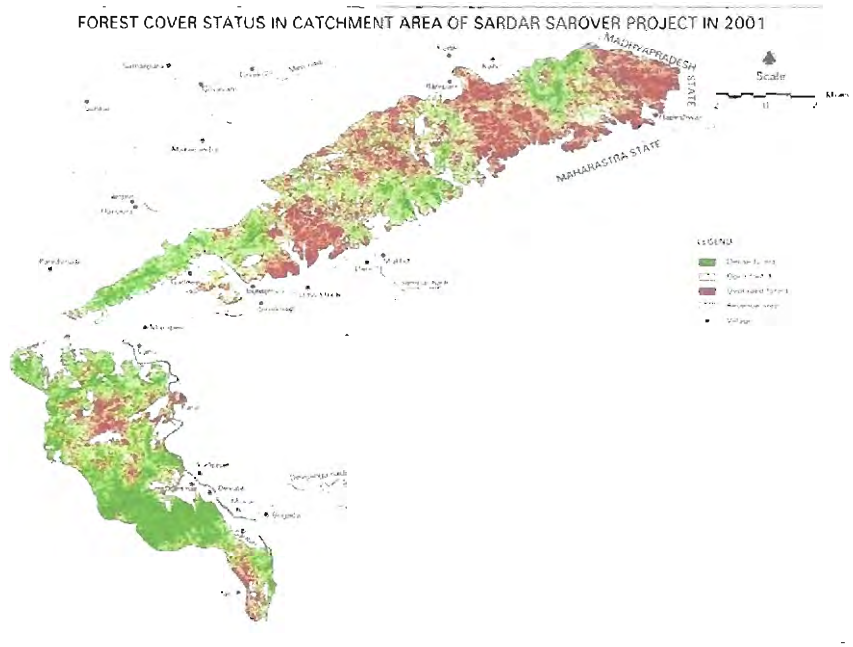


Fig. 21. GIS Map of CAT works in Gujarat State in SSP in 2001

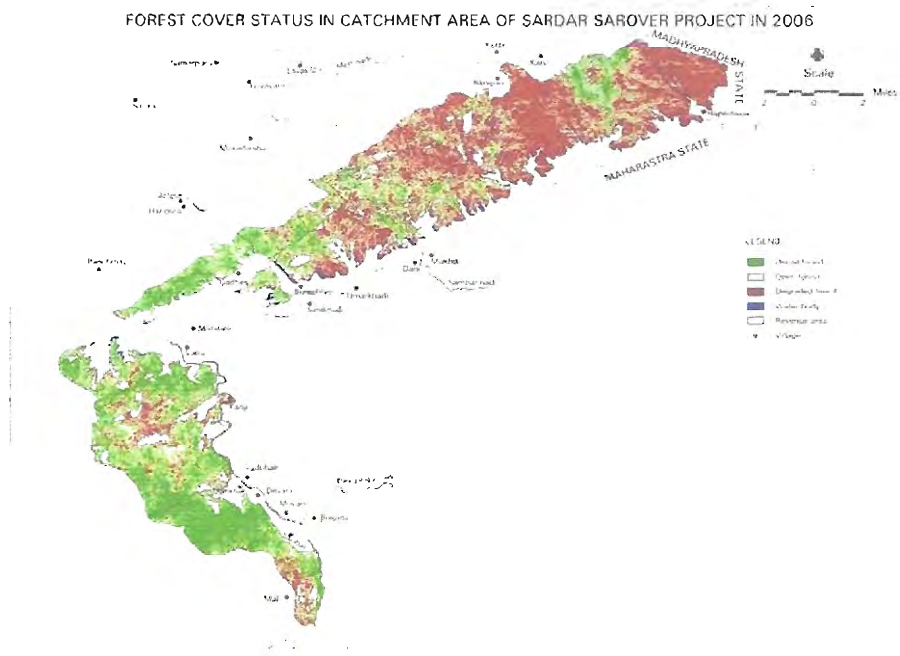


Fig. 22. GIS Map of CAT works in Gujarat State in SSP in 2006

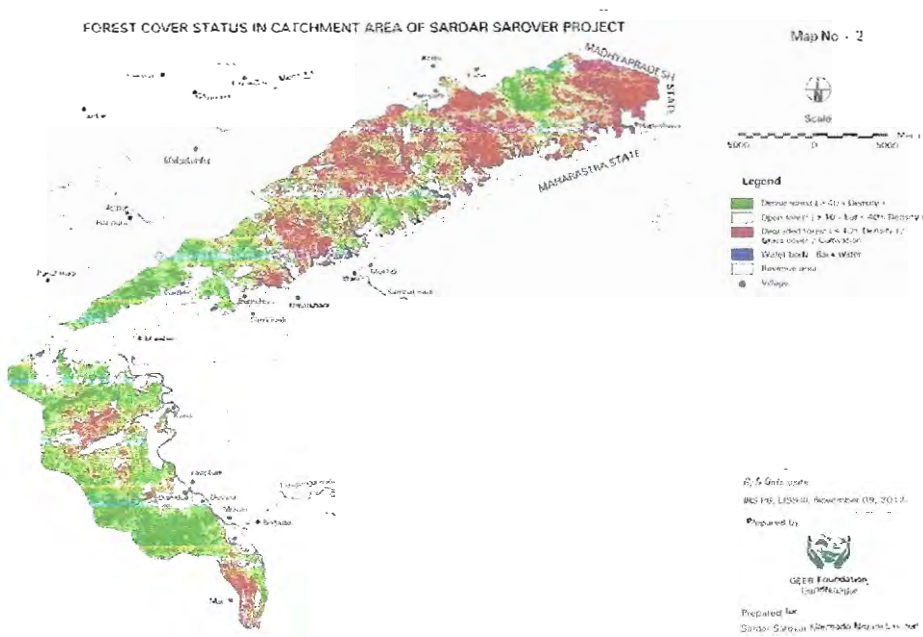


Fig. 23. GIS Map of CAT works in Gujarat State in SSP in 2012

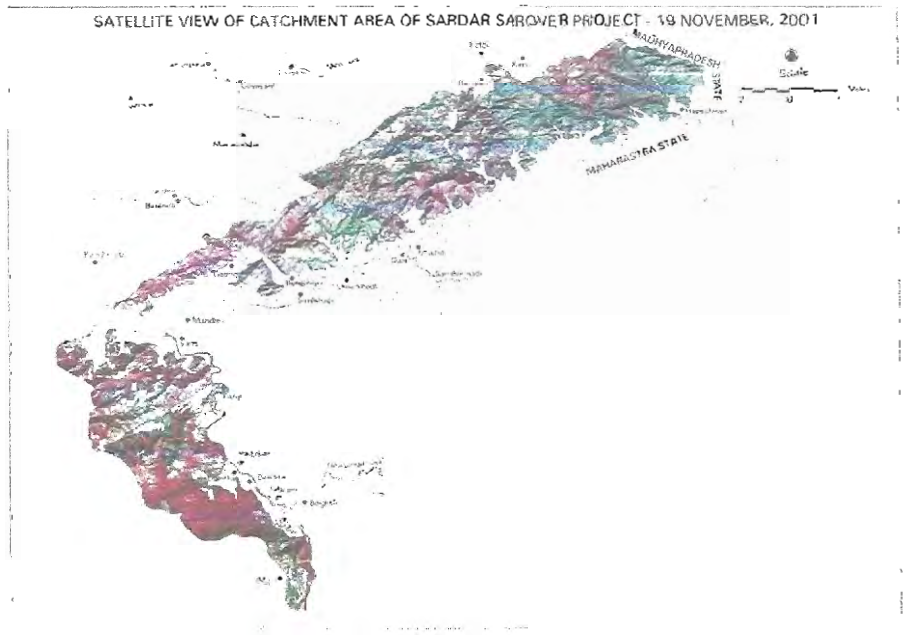


Fig. 24. Satellite data of CAT works in Gujarat State in SSP in 2001

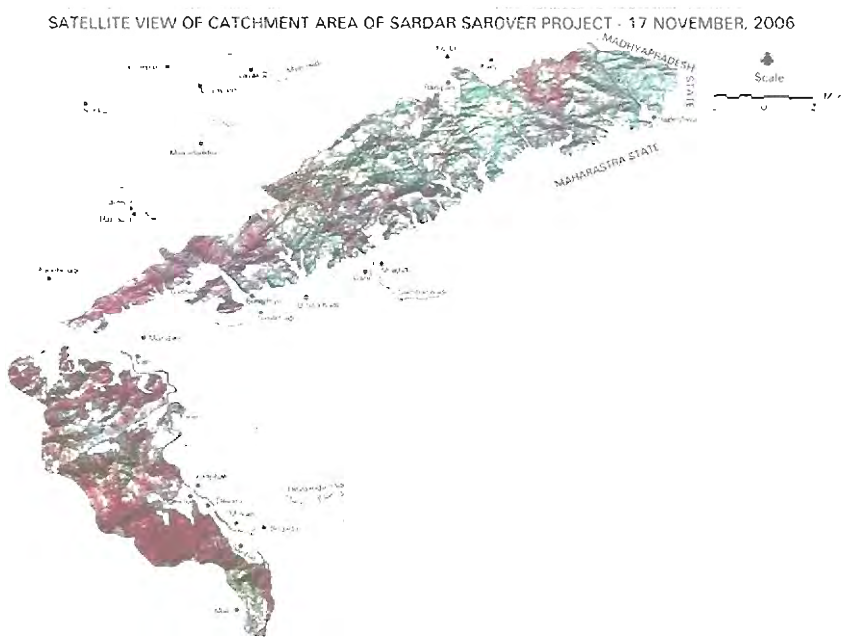


Fig. 25. Satellite data of CAT works in Gujarat State in SSP in 2006

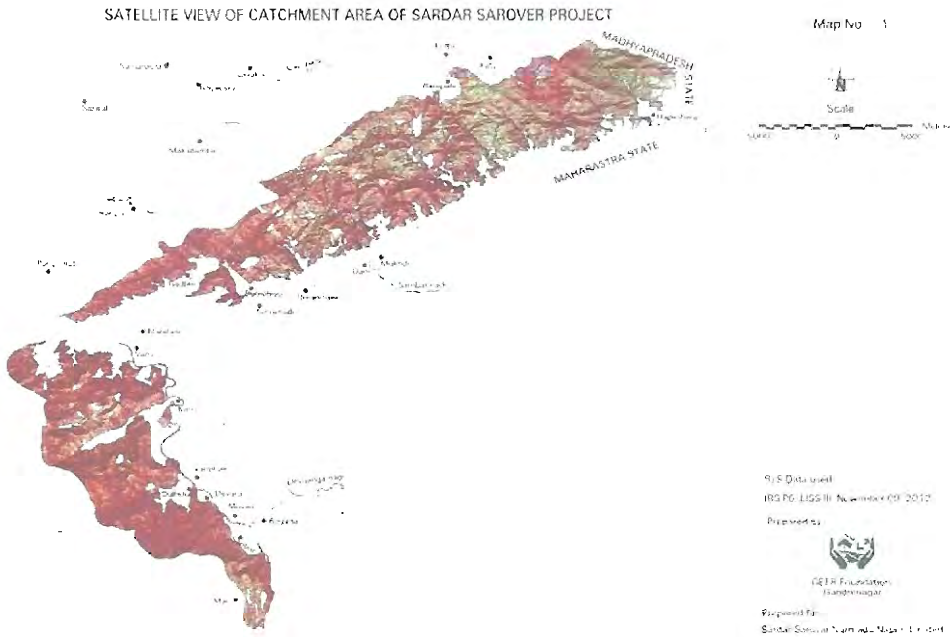


Fig. 26. Satellite data of CAT works in Gujarat State in SSP in 2012

Following are some photographs of catchment area treatment works in Gujarat:

D.12 - Site preparation for CAT (92-3) at **CHAPAT (BHARUCH).**

D : B R P CATCHMENT AREA TREATMENT

D.11 - Temporary field nursery (91-2) at **VEDGAM (BHARUCH).**

B : STATUS OF B D IN PROJECT AREA :

B.5 - A General view of Degraded Narmada Environment in project area at **MOKHDI (BHARUCH).**

E.20 - A three year old (1990-91) treated area at Gadher (care is key to restoration of B D)

E.19 - A closed canopy (three year plantation of 1992-93) at Vedgam (Nature (Bamboos) taming the nature (Devastating current))

E.18 - A young plantation (one year old 1991-92) at Gulwani (Closure and cutting back blooms the nature).

E.16 - Closed plantation site at Ingawadi one year old effort 94-95.

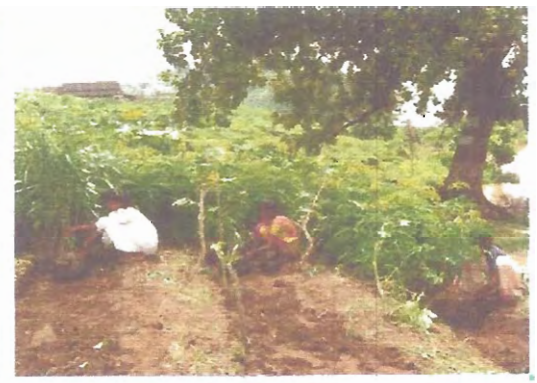
E.15 - Check dam (1991-92) at Gulwani. (Augmenting life support system for tribals)

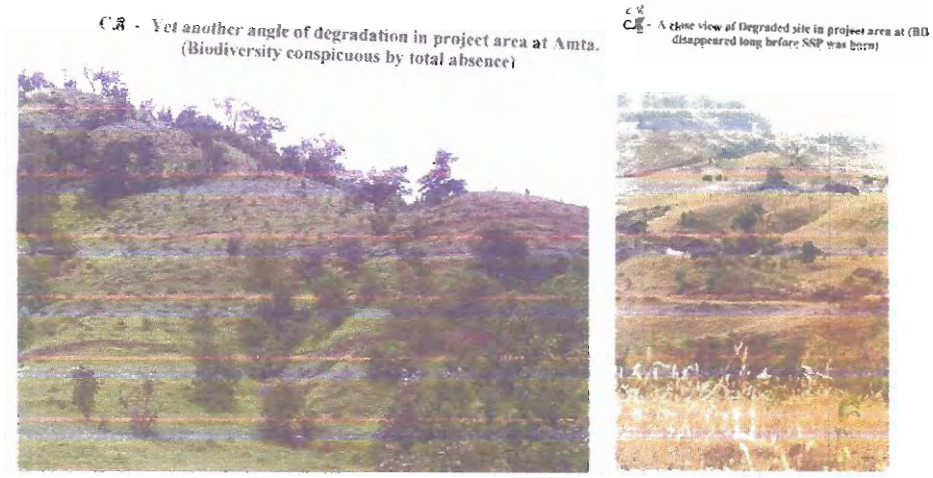
E.14 - Wallflow control in nala at Mokhadi. (Cutting of wings before they harness air currents)

E.13 - Site preparation for B P P at Chopat (1992-93)

E-BDPCAT

E.12 - Tamporary women nursery at Khokhara (1994-95)





Pic 11. Some photographs of Catchment Area Treatment works in Gujarat

Sharing of Cost of Catchment Area Treatment Works

The issue regarding the sharing of cost of catchment area treatment related to Sardar Sarovar project by the Party States had been under discussion in various meetings of NCA since April 1990. As there was no consensus on the issue amongst the party States, the matter was put up to the RC, NCA the in its 6th meeting but the matter could not be discussed. It was decided by the government of India in July 1992 that the treatment of directly draining catchment should be carried out with the project works at project cost. Accordingly 1,79,180 ha of catchment of Sardar Sarovar reservoir was planned to be treated. The total cost for catchment area treatment was 171.44 crores.

Catchment area treatment is an activity related to the upstream area and is a part of environmental Action Plan. It is one of the most important environmental safeguard measures for conserving soil and moisture in the catchment of reservoir. A sub-heads viz "X-Environmental & Ecology" existed in standard format prescribed by planning commission in the estimate of Unit-I- Dam and Appurtenant works for debiting the environmental works related to the construction of dam/formation of reservoir. Keeping these guidelines in view it was found reasonable to debit the cost of catchment area treatment related to Sardar Sarovar project to Unit-I. Therefore the cost shared by the parties States for catchment area treatment was decided to be shared in the ratio prescribed for Unit-I by the NWDT and is given in following table:

Table 10. State wise share of cost of catchment area treatment works

State	Amount (in crores)	Share of Cost (percentage)
Gujarat	87.434	51
Madhya Pradesh	54.861	32
Maharashtra	25.716	15
Rajasthan	3.429	2
Total	171.44	100

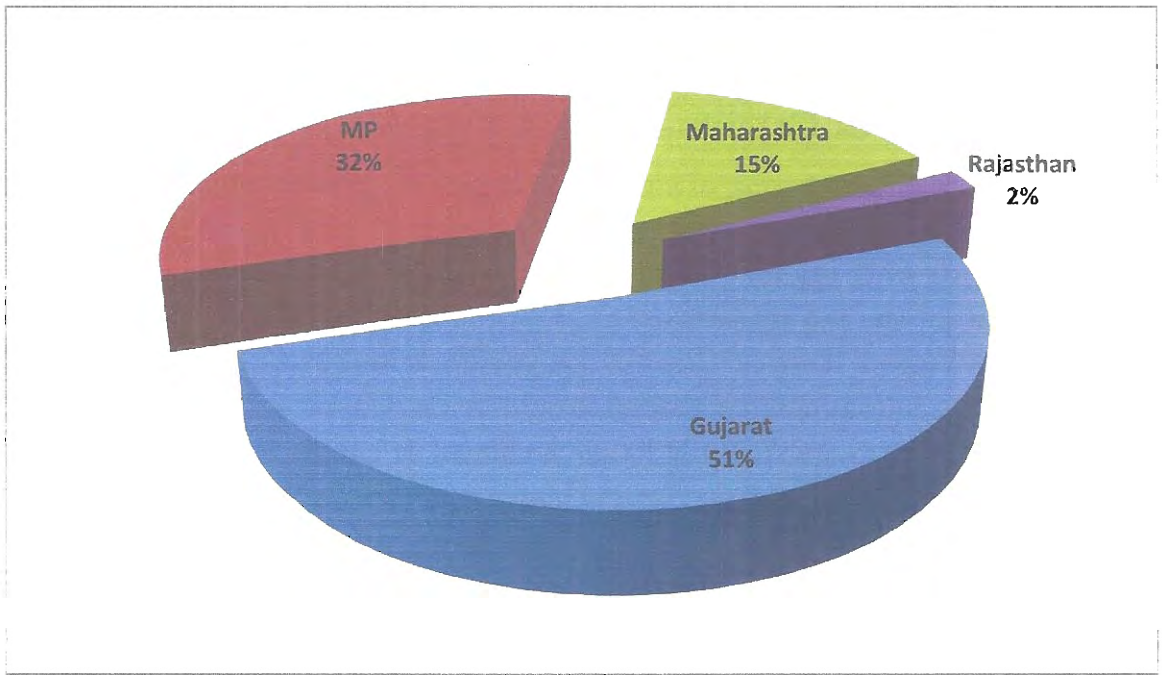


Chart 9. State's share of catchment area treatment works

Impact of Catchment Area Treatment works

It is observed that almost all the works like, nalas, bunds and many of the check dams, WHS were silted up and water retented there-in was percolated below the ground has justified the purpose for which the above structures had been constructed. Water harvesting structure (Pucca check dam) has proven to be very effective in arresting the soil erosion and in conservation of moisture. In some of the water harvesting structure water availability could be seen till end April too. Due to recharge and increase in water table, local formers are earning more income from water intensive cropping, increased productivity and also from olericulture (vegetable farming), and floriculture. It was observed that only after treatment and protection of the catchment areas, natural

regeneration of several species has started springing up in the treated areas, whereas the natural regeneration was almost absent in the untreated areas due to biotic pressure and unfavorable soil conditions.

Cost of siltation in Sardar Sarovar reservoir

A study was done by V. C. Pande, R. S. Kurothe, D. R. Sena and Gopal Kumar and was published in Current Science, Vol. 106 no. 1 on 10 January 2014 to find out estimates of the marginal cost of siltation in the Sardar Sarovar Project (SSP) reservoir. The losses due to sedimentation had been estimated in terms of losses in hydropower and irrigation. The data on siltation into the reservoir for this study was collected from the report submitted by the CSWCRTI to SSNNL. It was assumed that the reductions in benefits are permanent. By reducing the reservoir capacity, siltation reduces the area which can otherwise be irrigated and this also impairs the existing irrigation infrastructure. The canals, their distributaries and water courses get filled with silt. As a result, the efficiency and economy of the whole irrigation system is adversely affected.

It was concluded that non-adoption of proper soil and water conservation measures, including forest plantation, in the catchment area of the Sardar Sarovar reservoir would result in annual loss of Rs 1105–1137 million by accounting for loss in power generation and reduction in irrigated area alone in the command area. However, these losses can be minimized by treating the catchment area with appropriate location-specific soil and water conservation measures.

Thus it can be said that the proper and careful catchment area treatment works has helped in evading the potential loss due to siltation of reservoir and canals.

Chapter 3 Compensatory Plantation

Introduction

All kinds of development activities have some impact on environment. In case of dams, the reservoir created on the upstream of dam submerges the land. If all or some part of that land is under forest, then that forest has to be cut before submergence begins. To compensate this deforestation, compensatory plantation or compensatory afforestation is carried out.

Compensatory Plantation or Compensatory Afforestation (CA) is defined as the process of afforestation, and associated regeneration activities that are done to compensate for destroyed forest land that has been diverted to non-forest activities. In this context, non-forest activities mean these are of forest land coming under submergence in the reservoir created due to dam and the area of forest land which will be used for construction of rehabilitation colonies.

Examination of the project proposal for granting clearance from environmental consideration by the MoEF revealed that diversion of forest land was also required. Accordingly the order of clearance directed MOWR to seek permission for diversion of forest land separately, from the Forest Division of the MOEF in accordance with the provisions of the FCA 1980.

Subsequently on the request received, approval for the diversion of forestland for the SSP was also granted by the MoEF in 1987 (for submergence), in1990 & 1994 (for R&R works in Maharashtra) but several conditions were attached relating to the planning and implementation of CAF. Principals amongst these are 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-forest land plus reforestation on two hectares of degraded forest.
- For the 4,200.00 hectares of forestland in Maharashtra, which is to be used for R&R, an equal area of non-forest land or double the area of degraded forest 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.

Action Plans

In compliance with the conditions set by the MoEF, each state has prepared an Action Plan for the CAF of areas within its boundaries. The relevant documents are:

- Government of Gujarat Work Plan for Management of Environmental Effects, Section on Forests and Wildlife: The Compensatory Afforestation Plan for the Rann of Kutch, 1986.
- Project for Afforestation in Sardar Sarovar Project Impact Areas due to Diversion of forestlands for Sardar Sarovar Project (GoG), 1991.
- Compensatory Afforestation Scheme in Lieu of Sardar Sarovar Project in Dhule District, Maharashtra State (1989).
- Government of Madhya Pradesh Forest Department Action Plan of Compensatory Afforestation for Sardar Sarovar Multipurpose River Valley Project (1989).

These plans were submitted in varying stages of completeness and each has been revised, updated and implemented as per the details given below.

Planning

The Action Plans spelled out a programme of tree planting in the three states on both non-forest and degraded forest areas at locations shown in following map:

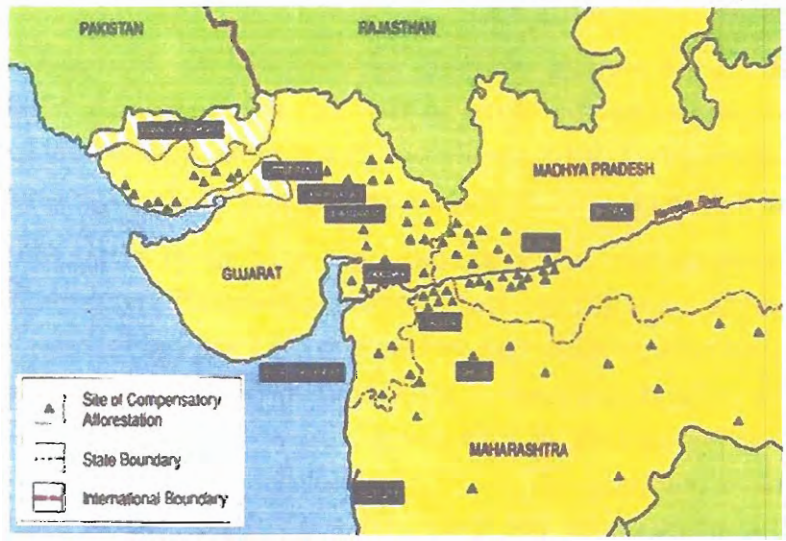


Fig. 27. Locations of non-forest and degraded forest for compensatory plantation

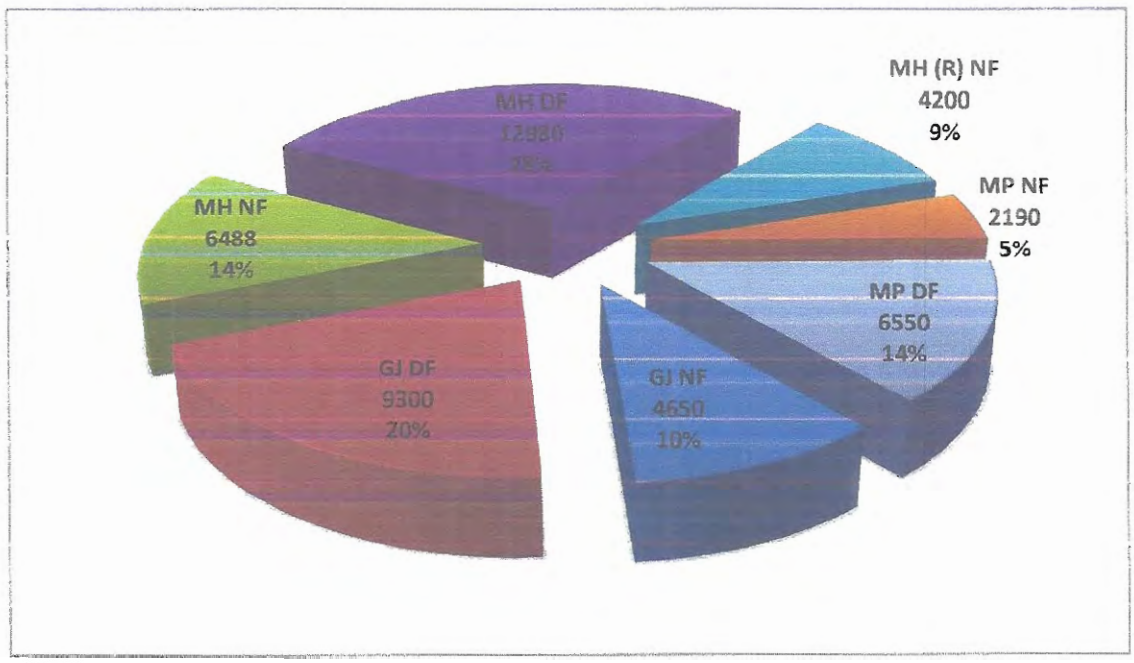
Implementation

An area of 13386 ha was diverted by MoEF vide its order of 1987. It was stipulated in this order that plantations shall be carried out in equal non forest land in addition to the plantations on degraded forest land 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.

Table 11. State-wise distribution of areas of forestland diverted for SSP and areas of non-forestland and degraded forestland to be reforested

Particular	Gujarat	Maharashtra	Maharashtra (R&R)	Madhya Pradesh	Total
Areas of forestland diverted for SSP	4523	6488	4200	7232	17943
Areas of non-forestland to be reforested	4650	6488	4200	2190	17528
Areas of degraded forestland to be reforested	9300	12980	0	6550	28830
Total area to be reforested	**13950**	19468	4200	8740	46358



Note: GJ=Gujarat, MP=Madhya Pradesh, MH=Maharashtra, NF-Non Forest, DF=Degraded Forest

Chart 10. State-wise distribution of areas of forestland diverted for SSP and areas of non-forestland and degraded forestland to be reforested

State Governments have prepared the plans for plantations of 46,358 ha besides reforestation of 28,830 ha area including plantations over 4,200 ha of non-forest land in lieu of the land released for R&R works in Maharashtra.

In Maharashtra State 4200 ha forest land was released for R&R works in two phases. In 1990 an area of 2700 ha was released in Taloda taluka. Further 1500 ha were 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 (against a target of 42,155 ha in lieu of 13,386 ha of diverted land for submergence) is given in the table below:

Table 12. Year wise progress of compensatory afforestation works

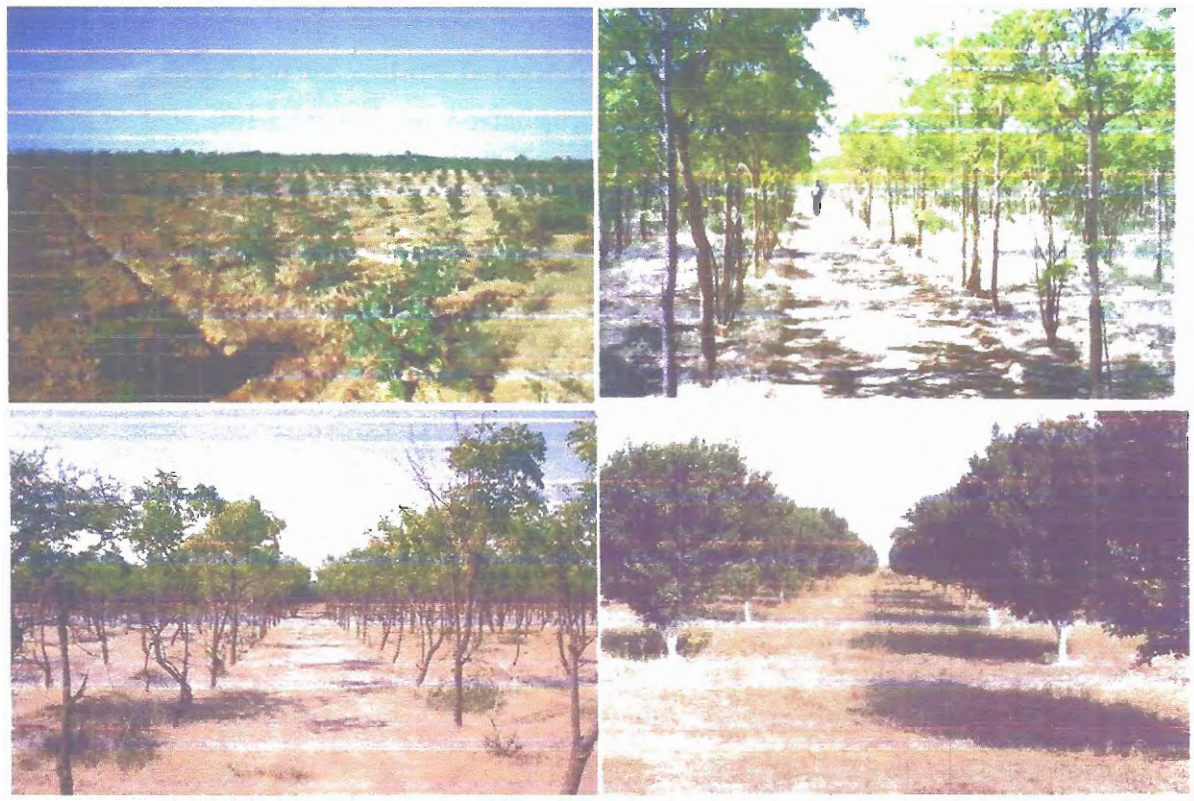
Duration	Gujarat		Maharashtra		Madhya Pradesh	
	Degraded forest	Non-forest	Degraded forest	Non-forest	Degraded forest	Non-forest
90-91	-	2,150.00	-	-	132.00	716.00
91-92	2,834.00	350.00	8,383.00	-	1,200.00	373.00
92-93	2,450.00	847.00	4,552.00	2,276.00	2,532.00	-
93-94	2,500.00	460.00	20.00	1,156.00	1,623.00	86.00
94-95	1,516.00	843.00	-	2,894.00	827.00	200.00
95-96	-	-	22.00	-	60.00	-
96-97	-	-	-	-	-	-
97-98	-	-	-	-	178.00	506.00
98-99	-	-	-	75.00	-	277.00
99-2000	-	-	-	-	-	26.00
2000-2019	-	-	-	88	-	-
Sub-total	9,300.00	4,650.00	**12,977.00**	6,489.00	6552.00	**2184.00**
Total	**13,950.00**		**19,466.00**		**8,736.00**	
Target	**13,950.00**		**19,466.00**		**8,736.00**	
Status	**Complete**		**Complete**		**Complete**	

Note: All areas are in ha

Compensatory Afforestation against 4200 ha forest land released for R&R works in Maharashtra vide MoEF order dated 1990 (2700 ha) and 1993 (1500 ha) is given in table below:

Table 13. Compensatory Afforestation against 4200 ha forest land released for R&R works in Maharashtra in 1990 (2700ha) and 1993 (1500 ha.)

Year	Land released	Progress 1993-94	Progress 1994-95	Progress 1995-96	Progress 2000-01	Total Progress	Balance targets	Area unfit for Plantation	Balance
1990	2,700.00	2,192.37	311.00	184.50	9.63	2697.5	2.5	2.5	0
1993	1,500.00	0.00	0.00	896.00	604	1500.00	0	0	0
Total	**4,200.00**	**2,192.37**	**311.00**	**1,080.50**	**613.63**	**4197.5**	**2.5**	**2.5**	**0**



Pic 12. Some pictures of compensatory afforestation sites.

After-care & Maintenance

Regulatory Regime

- In terms of the order of clearance the non forest areas planted up by the project authorities are required to be handed over to the regular territorial forest divisions for regular upkeep & maintenance and till such time these were to be handed over Plantations were required to be maintained with watch & ward as per the planned programme.

- Environment Sub-Group also directed Impact Assessment Studies for the new eco-system that developed in the areas planted up under the compensatory afforestation programme especially for the areas in Gujarat being away from the Narmada Ecological zone. Sub-Group also directed that survival count along with species composition, year of count and the areas under each category should be regularly monitored

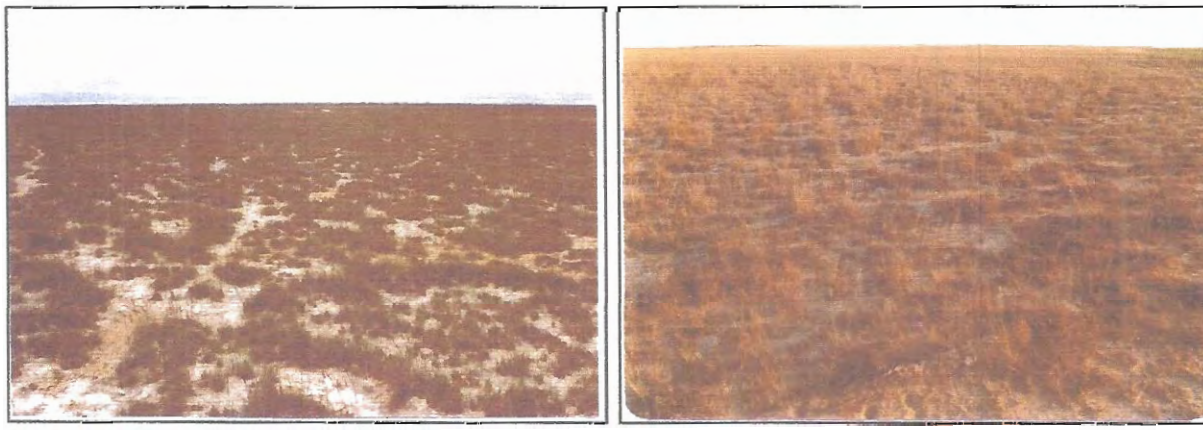
Progress

Progress achieved by each state was as under:

Gujarat

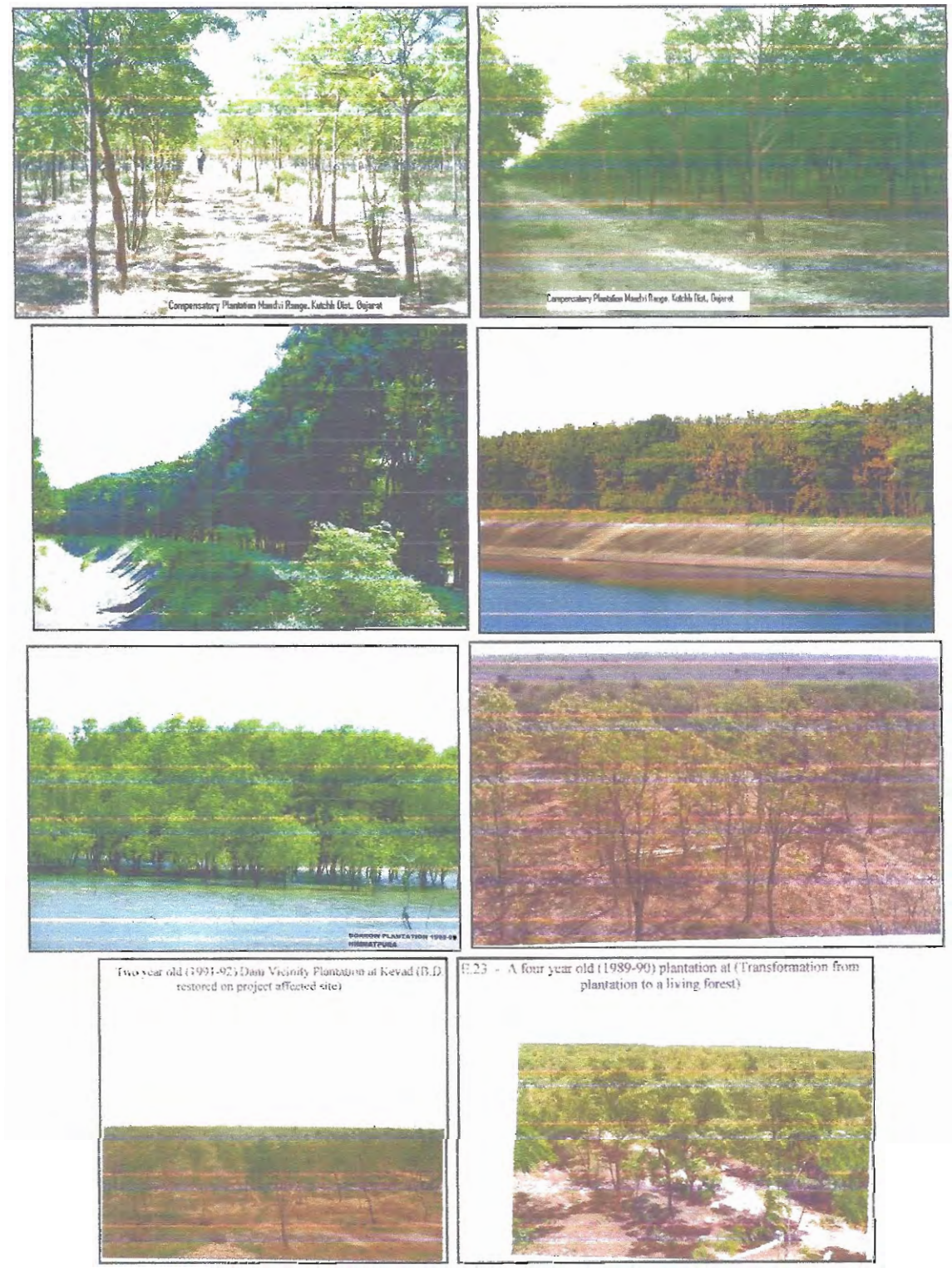
- Government of Gujarat initiated ecological studies for the Neo-ecosystem under Compensatory Afforestation accomplished in district Bhuj and a preliminary report was submitted during 1998.
- Process of declaring the non forest areas as forest land was initiated for the entire plantations of 4650 ha. Accordingly the process of placing the afforested areas was initiated.
- Government of Gujarat made available reports on survival count and species composition for some of the areas planted up in both the forest & non forest areas.
- Till date a total of 13,950 ha has been planted against a target of 13,950 ha and thus the compensatory plantation work is considered complete.

Some pictures of Compensatory Afforestation sites before plantation are as follows:



Pic 13. Some pictures of Compensatory Afforestation sites before plantation in Gujarat

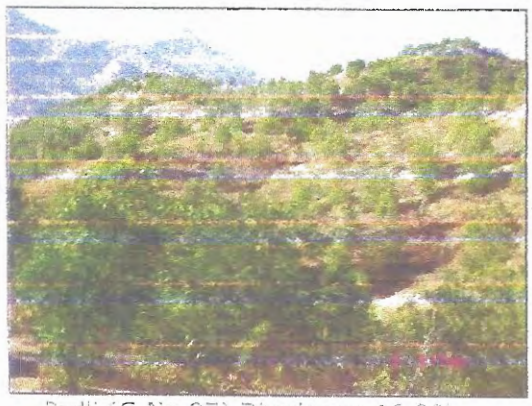
Some pictures of Compensatory Afforestation sites after plantation are as follows:



Pic 14. Some pictures of Compensatory Afforestation sites after plantation in Gujarat

Maharashtra

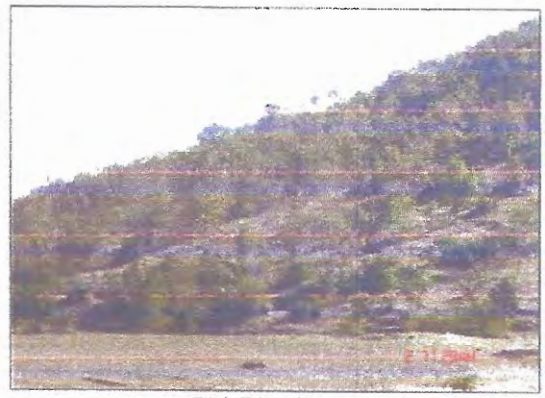
- Process of declaring the non forest areas as forest land was initiated for the entire plantations of 6500 ha.
- Government of Maharashtra made available reports on survival count and species composition for some of the areas planted up in both the forest & non forest areas.
- Till date a total of 19,466 ha has been planted against a target of 19,466 ha and thus the compensatory plantation work is considered comp.ete.



Padli (G.No.97) Dhadgaon,16.00ha, year1998

Padamund (G.No.84)Dhadgaon, 38.00 ha year 1994

Mundaiwad (G.No.100)Dhadgaon,30.00ha, year1994



Old Dhadgaon (G.No.28),20.00ha,year1994

Sisa (G.No.95), Dhadgaon,25.00ha,year1998

Source: Environmental Safeguard Measures in Maharashtra: A Status Report, Nov 2010

Pic 15. Some photographs of compensatory afforestation sites in Maharashtra

Madhya Pradesh

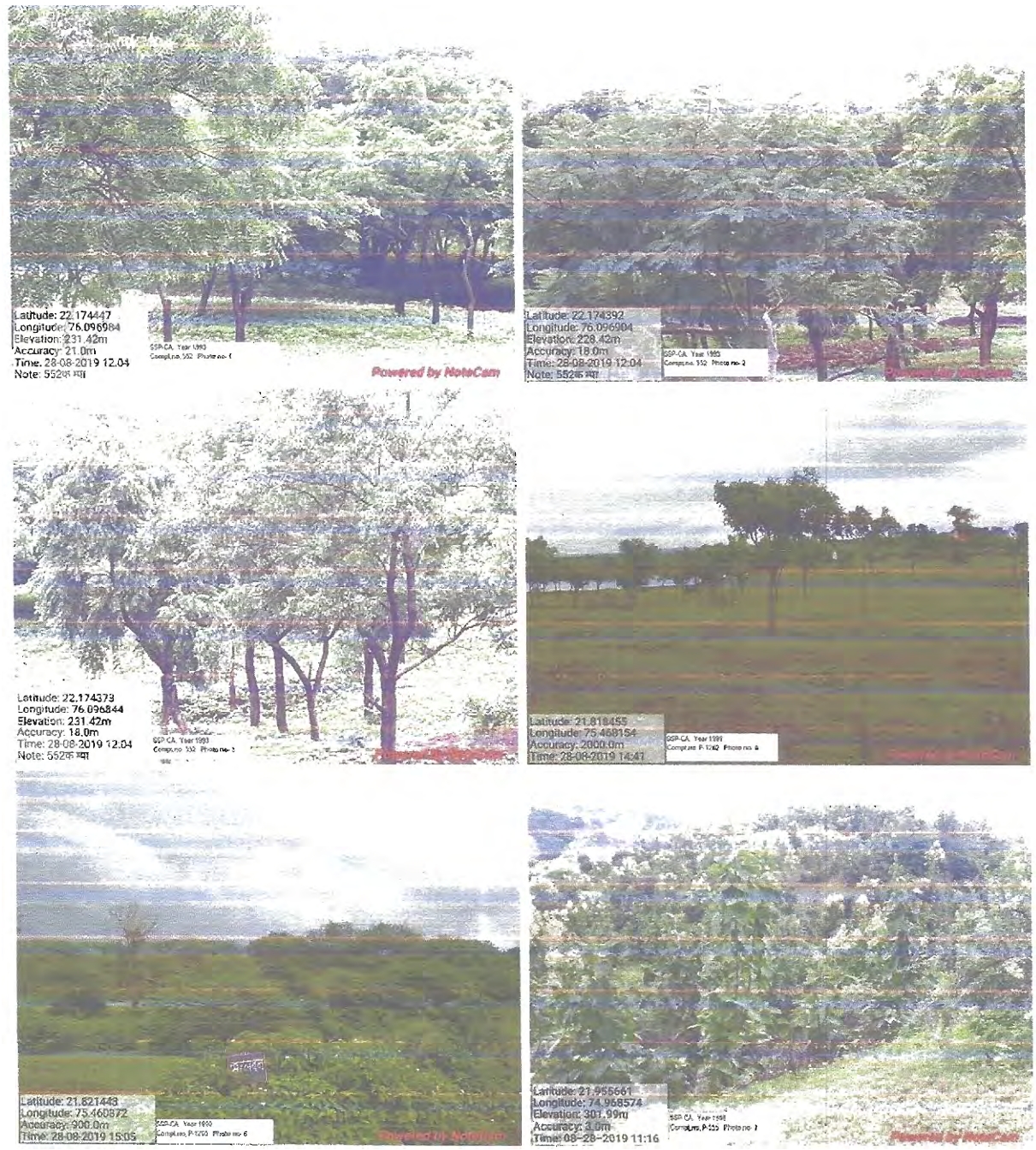
In the compensatory afforestation works seedlings of tree species ware planted keeping in view, the agro-climate conditions along with ensuring utility from the point of view of forage, fuel wood, food, medicines, minor forest products like gum and honey and also shade. The following species have been planted in the plantations carried out areas depending upon the property of soil and agro climatic conditions this has resulted in enlarging the biological diversity of the plantation.

Table 14. Details of seedlings planted in compensatory afforestation in Madhya Pradesh

Sr.	Botanical Name	Local Name
1	Dalbergia latifolia	Shisham
2	Madhuca indica	Mahua
3	Azadiracta indica	Neem
4	Acacia nilotica	Babul
5	Tectona grandis	Teak
6	Pithocolobium dulce	Jungle Jalebee
7	Prosopis juliflora	Vilayti Babul
8	Acacia Leucophloea	Rinjha
9	Ziziphus mauritiana	Ber
10	Tamariindus indica	Imli
11	Acacia catechu	Kher
12	Albizia lebbeck	Black siris
13	Butea monosperma	Palas
14	Holoptelia integrifolia	Chirol
15	Aegle mormelus	Bel
16	Bauhinia racemosa	Astra
17	Dendrocalamus strictus	Bamboo
18	Emblica ofticinalis	Aonla
19	Bauhinia variegata	Kachnar

- Process of declaring the non forest areas as forest land was initiated for the entire plantations of 2732 ha.
- Government of M.P. made available reports on survival count and species composition for some of the areas planted up in both the forest & non forest areas.
- Till date a total of 8,736 ha have been planted against a target of 8,736 ha and thus the compensatory plantation work is considered complete.

Latest Photographs showing current status of compensatory afforestation works by Kaveri C.A. Division Khandwa NVDA are given below:



Pic 16. Latest Photographs showing current health of compensatory afforestation works in MP

Pic 17. Latest Photographs showing current health of compensatory afforestation works in MP

Impacts of Compensatory Afforestation

Compensatory afforestation has considerably helped in improving the local habitat of the wildlife of Chinkaras, Nilgai, Wildboar, Jackal, Monkey, Fox, Mangrove, Wolf, Barkingdeer, Hare, Samber etc. Bird species like Peafowl, Bulbul, Pond heron, Grey partridge, Cotton teal etc. has increased in number with the improved habitat. The

compensatory afforestation scheme has helped to create employment for local people. These areas yield good quality of palatable grasses which is allowed to be cut and taken away by local people free of cost. The area overall has improved with natural vegetation. There has been enhancing in natural regeneration of species like Acacia nilotica, Butea monosperma, Prosopis Juliflora, Azadirachta indica, Tectona grandis.

Declaration of Forest

In the 50th Meeting of Environmental Sub-group held on 01st May 2017 at New Delhi following submissions were made:

- The representative of Government of Gujarat (GoG) informed that the notification of 3009 ha. non-forest area brought under compensatory afforestation as reserved/protected forests is in various stages of declaration like all 3009 ha. have already been notified under Section 4 and various other process required for declaration is in progress and is planned to be completed by July, 2017.
- The representative of Government of Madhya Pradesh informed that all 2199 ha. non-forest area brought out under Compensatory Afforestation had already been declared reserved/protected forests.
- The representative of GoM reported that the notification of remaining 67 ha. non-forest area brought out under Compensatory Afforestation as reserved/protected forests is in progress and the same is planned to be completed by 31st May, 2017.

Survival Studies

Following table shows the summary of the status of aftercare/maintenance of plantations in MP, Gujarat and Maharashtra:

Table 15. summary of the status of aftercare/maintenance of plantations in MP, Gujarat and Maharashtra

State	Success rate
Gujarat As per GoG letter dated 23.06.2004, 28.12.2004 and 11.04.2014	The representative of Government of Gujarat submitted in 50th ESG Meeting that the rate of survival of plantations is about 70% as per latest assessment.
Maharashtra As per GoM Lr dated 27.06.2003 and 31.05.2007	In the 50th ESG Meeting, the rate of survival of the plantation was reported to be 80% in non-forest and more than 42% in degraded forests.

Madhya Pradesh As per GoMP's letter dated 21.06.2004 and subsequent ATR	survival %	Area
	> 50%	3966 ha
	30 - 50%	480 ha
	below 30%	3901 ha
	Grazing land	390 ha

Increase in Biodiversity due to Compensatory Afforestation

Member (E&R), visited Compensatory Afforestation areas covering 60 ha. in Sulibhanjan in district Aurangabad during 22 to 23 July 2016. The Compensatory Afforestation was done in 1995 on degraded land covering about 550 ha. area in Aurangabad district. The assessment indicated that dense forests have now been developed with varieties of flora and fauna and the same is under protection of Joint Forest Management Committee. The Compensatory Afforestation also forms a catchment to the series of lakes like Kore Talav, Aam Talav and Jamun Talav. The Compensatory Afforestation has transformed the barren area into green, lively and vibrant landscape and is now fit for Eco-tourism.

Member (E&R), NCA visited KBC and Compensatory Afforestation areas in Bayat and Bhachau of Kutchch district during 2 to 3 May 2016. The assessment indicated that the good works have been done related to wildlife passage like village road, bridge and siphon for easy access to the wild Ass and other wild fauna in KBC area. The introduction KBC has attracted bird fauna and now water birds in the low-lying areas along with the canal and green cover have been observed in the area which indicate the enrichment of biodiversity in the region. The Compensatory Afforestation in Bayat and Bhachau in Kutchch having more than a dozen species of trees, shrubs and grasses have enriched the eco-system and its biodiversity. It has also resulted improvement of the habitat of wild fauna including endangered species like great Indian Bustard.

Chapter 4 Command Area Development

Introduction

Command area is the area which can be economically irrigated from irrigation project without considering the limitation on the quantity of available water. It includes the area which is, otherwise, uncultivable. In all irrigation projects, the dam need to be supplemented with a network of canals and associated structures to carry the water from reservoir to the fields. Development of this network of canals and associated structures is called as command area development.

It has been observed that after the construction of irrigation projects, the beneficiary population residing in the command area sees an increase in prosperity and living standards. The same has been observed in Sardar Sarovar Project. This is because when farmers get assured irrigation, they start growing good quality crops which give higher returns.

The command area of the Sardar Sarovar Project is fixed based on the areas included by NWDT for purposes of considering requirement of Narmada water for irrigation in Gujarat & Rajasthan. Accordingly, the GCA of the project is 3.43 million hectares in Gujarat of which Culturable command is estimated to be 1.869 million hectares. In Rajasthan as per revised estimate the GCA of the project is 2.46 million ha. The command area in Rajasthan & Gujarat is characterized by wide diversity in agro-climatic and socio-economic conditions.

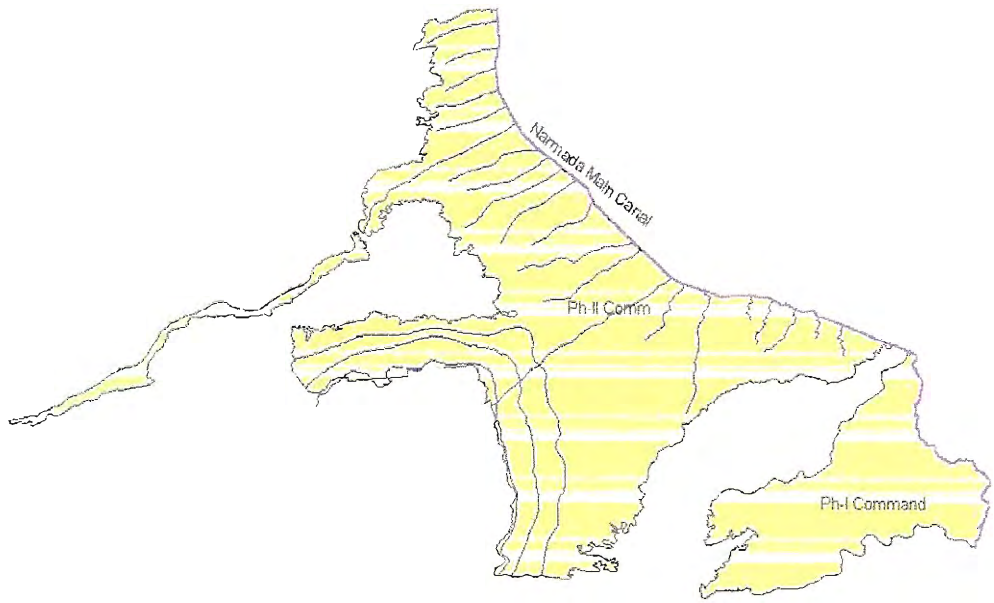


Fig. 28. Command area of Sardar Sarovar Project along with Canal alignment

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 about 458 km before entering Rajasthan near village Silu, Tehsil Sanchore, district Jalore.

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.

Command Area Development Planning

The Canal system would command a gross area of 3.43 M ha. and cultivable area of 1.84 M ha. in Gujarat. 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:

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

Annual Rainfall

Following table shows the average annual rainfall in Phase-I and II of the command area of Sardar Sarovar Project:

Table 16. Annual rainfall in Phase-I & Phase-II command.

Sl.No.	Phases :-	Annual Rainfall
1	Phase-I areas (Vadodara Taluka)	892 to 1056 mm. (35+ to 41+ inches)
2	Phase-I Region-3 & 4	700 to 800mm. (27+ to 31+ inches)
3	Phase-II (Region 5 & 6)	700 to 800mm. (27+ to 31+ inches)
4	Phase-II (region 7 to 10)	600 to 700 (23+ to 27+ inches)
5	Phase-II (region 11 to 13)	400 to 600 (15+ to 23+ inches)

Ground Water Table

Following figures show the availability depth contours of ground water table in Sardar Sarovar Project command area. In Phase-I map red contours are for water depth of less than 5 m. and green colour contours are for depth of water level from 5 to 10 m (data of 2002). In Phase-II map light blue colors indicates less than 5m depth & deep blue indicates water depth of upto 10m. Whereas green colour indicate water depth upto 20 meters. Red and pink colour indicates areas where water depth is upto 40 to 70 meters but such areas are very little in extent.

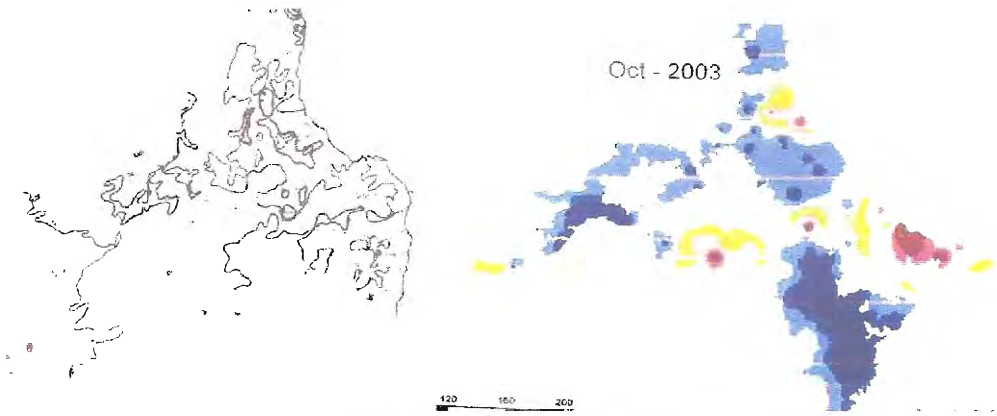


Fig. 29. Ground water table contours/depth in phase-I & II of the command

Land Irrigability Classification

The Soil Survey Manual (IARI 1970) recognizes 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.

Following GIS map shows the land irrigability classes in the command area of Sardar Sarovar Project in Gujarat. Different colour indicates different soil types: Bottle green is class2 while lemon yellow is class3 land. Purple and peach indicates problem areas.

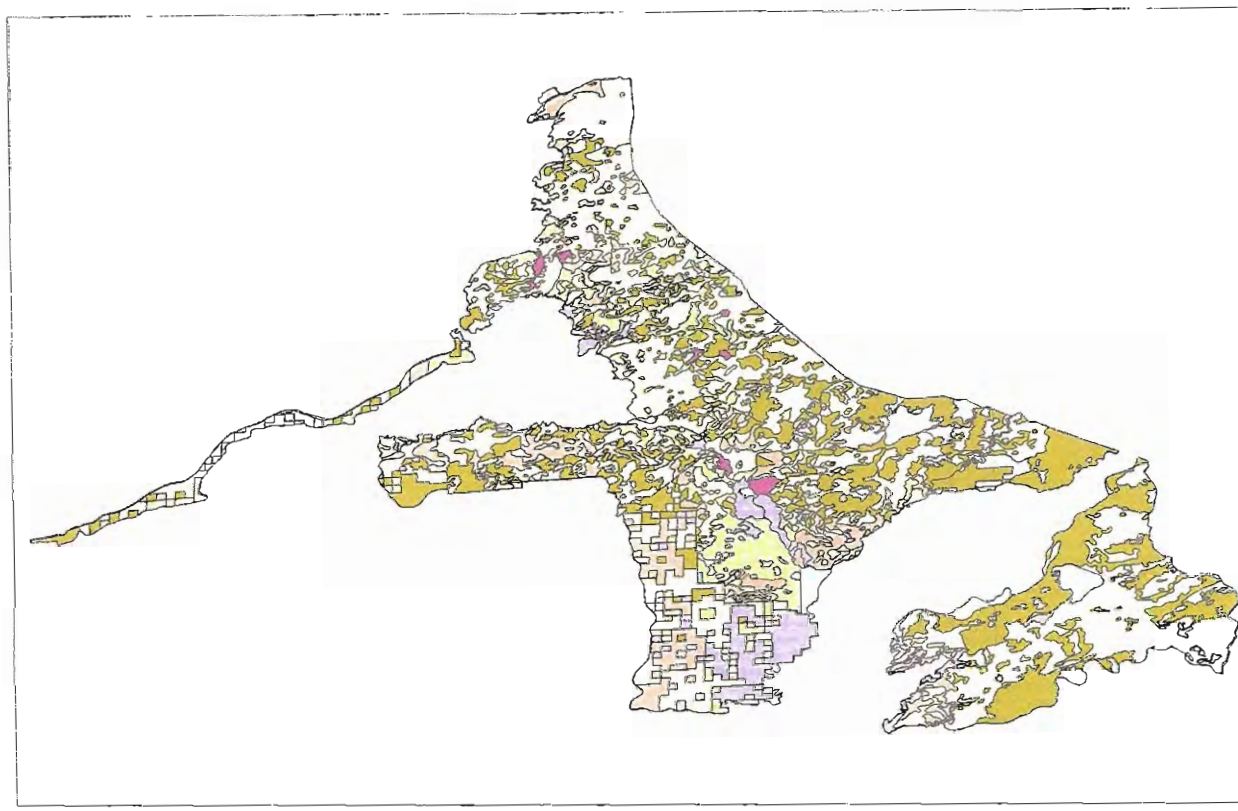


Fig. 30. Land irrigability classes in the Command area of SSP in Gujarat

Considering these factors, the command has been divided into 13 regions. The main regions, their names, GCA and CCA are given in following table:

Table 17. Major division of Sardar Sarovar Project command area based on annual rainfall, ground water table and land irrigability

Sl.No.	Name of the region	Region No.	GCA	CCA (Macro Plan)	Revised CCA (thousand ha)
1	Sankheda-Savli	1	253100	161900	131.0
2	Sinor-Vadodara	2	273100	187600	142.7
3	Bharuch-Amod	3	153200	84900	95.5
4	Vagra-Jambusar	4	111300	36800	58.9
5	Mehmedabad-Daskroi	5	295700	192300	166.0
6	Sanand-Kadi	6	181700	125700	93.5
7	Dholka-Dhandhuka	7	476000	264300	222.3
8	Limdi-Botad	8	294000	182600	198.4
9	Halvad-Malia	9	268400	168000	146.4

10	Viramgam-Dasada	10	344600	242100	187.3
11	Sami-Harij	11	191700	115200	115.1
12	Radhanpur-Vav	12	462800	319700	255.0
13	Rapar-Mundra	13	122900	42800	57.3
	Total of all regions		3428500	2123900	1869.4

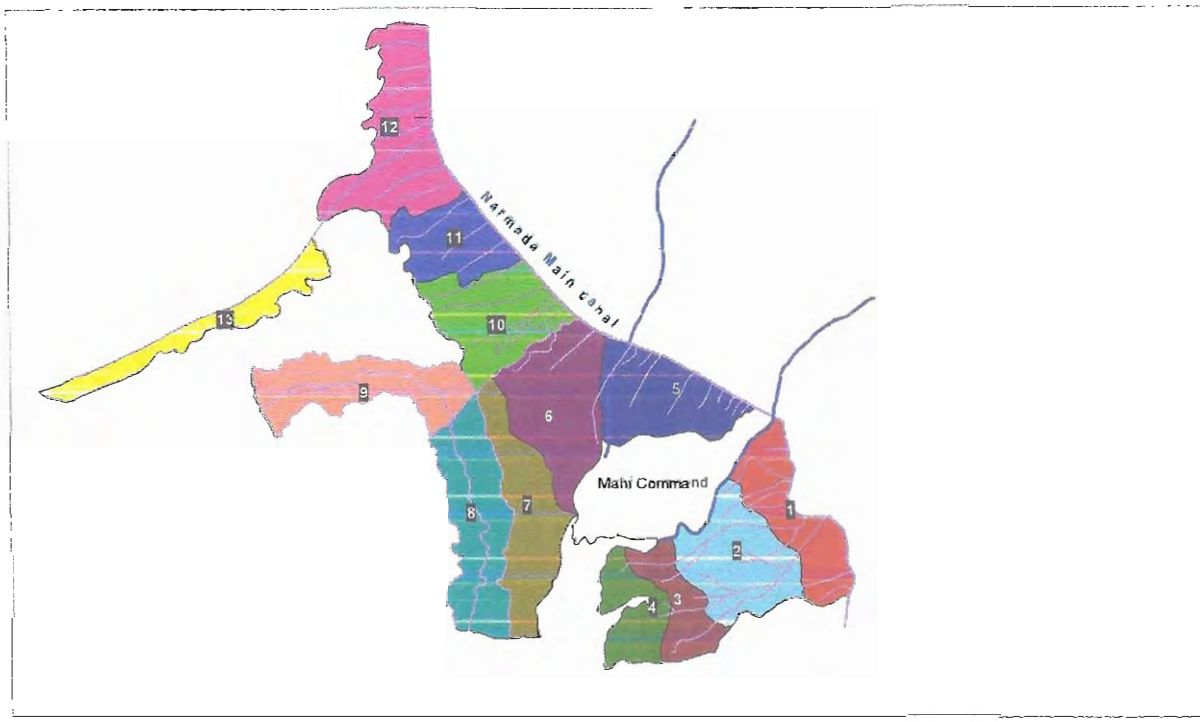


Fig. 31. Agro-climatic zones in the Phase-I & II Command of SSP in Gujarat

Environmental Management

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 irrigation projects in the past. In view of the potentially far-reaching effects of water distribution in the SSP command area, mitigating measures have been determined requiring, control and monitoring.

To determine, these impacts the project authorities have undertaken a large number of studies and most of these studies are now complete. The results of many studies available by the end of 1993 were used to prepare an assessment report for the development of the Command Area by the H.R. Wallingford. This report recommended a series of actions and completion of the remaining studies before

preparation of an integrated plan for the development of the command area. The key features brought out in the report included the following.

- Socio economic factors
- On farm/ off farm development works
- Municipal and Industrial supply
- Public Health
- Water quality
- Chemical used in Agriculture
- Drainage, water logging and salinity
- Natural fisheries and aquaculture
- Forest loss and afforestation
- Flora & fauna
- Archaeology

Proposed 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 following are the proposed measures to prevent environmental degradation.

Water logging and salinity

Mechanized, well-controlled canal lining: All the canals right down to the 8 ha blocks are carefully lined to reduce the seepage losses. The main canals and branches were concrete lined with mechanical pavers.

Pic 18. Mechanized lining adopted in canal system of Sardar Sarovar Project

The distribution system is brick lined with a sandwiched rich mortar layer. Use of polyethylene membranes is also contemplated.

Provision of surface drains: The drainage for 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 was concurrent with the construction of canals.

Conjunctive utilization of surface and ground water, limited water delta: The amount of water supplied per unit of area in the SSP command is 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 naturally calls 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 projects where well irrigation is concurrently practiced, the problem of water logging has reduced.

Better water management, Automated canal regulation, Rotational water supply on volumetric basis, and active participation of farmers: A draft legislation has been prepared to regulate the distribution and use of canal and ground water by Government of Gujarat. On the Sardar Sarovar Project volumetric supply of water through a computerized semi-automated operation system is planned. Under this system, the discharge from the canals down to 8.5 cumec (300 cusecs) capacity is regulated through automatic computer control. According to Government of Gujarat these measures do not allow the canals to draw more water than planned. As the tariff for the water is on the basis of the quantity supplied, the farmers try to use it most economically. This further ensured through better water management through farmers associations and rotational water supply. The irrigation water depths actually required are 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 by the Government of Gujarat. Wherever possible, drip and sprinkler methods of water application is encouraged.

Carrying out water balance and salt balance studies and necessary monitoring: During monsoon season surplus water is likely available in the canal. This excess water is used for flooding and leaching the saline soils. Continuous monitoring of salt and water balance has also been planned for such marginal soils.

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.

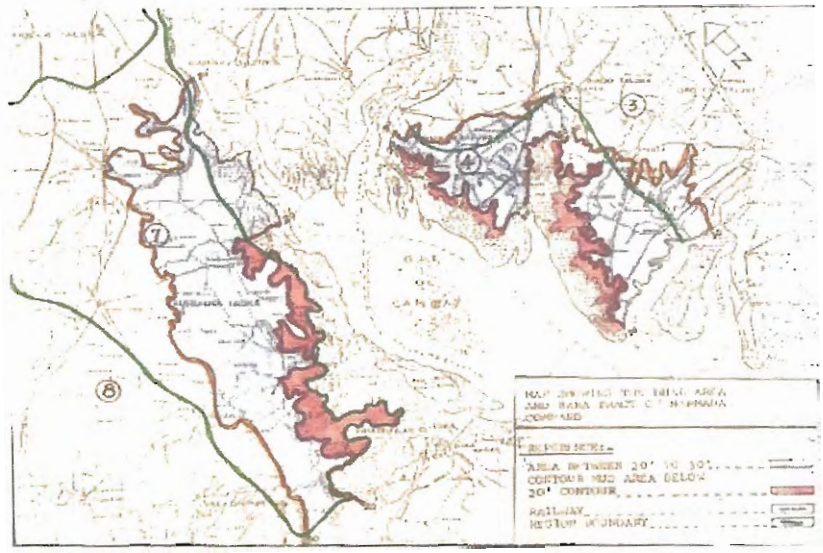


Fig. 32. Special problematic areas of Bhal and Bara tract in Sardar Sarovar command area

Biological resources and issues in the command

In Gujarat forests constitutes only 6.92% of the geographical area. According to estimates of 1980-81, about 1.3% of the total command i.e. about 44,500 ha of the command area was forest of this about 200 ha shall be required for construction of canal networks.

The diversification of agro-based plants and animals is crucial for the State's ecological security. Its present status changes therein and future trends are, therefore, important for biodiversity conservation. Despite the domestication in the agricultural crops, various land varieties have existed in different types of crops. Over a period of time their cultivation and propagation has been affected due to the availability of high yield verities. The relevant information pertaining to, these now depleted land varieties with reference to its number, area of occurrence and distribution is not readily available. This information, which is very relevant in the overall conservation of agro-biodiversity, is a serious constraint.

Heavy use of chemical fertilizers and pesticides has led to a drop in the productivity of the soil, bio-accumulation of toxic substances and disruption of food chains of the agricultural ecosystem (by direct and indirect effects). These have contributed to crop failure, steady decline in production and long-term health hazards all the way to the end users, i.e., humans.

The old native varieties (land races) are fast giving way to new hybrid / high yield varieties in a majority of crops. This is leading to impoverishment of the gene pool of native varieties of crops. In several cases, such native races have been lost forever. Relative least use of organic and natural farming is leading to continued reduction in land fertility and production.

Sanctuaries in the command

According to the Biogeography zonation, the following zones would be impacted by the waters of the Narmada due to the Sardar Sarovar Project. The consequential ecological shift and a plan to mitigate the negative consequences was required. These zones include 3 main habitats viz. Nal Sarovar, Black Buck and Wild Ass sanctuary of the endangered wildlife.

Fig. 33. Different sanctuaries in Sardar Sarovar command area

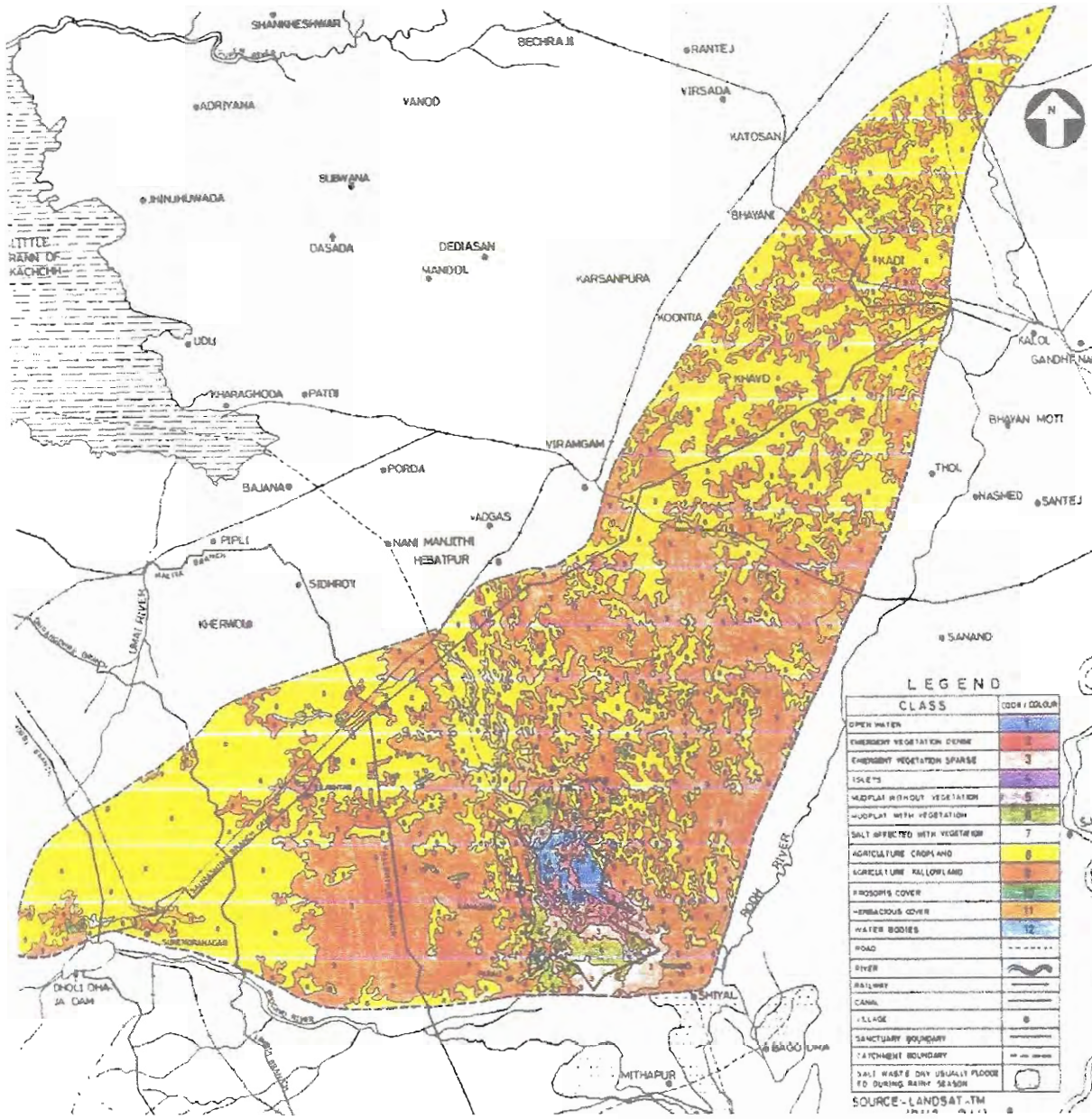
Nal Sarovar Bird Sanctuary (115 sq.kms).

Floral & Faunal composition of the unique wetland may change besides changes in physiochemical properties of the lake environment, changes in the cropping pattern in the command, changes in micro-climate, anthropogenic changes & pressures, primarily due to following:

- Quality of agricultural run-off laden with pesticides / insecticides or fertilizers to Nal Sarovar from the catchment area (which will be irrigated) shall impact the sanctuary.
- Water may also be drained (in flow of Narmada Water) in the lake through tail distributaries of the Command Area.
- Risk of flooding the lake from excess water may also result from escape of the Saurashtra Branch Canal, in case of sudden failure of pumps and electricity.

Pic 19. Nal Sarovar bird sanctuary – Fauna

Pic 20. Nal Sarovar bird sanctuary – Flora



Source: LandSat-TM

Fig. 34. Land use Land cover GIS map of Nal Sarovar Bird Sanctuary

The identified impacts are outlined below:

- Entire flora can be washed out altering the food and other resources available to water fowl in case of failure of the planned irrigation system.
- Waders, surface feeders and herbivores bird species shall be adversely impacted due to release of water in the lake between November to March as entire eco-system of the lake would experience negative changes.

- In case capacity of the lake is increased beyond RL 9.4 this would adversely impact the shallow lake eco-system representing unique wetland.
- Due to absence of drying of the lake eco-system might metamorphose into some other degenerated wetland.
- Any fishing activities beyond practice today would disturb the peace of the wetland.
- Due to additive property of the agriculture chemicals and their non degradable nature will be enter the food chain and web poisoning the entire fauna of the wetland.
- This wetland being near to the metropolitan town of Ahmedabad would experienced increased industrialization and resulting increase in pollution loads and consequently toxicity of the soil, besides impact of urbanization, industrialization and shift in land use pattern due to increased value of the land.
- Increased unregulated tourism and other allied activities.

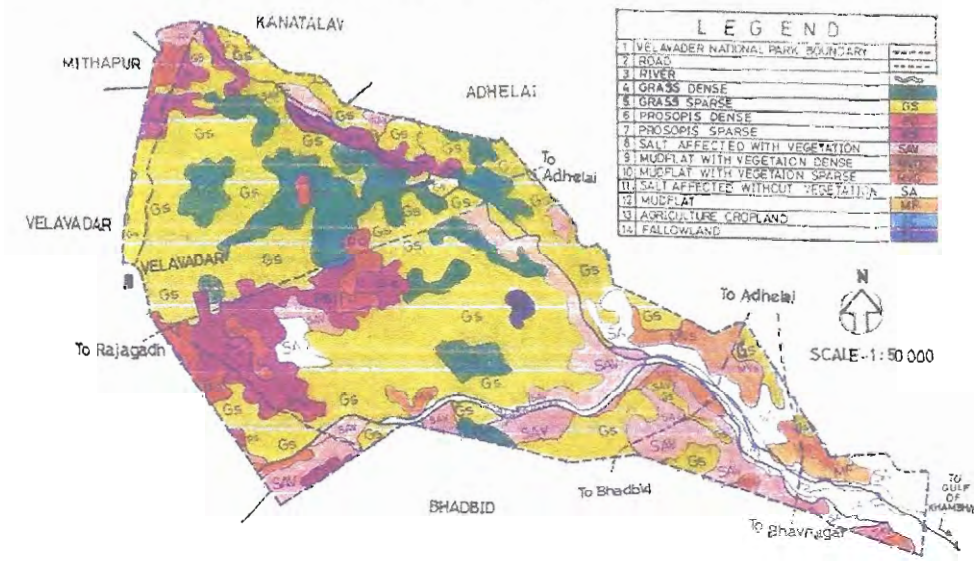
Wildlife Protection Act prevents any activity which is harmful to animal or its habitat. Government of Gujarat vide their letter dated 1-12-04 submitted a copy of the action plan for Nal Sarovar Bird Sanctuary. The features of the plan, however places reliance on:

- Efficiency of the irrigation system, as planned
- Reliability of the irrigational operational mechanism
- Training and education to farmers.
- Development and setting up of a system of monitoring based on proposed programme
- Conjunctive use
- Mechanism for removing drainage congestion during monsoon
- Monitoring network of piezometers
- Present fertilizer consumption is 69 kg./ha for an average productivity 1644 kg/ha of the food grains which is much low and provides some room for the time being. Gujarat has much lower level 1/3 of fertilizer consumption as compared to Punjab. However use of bio-fertilizer is proposed to be encouraged.
- Maintaining of the water level in the wetland
- Monitoring of water quality of surface and ground water
- Promoting fisheries outside the lake areas.
- Promoting awareness, demonstration regarding use of organic manure, integrated pest management, drip irrigation system, farmers meeting, training at levels and publicity material.

Black Buck Sanctuary (34 sq. kms)

The 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 water logging 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.



Source: Environment Impact assessment of SSP on Velavadar National Park, GEER Foundation, August 1997

Fig. 35. Land cover classes in Velavadar National Park as on 1984

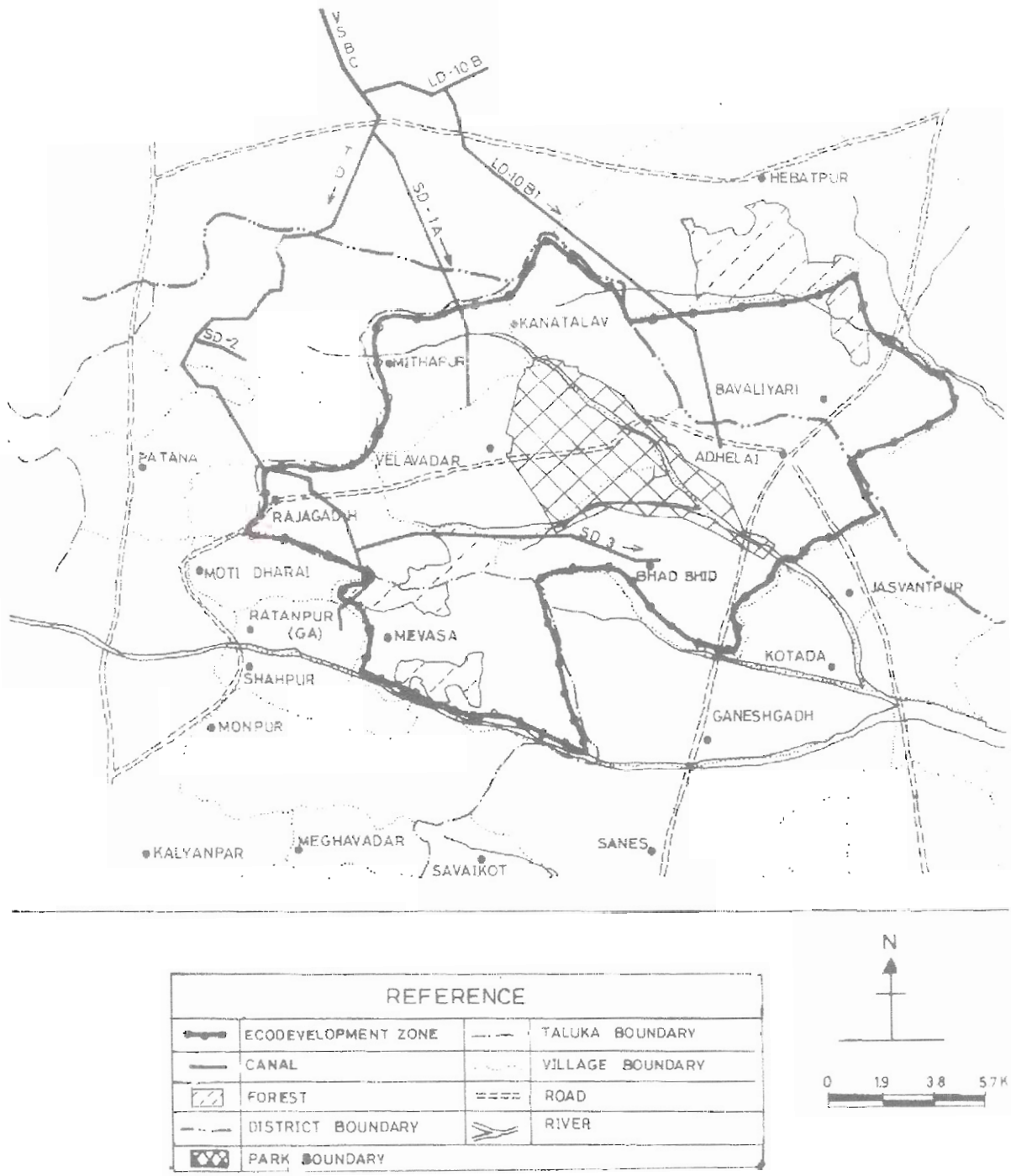


Fig. 36. Layout map of Black Buck sanctuary, Velavadar

Pic 21. Black Buck Sanctuary, Velavadar

Government of Gujarat submitted a copy of the Action Plan for the park prepared by Dr. S.A.Chavan which included following mitigatory measures. However Phased action programme for the incremental measures, provision of budget and monitoring mechanism is not yet in place.

- Increase in the area of park
- Lining of the canal surrounding the park
- Two corridors of 50 m width on canal SD-3 for movement of Black Buck across the canal
- Removal of prosopis species and development of grass land
- Plantations of Salvadora species
- Denning area of the wolves outside the park should be protected both inside & outside the park
- Devalia-Paliyad zone should be managed as satellite core & brought under the management of Park Authorities.
- Existing salt pans should be rehabilitated at alternate sites and no further permission should be given.
- Bio-gas plant, Cattle vaccination, immunization programme, increase in gauchars, fuel wood and fodder
- Agro-forestry would be encouraged

- Conservation awareness programme through audio & video
- Control of blue bull
- Limiting the use of insecticides and promoting bio-fertilizers
- Cropping pattern should be managed to prevent animal human conflict over the resource during summers.

Wild Ass Sanctuary: Little Rann of Kutch (LRK) (4953 sq kms)

This is one of the unique desert ecosystems and most fascinating wilderness areas in the world. True saline desert of the LRK is last abode for Indian wild ass, Equus hemionus khur, only gene pool in the world. LRK has been identified by the GOI as an important site for Biosphere Reserve due to uniqueness of the area and its support to rich biodiversity including some of the rare and endangered species (11 species listed in Schedule-I) of the Wildlife (Protection) Act, 1972). LRK is known for very high scientific research and wilderness values with high potential for nature & environmental education and wildlife tourism.

Pic 22. Wild Ass Sanctuary: Little Rann of Kutch

- Five branch canals viz Maliya, Jhunjuwada branch, Rampura branch with two distributories viz Jayanagar and Taranager, Amarpura branch and Kutch branch which (pass through the Narrow neck at the Northern tip of LRK joining with GRK sanctuary) will, with their command, shall impact the sanctuary.

- The Kutch Branch crosses the neck dividing the Little Rann and the Great Rann. This is likely to impede the movement of Wild Ass, Chinkara and other animals between the two runs especially during the winters. This is required to be resolved.
- It has mangrove vegetation in Hadakiya creek near south west direction. The mangroves are regenerating in these areas. Besides Marsh vegetation is also improving.
- The sanctuary is under pressure because of salt industries and intrusion of cattle besides invasion of Prosopis species.

The suggested mitigatory measures included structures facilitating the movement of Wild Ass, regulation of salt works, Conservation and change in legal status of bet, habitat conservation, control of Prosopis, identification of salinity ingress and periodical monitoring. The EIA report suggested further studies on movement of Wild Ass and recommended that the most appropriate structure for the crossing is required to be worked out in consultation with Equus specialists so as not to impede the movements of Wild Ass. The macro plan submitted by GoG suggested that

- Canal could be laid underground at four identified places; to facilitate the movement of wild asses at ground level with natural light between the Little Rann and Great Rann.
- Besides the above passage, there could be passages over the canal at intervals of 1.5 km for movement of people and animals which can also help migration of wild ass.

Considering the importance of the Sanctuary, these suggestions are subject to scrutiny of Equus specialist and are required to be supported through further studies as suggested by the EIA study group.

Public Health

Introduction

Despite multiple benefits, however, dams may have certain adverse effects on health which accompany them. Effective health planning to mitigate the adverse effects can make dams a great boon. Environmental changes occur due to construction of dam and due to submergence of the land. The change in environment equally effects the population living in the vicinity of the area. They are exposed to increased humidity, insects and parasites. Similarly in command area of project, if proper drainage arrangements are not in place then it may result in water logging and soil salinity. All these causes together are responsible for increase incidence of diseases and increased morbidity load on the area. It needs immediate effective actions through preventive,

curative and promotive health services. A systematic data collection makes planning process easier. Sometimes a fake notion exists that bigger the size of dam bigger is the problem but actually this is not the case. Smaller or bigger Dams are equally responsible for creating the health problems. The problems involved could easily analyzed if the proper data collection is carried out. Similarly the health hazards can be easily handled if proper health action plans are in place and are executed properly.

The health planning almost amounts to mitigation plan for averting the likely adverse effect due to construction of dams. It is called as action plan or project mitigation or health management of area. The main objective is the proper implementation and certain actions to eliminate adverse health impacts or to reduce them to acceptable levels. The planning process involves certain preliminary steps which includes collection of basic data of area by the retrospective studies from the available records and prospective studies through intervention of experts of the field. This project is called as detailed project report with activities to overcome the adverse effects.

Public Health Management for Sardar Sarovar Project

- Major environmental apprehensions are with reference to the water-related diseases of malaria, filaria and schistosomiasis.
- Malaria is found to occur naturally in epidemic cycles in Gujarat, partly Influenced by climatic factors. 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.
- Filaria caused by the mosquito species of Culex qinquefasciatus (fatigan) is confined to coastal areas of Saurashtra and South Gujarat
- Other water related diseases like dysentery, typhoid, hepatitis, gastroenteritis etc. and major factors like sewage disposals, septic tank discharges, overall hygiene of the rural population and quality of domestic water supply under cities and towns are the key issues.

Action Plans

Integration of all developmental activities related to irrigation, drainage, agriculture, co-operatives, roads, marketing, forests, rural electrification etc. is considered as a basic requirement for the command area development programme targeted for SSP. Action Plans are required to be firmed up the key issues like water logging, drainage, health, fisheries, flora fauna etc. for the Command Area.

Macro plan for development of the Phase-I area of the project

Covering the command between the Narmada and the Mahi rivers was submitted by Gujarat during 2004-05. The essential component of this plan included the following measures.

Flora and Fauna

- Plantation Programme
- Existing Plantation Programme in the Command
- Irrigated plantation
- Community forestry
- Farm forestry
- Programme of the works on SSP command
- Development of botanical garden for ex-situ and in-situ conservation of key flora of the SSP command
- Bio-diversity Conservation plan including Agro bio-diversity Conservation, Domestic animal diversity conservation
- Financial Outlay

Fisheries Conservation and Development

- Project Planning
- Project Cost
- Management and Operation

Prevention of Soil Salinity and Water Logging

- Conjunctive use of water
- Environmental impacts & related observations
- Usefulness of groundwater monitoring in mitigating the impacts on environment
- Action taken on recommendations by the study group.

Agriculture

- Water courses and field channels
- Land leveling,
- Field Drains
- Support and Assistance to Farmers
- Network of approach road
- Marketing and Warehousing
- Establishment of Agricultural Research *cum* Demonstration centre
- Consolidation of land holding where possible

- Extension of Agricultural Activities
- Agro-Industries
- Problem area: Bara Tract Area (Region 4)

Public Health

- Development Planning
- Policy Prescription
- Strategic Planning
- Existing Health Programme
- Health Infrastructure in command area
- Health Infrastructure at Project Site
- Health Infrastructure at R&R Sites
- Phased Programme Phase-I
- Project Implementation and Operation
- Financial Implication

Water Quality

- Surface Water
- Ground Water
- Agricultural chemical use
- Industrial waste and Effluent discharge

Development of delivery system v/s implementation of Environmental Safeguards.

Construction of Canal Phase-I (Ch 0.00 km to 144.500 km, Mahi crossing) along with the distributaries have been completed in all respects. Construction works in the reach between kms, 144.500 and kms, 263.165 i.e. NMC Phase-II-A have been completed in all respect. The construction works in the canal reach between kms 263.165 and kms 357.196 i.e., NMC Phase-II-B are in advance stage of completion. Surface drainage is being provided up to 40 ha chaks concurrently with the construction of canals. The command coming under Phase-I extends up to Narmada-Mahi doab and areas coming under this belongs to agro-climatic zone no 1 to 4. By now, almost all the major studies have been completed and impacts are known. Action points have also been determined. The status of the command area development activities and environmental safeguard measures is presented below.

Table 18. Status of Implementation of Environment Safeguard Measures for Command Area & downstream of SSP.

Sr.	Activity	Total Target	Target 2012-13	Achievement
1	**Measures in susceptible water logging areas**			
A	Plantation	160 ha	120 ha	120 ha
B	Seeding distribution	4 lakh	3 lakh	2 lakh

C	Khedut Talim Shibir	20 nos.	12 nos.	8 nos.
2	**Measures in Saline Area**			
A	Plantation	80 ha	60 ha	60 ha
B	Seedling distribution	4 lakh	3 lakh	2 lakh
C	Khedut Talim Shibir	20 nos.	13 nos.	8 nos.
3	**In-situ conservation**			
A	Canal bank plantation	20 ha	15 ha	15 ha
B	Seedling distribution	4 lakh	3 lakh	2 lakh
C	Khedut Talim Shibir	20 nos.	12 nos.	8 nos.
4	**Ex situ conservation**			
A	Biodiversity conservation	30 ha	-	-
B	Strengthening of botanical gardens of universities in command	2 nos.	-	MS University of Vadodara executing the plan

Downstream Environment: Environmental Flow from Sardar Sarovar Project

During the NWDT Award there was no concept of environmental flow. Later it was decided that to save the environment in the downstream reach of Sardar Sarovar project, a constant discharge of 600 cusecs of water was required to be relieved at all times. These 600 cusecs of water, when added to the water released after generation of power from the riverbed powerhouse, was sufficient to maintain the ecology and environment in the downstream reach of Sardar Sarovar Project. But due to drought in the last two years this 600 cusec water was not sufficient. To maintain the same, it was represented before the NGT that the constant release of water should be increased from 600 cusec to 1500 cusec. The NGT then stated that the environmental subgroup of NCA has members from all party States and from the Central Government, thus it can review the release for environmental flow.

This issue was taken up in the 51st Meeting of Environmental Sub-group and it was decided that Environmental Subgroup should wait for the Environmental Flow study, which is under preparation, to be completed before taking any decision. It was reported that the said report is expected within the next six months or so.

Current Scenario in Rajasthan: Sources of Impacts

Sanchore is a town in Jalore district in the State of Rajasthan. It is the headquarters of Sanchore tahsil located on National Highway 15. This historical town is situated 63.2 from the city of Jalore. Narmada Canal enters Rajasthan at Silu Village - 8 kms from Sanchre city.

Narmada Main Canal

Rajasthan has been allocated 0.5 MAF (616 MCM) of Narmada water under the final award of NWDT. To utilize its share of the Narmada water, Government of Rajasthan had planned a 74 km long main canal to run along contour and 9 distributaries to irrigate 73,157 ha. of land in the drought prone districts of Jalore and Barmer.

The scheme has since been revised to cover a C.C.A. of 2.46 lakh ha through lift and flow schemes. Besides irrigation benefit to 89 villages (74 in Jalore & 15 in Barmer), the project also envisages to provide drinking water to villagers of the District of Jalore & Barmer.

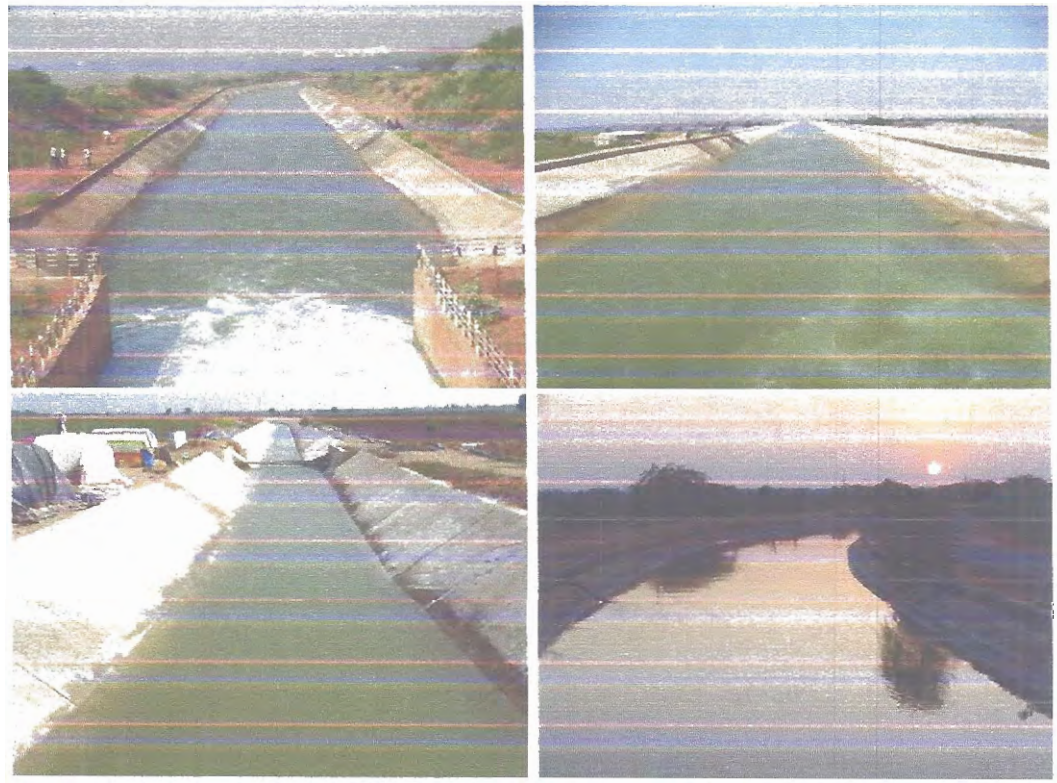
The entire Narmada Main Canal works in Rajasthan are complete. There is drastic positive impact in living standards of people in Jalore and Barmer districts after the introduction of NMC. People have started farming in these areas which was once considered drought prone.

Pic 23. Cotton and Pomegranate farming in Jalore and Barmer Districts showing an increase in living standards of local people

Salient features of Narmada Main Canal in Rajasthan are given in following table:

Table 19. Salient features of Narmada Main Canal in Rajasthan

Sr.	Particular	Value
1	Gross Command Area	3.00 lakh ha (Revised)
2	Culturable Command Area	2.46 lakh ha (Revised)
3	Breakup of areas under irrigation	
	Kharif	Nil
	Rabi	2.46 lakh ha
	Intensity of Irrigation	70%
	Capacity Factor	0.456
4	Cost per hectare of gross irrigation area	Rs 48,233
5	Cost per 1000 m^3 of water delivered at the head of canal	Rs 8,099



Pic 24. Narmada Main Canal in Rajasthan

Water Delivery Network

The water delivery system caters 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 distributaries. This outlet remains fully open for a fixed period during irrigation water demand and closed during periods of either no water demand or no water availability. Water is delivered only on the basis of the demand to a group of organized 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 distributed through Warabandi and Osarabandi system.

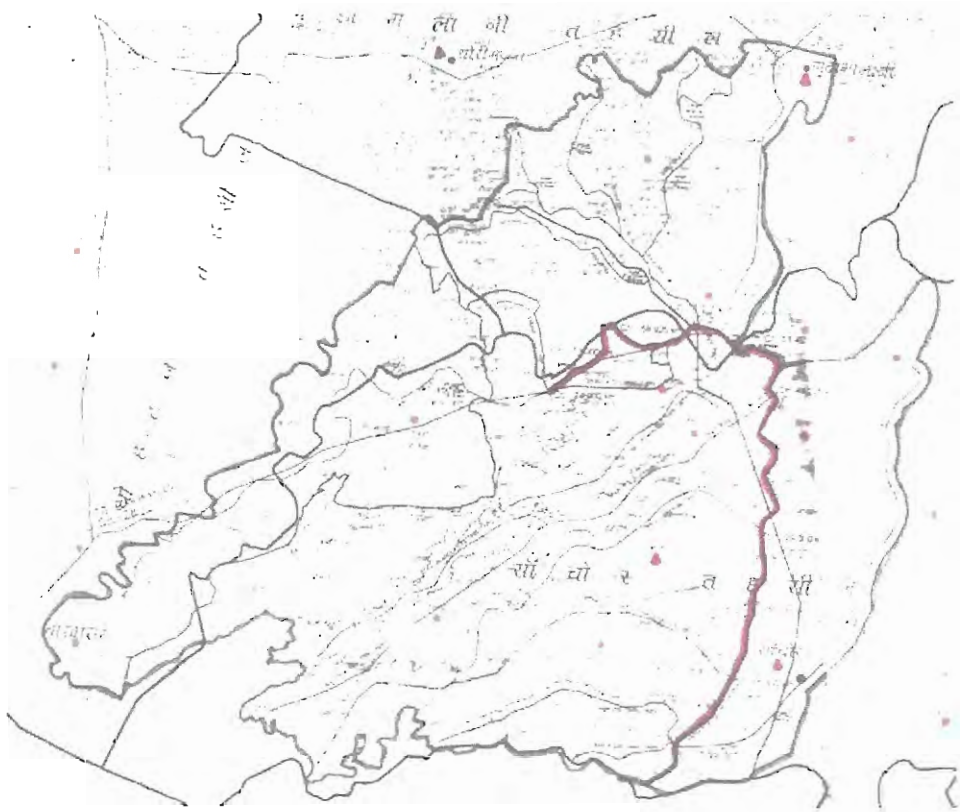


Fig. 37. Water delivery network map in Rajasthan

Pic 25. Water delivery network in Rajasthan

The Distribution System under Village Service Areas

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.

Pic 26. The Distribution System under Village Service Areas

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 liters/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 judicial 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 synchronizing 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.

Environmental Planning

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 during 1990. Ministry of Environment & Forests directed that since Command area in Rajasthan was a part of the Sardar Sarovar Project being monitored by the Narmada Control Authority for compliances of the conditions imposed by the MoEF they should submit this plan to the NCA for scrutiny & further advice. Environment Sub-group of Narmada Control Authority suggested further studies on detailed EIA. In follow up Government of Rajasthan assigned certain studies on Command area in Rajasthan portion to WAPCOS. The WAPCOS submitted its final report during 1998. The key recommendations were as follows:

Negative Impacts

- About 990 persons in 23 villages are likely to be displaced.

- Major water related diseases in the project area is malaria with API being as high as 11.0 in some areas. Thus there is a probability of increased incidence of malaria in project operation stage.
- 867 ha of land would be acquired of which 52.8% is B-I, 21.1% is B-II and 26.1% is B-III category.
- Increased irrigation impact and associated seepage and infiltration losses can lead to problem of water logging and soil salinization.
- Continuous irrigation can lead to reduction in permeability, which along with rise in groundwater levels can result in water logging.
- Increased cropping intensity can cause change in soil fertility, soil structure and texture.
- Introduction of irrigation replaces the xerophytic plants by new plants which become weeds in irrigated areas. The weeds likely to proliferate are *Asphodelus tennifolies (Pyazi), Carthamum oxycantha (Piliphuki), Fumasia indica (Kilano),* etc.
- Introduction of irrigation increases the runoff. The agro-chemicals are also transported along with runoff. This can create problem of Eutrophication in the post project phase.

Positive Impacts

- No impacts are anticipated on the forest lands, historical and cultural monuments.
- Project proposes provision of sustained irrigation over an area of 75,157 ha. The irrigation intensity would increased by 54%.
- Estimated net value of agricultural production would increase from Rs.303.7 million (pre-project) to Rs.1,022.85 million (post-project) at 1992-93 price levels;
- About 47,487.6 ha (31.09% of the GCA comes under the category of wastelands which can be utilized under social forestry and pasture development programmes.
- Commissioning of the project would lead to industrialization and urbanization of the area. Many agro based units such as oil extraction and flour mills are likely to come up in the area.
- Construction of the project would increase the fodder production by 84,500 tonnes per year which can satisfy the fodder requirements of about 9,260 cattle per year.
- Project will provide drinking water facilities to 124 villages in the command area. The population served will be about 3.20 lakh (in the year 2030-31).
- Increased water availability will lead to domination of trees like *Prosophis juliflora Zizyphus sp.* and *Acacia sp.*

- Introduction of irrigation will raise the moisture content from 0-7% to 15-22%. Under such conditions, there will be increase in the population of earthworms.
- Amongst the microorganisms, the dominant species would be *Aspergillus, Fusarium, Pencillum* and *Rhizopus.*
- Introduction of irrigation will increase the soil moisture, vegetal cover, and improve the land grading conditions. This will reduce the soil erosion by about 75%. Hence, the pre-project soil loss of 0.16 million tones / year will reduce to 0.04 million tones / year.

This report was approved by the Government of Rajasthan. The State Government initiated actions related to the recommendations contained in the report. The action taken by the State Governments on the recommendations of the WAPCOS included the following:

- To review the technical, operational and management parameters so as to make the Project sustainable and environment friendly.
- It is proposed to extend the command through lift irrigation,
- Increase in running days of the canal, differential reduction in duty,
- Increasing irrigation intensity,
- Conjunctive use of water,
- Participatory irrigation management,
- Volumetric delivery of water into storage tanks to water user.
- Setting up of the associations,
- Use of pressure irrigation captive power generation
- The use of unconventional source of power for pumping.

The revised project proposal was estimated to cost Rs.1446.88 crores, the gross command area was increased to 3.0 lakhs ha and the cultural command area to 2.46 lacs ha. This project proposal was approved by the Cabinet Committee vide dated 20th September 1999.

Chapter 5 Flora, Fauna, Wildlife and Carrying Capacity

Introduction

The guidelines of the MOEF required that while seeking environmental clearance for the hydropower projects, surveys should be conducted so that the status of the flora and fauna present can be assessed, listed (rare and endangered) species can be detected, if present, and appropriate conservation measures devised.

On the basis of relevant details supplied by the various states, MOEF issued clearance. A condition of this clearance, as far as it related specifically to the Flora & Fauna, was that the Narmada Control Authority would ensure in-depth studies on flora & fauna needed for implementation of Environmental Safeguard measures. 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

- Gene pool, if any, likely to be affected.
- Details of wildlife habitat in the region
- Measures proposed to rehabilitate endangered species of flora fauna, if any.
- Assessment of the carrying capacity of the neighboring areas where in the wildlife would dispose if the scheme were implemented.
- Plan for rehabilitation of endangered flora & fauna.

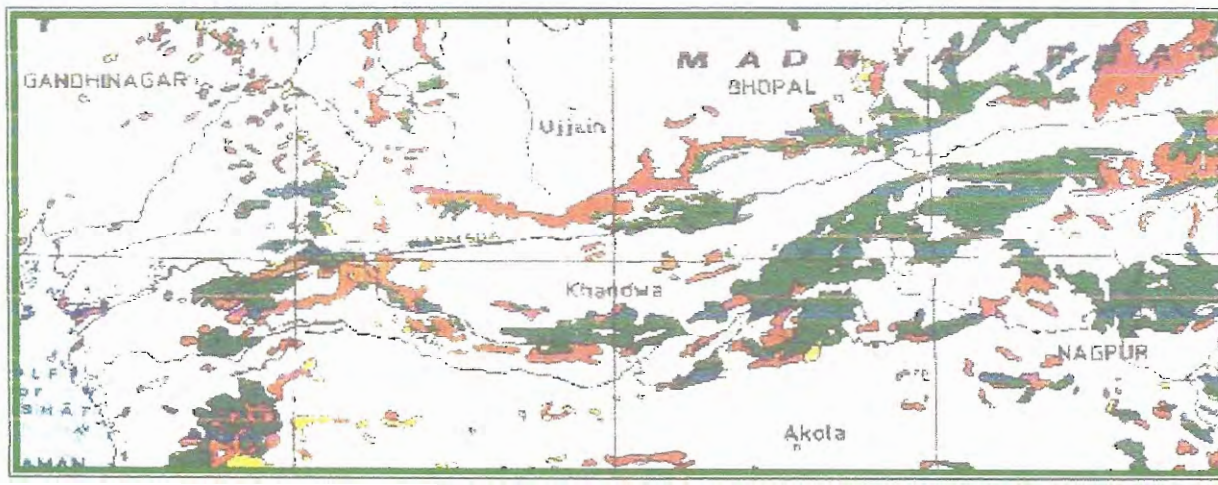


Fig. 38. Vegetation map of Narmada Basin as published by Forest Survey of India

Studies / Surveys

Important survey work included the following:

- The Environmental Impact Study of 1983 prepared by MSU.
- Preliminary Report on First Botanical Exploration and Plant Collection from Narmada Valley by the Botanical Survey of India in 1986.
- Report on the Survey of the Narmada Sagar Area by Zoological Survey of India, 1988.
- Note on Sardar Sarovar Project - Preparation of Environmental Work Plan for Forest and Wildlife by the State Forest Department, GOM, 1988.
- Status of Flora and Fauna in and Around Sardar Sarovar Project, Maharashtra is studied by the University of Pune (1992-94). Final report is received in NCA.
- Eco-Environmental and Wildlife Management Studies in the Sardar Sarovar Area in Gujarat, 1992, by MSU.
- 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 and financed by the NVDA. This study was completed & report was submitted in 1994.
- Workshop on Approaches to Integrated Wildlife Management in Gujarat: A Report by the SSNNL, October 1990.
- People's Involvement in Wildlife Management, by VIKSAT in 1991.
- Wildlife Management Studies in the Submergence and Catchment Area of Narmada Project: With Special Reference to Shoolpaneshwar Wildlife Sanctuary, by the SSNNL, 1992.
- Narmada Basin Water Development Plan: Development of Fisheries, 1987, was prepared by the Narmada Planning Agency, GOMP.
- Rapid Reconnaissance Survey of Limnological Aspects Part I, II and III, 1987, were undertaken by the Bhopal, Vikram and Rani Durgavati Universities for GOMP.
- The Central Pollution Control Board, Central Water Commission, the State Pollution Control Boards and the National Institute of Oceanography have collected water quality data.
- Narmada River Basin Development Project: Fisheries Component, 1991 by the German Consultants to the World Bank, GOPA.
- Sociological Survey of the Fishing Families of the Narmada River by CICFRI, 1991.
- Aquatic Fauna (Fish) Studies in Indira Sagar Submergence Area, prepared by the Friends of Nature Society in 1991 on behalf of the NVDA reported on the fish fauna of the Narmada.

- Pre-and Post-Impoundment Limnological Studies of Narmada Basin, by three universities coordinated by Barkatullah University for the NVDA. (1989-92) Study report was available in 1994.
- Studies on Fish Conservation in Narmada Sagar, Sardar Sarovar and its Downstream, is a desk review sponsored by the NCA and undertaken by CICFRI, 1993.
- 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 CICFRI. Recommendations of Key Studies

Several aspects of the Sardar Sarovar Project have potential to cause adverse effects on the terrestrial ecology of areas upstream of the dam, principal amongst these were related to changes in the land and water environment including the following:

- Changes in land use pattern including submergence
- Changes in the Micro-climate
- Changes in the aquatic environment in upstream, downstream & also in the command area

Government of Gujarat

For areas in Gujarat, the study was conducted by the Department of Botany & Zoology M.S. University, Vadodara. The study concentrates upon ecology & environmental aspects of the submergence & catchment area. The study is actually an extension of the earlier bench-mark study conducted during 1983 which highlighted the positive & negative aspects in the upstream, downstream & command of the Dam and environmental impact statement". The study concentrated upon the study area was about 20 km. On each side of Sardar Sarovar in Gujarat & extended Shoolpaneshwar sanctuary encompassing about 1599 sq.km. area. A chapter of this study contains suggested "Management strategies & action plans to mitigate the adverse impacts. .M.S. University, Vadodara conducted EIA & recommended several measures for preparation of Environmental Management plan for the upstream environment. Key recommendations focused amongst others on the following issues.

- Rehabilitation plan for the identified animals and plants
- An independent monitoring and evaluating infrastructure is an absolute necessity for successful execution of these strategies and action plans.
- To undertake development programmes in rural areas in natural watershed unit.
- Institute rational land use planning,
- Undertake reseeding programmes

- Training the manpower for necessary industrial skills and establishing interactive relationships among different units of the state.
- During 4th field visit of ESG it has noticed that project authorities have undertaken various activities in Shoolpaneshwar sanctuary. 25% of plantations within the sanctuary shall include 11 species of local variant and also includes yellow variants of Butea monosperma. Eco-development works are also taken up in the buffer zone. Development of medicinal plants has also been introduced.

Government of Maharashtra

For areas in Maharashtra, the study was conducted by Department of Environment Sciences, University of Pune at the instance of Department of Environment, Government of Maharashtra. The study encompasses the SSP impact areas in Maharashtra only. The study was conducted by School of Environmental Sciences, University of Pune at the instance of Department of Environment, Government of Maharashtra. The study was conducted along the Maharashtra border for a period of 18 months (1992-1994). The area covers roughly 70 Km long and 20 Km wide belt 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 key recommendations were as follows.

- Survey of animal species required long duration and hence not covered. Further detailed recommendations were made for further investigation of identified species of plants and trees. However, management of corridors for shifting of wildlife, several corridors, passing through moderate to good (0>3) vegetation cover was suggested.
- 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.
- Seed bank of the surface soils from low-lying (e.g. valley bottoms) areas were to be used for developing vegetation (natural) in degraded catchment.
- 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 ,improvement of high diversity vegetation cover and soil potential should be exploited and encouraged.

Government of Madhya Pradesh

For areas in Madhya Pradesh, the study was conducted by the State Forest Research Institute, Jabalpur and 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 of the impact area of SSP falling in the state of Madhya Pradesh. The submergence (impact) areas were mainly falling in the three districts called Dhar, Jhabua and Khargone."The study indicate that the forests in the impact area were highly under stocked and their distribution by girth class very erratic the condition of impact area is not conductive to support good wildlife and as such it appears less likely that some corridor would be needed to act as escape route for wild animals. However to provide alternate habitat for the wildlife two sanctuaries namely Mathwad (34659 sq. km.) in Jhabua district and Bokrata (3559 sq. km.) in Khargone district were proposed. In the study the carrying capacity of forests of the impact area cannot be estimated with any accuracy. The key recommendations included the following:

- Catchment protection work both engineering and biological coupled with joint forest management. Reestablishment of indigenous forest ecosystem and local diversity.
- Production of fodder through agro-forestry or silvi-pastoral system through management of village wastelands. Production of bamboo through agro-forestry.
- Using state-of-the-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.
- Intensive campaign for forestry-cum-environment awareness, peoples participation backed by development legislation should also be launched.
- Introduction of quick growing exotics in interest of soil stabilization and meeting the requirement of people in short time.
- 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.
- The area is stated comparatively scarce in wildlife with no species that was endemic but to provide alternate habitat for the wildlife two sanctuaries namely Mathwad (346.59 sq. km.) in Jhabua district and Bokrata (35.59 sq. km.) in Khargone district were proposed.
- Studies recommended creation of two Wildlife sanctuaries namely Mathwad (34659 sq. km) in Jhabua district and Bokrata (35.59 sq.km) in Khargone district.

Action Plans: Wildlife (Terrestrial)

To ensure that the wildlife conservation measures were implemented effectively in consonance with the requirement of Environmental control in terms of the order of clearance and the relevant acts and statutes, action Plans for the three states were required. Most of the studies related to flora & fauna were completed by 1994. Current status of the submission of the action plan is as follows.

Government of Maharashtra

Government of Maharashtra prepared plan for buffer zone plantations to cover 2500 ha area for completion in three years period. The target has been achieved.

Government of Gujarat

Following the preliminary report of M.S. University, Vadodara 1992, Government of Gujarat enlarged (to about four times its original size) the Shoolpaneshwar sanctuary located near the dam site in Gujarat. This sanctuary was earlier known as Dhumkhal Sloth Bear Sanctuary whose area was 153 sq.km. The area of the sanctuary was enlarged initially up to the shore line of the reservoir to enable animals of the sanctuary to have access to the fresh water. Later the area of the sanctuary was further enlarged to cover up a total area of about 607 sq. kms. Subsequently action plan for biodiversity conservation in and around fuel Shoolpaneshwar century was received during December 2007.

Government of Madhya Pradesh

Following the recommendations of the EIA study report and by the Wildlife Committee constituted by the Government of M.P. GoMP proposed Social Forestry Plantations for absorbing the impact of submergence and notification of two sanctuaries in the vicinity of the impact zone of the Sardar Sarovar Project for rehabilitation of the Wildlife as per details given below:

- To cater to increase requirement of timber, fuel-wood etc., social forestry programme at an estimated cost of Rs. 5.0945 crores chargeable to SSP (price level of 1999-2000) with escalation of 9% per annum was approved by the State Wildlife Committee. It was reported that plantations have been taken up mostly on the private land. Implementation of the recommendations made by the Committee which visited the areas are awaited.
- Declaring the Island being formed during progressive filling of the reservoir as wildlife habitat. It was reported by the NVDA that further steps would be taken up after completion of the project.
- Studies recommended creation of two wildlife sanctuaries namely Mathwad (34.659 sq. km.) in Jhabua district and Bokrata (35.59 sq. km.) in Khargone

district. The State Wildlife Committee had not accepted these recommendations during its earlier meeting (July, 2000).

The Management map of the SSP showing status of SSP Environment is presented in following map. Light Yellow and green colored sub-watersheds (high and very high priority) were treated under Phase-I ,The blue (Maharashtra) and green (Madhya Pradesh) coloured sub-watershed of high and very high priority categories are being treated under Phase-II programme. Degraded forest areas within the impact zone are shown with purple and forests of density above 0.3 in green colour.

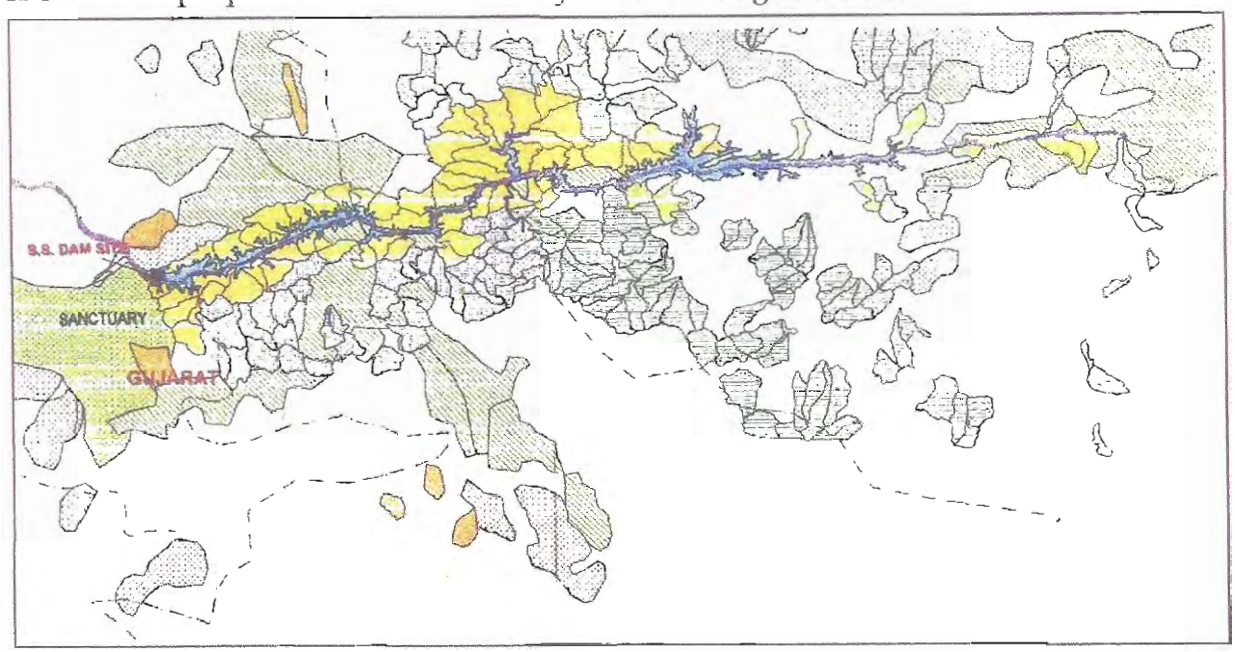


Fig. 39. Map of SSP showing status of SSP environment management

Action Plans: Fisheries (Aquatic Environment)

Action plans

Three State Governments originally submitted the fisheries development plans. These had to be re-planned as per recommendations of studies aimed for accounting eutrophication and allied risks, which are 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 Omkareshwar, Maheshwar and SSP areas. Phasing and programming with respect to pre and post-impoundment, clearance of the forests, training of fishermen, cooperative societies and post-impoundment management was proposed.
- Environmental Work Plan Sector Fish and Fisheries, GoG, 1986. This work plan, prepared in compliance with the agreement with the World Bank included the

establishment of fish hatcheries and fish farms, training of fishermen, 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 characteristic of the water and soil, and studies on flora, fauna, fish yield, plankton, and productivity in the reservoir. This plan was again revised by GoG in August 1997 & resubmitted to NCA during November 1997.

- Preparation of Environmental Work Plan for Fisheries Development in Maharashtra, revised plan of 2004 was submitted by the Government of Maharashtra.
- The original plan 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.

Implementation

Guidelines have been approved for development and conservation of Aquatic Ecosystem and to advise the state executive agencies for follow-up action. Test fishing in the dyke of SSP was carried out.

On-going Fisheries Activities in the Sardar Sarovar - Gujarat

Some fisheries development activities are already going in the Sardar Sarovar from the year 1992 onwards. From 1993-94, these programme received the financial support from the Sardar Sarovar projects. These activities were as follows:

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

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 project affected persons on the periphery of the Dykes / Reservoir were being trained for capture fisheries by the SSNNL, by providing fishing implements (like small tin boats and gill nets) through appropriate funding agencies, with the support of the SSNNL. A fisheries co-operative was registered at Panchmuli (Nadod Taluka) in 1998, under the title, Panchmuli Narmada Jalashay Vistar Adivasi Matsyodyog Limited of 102 fishermen with a share capital of Rs.17,000. The membership generally consisted of the project affected people of Panchmuli and nearby areas. Accordingly 26 persons were identified by the Assistant Director of Fisheries, Narmada District and they were trained in the fishing methodology/ capture fisheries by the Fisheries Department. The cost of the training was borne by the Fisheries Commissionerate under the ongoing training schemes.

Conservation of Aquatic Eco-System

The CIFRI conducted desk review study during 1994 and prepared pre & post impoundment plan requiring sequential action for conservation of aquatic eco-system as brought out below:-

Pre-Impoundment Stage:

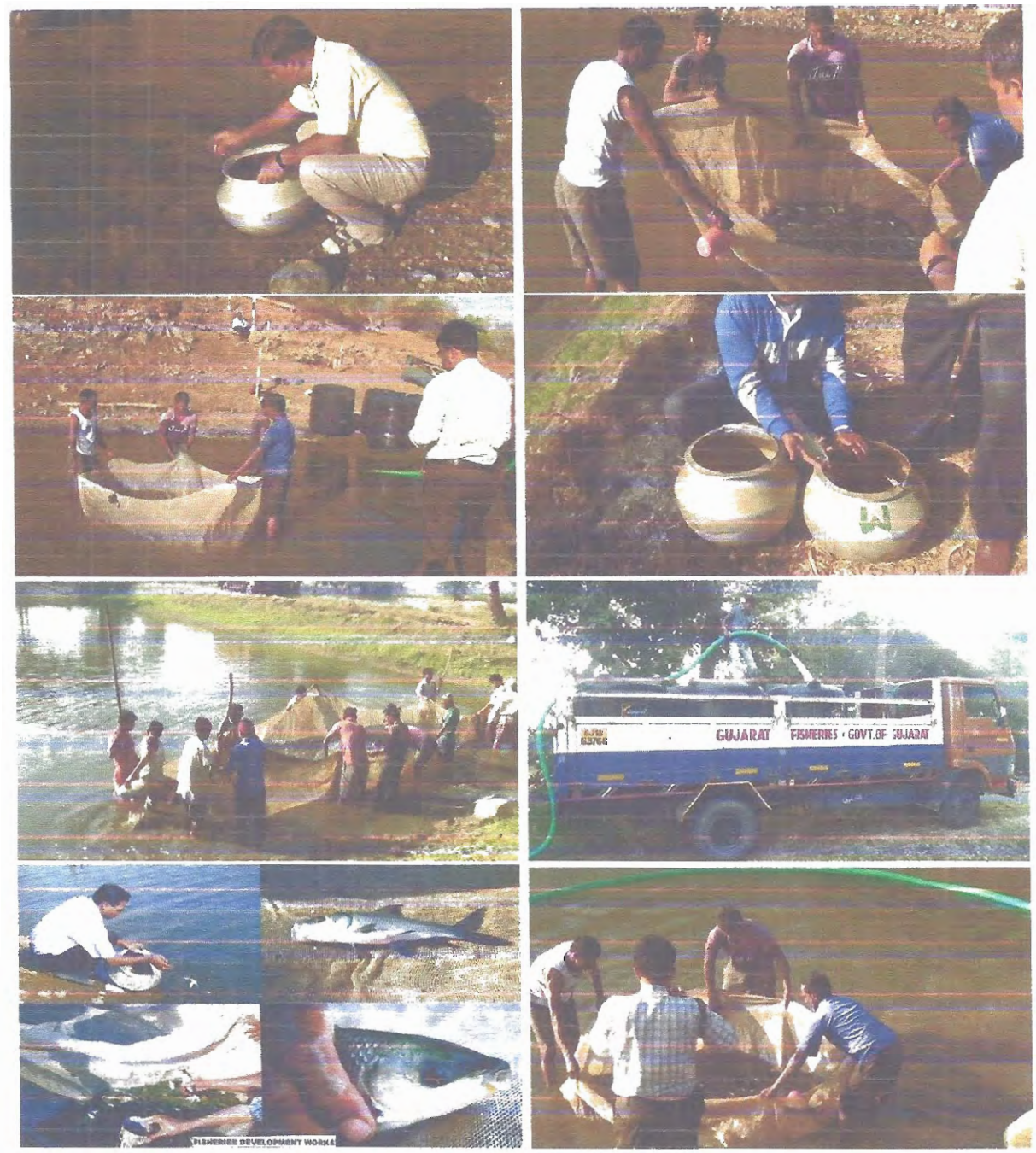
- Hydro-biological monitoring with particular reference to thermal stratification phenomenon should be taken up in the reservoirs like Bargi, Tawa, Barna and Kolar, sharing similar geo-climatic regimes. Investigations on the population of anaerobic bacteria may also be included. The studies would enable drawing tangible programmes during the post-impoundment phase of the River Narmada.
- Fisheries survey of the entire Narmada River basin is required to know precisely, the prevailing status of the important fish taxa comprising the fishery. This should be based on a statistically designed programme covering representative sectors of the basin. Faunistic survey of deep pools existing in the Narmada River has great relevance in delineating their possible role as sanctuaries since these provide congenial habitat to a number of endemic fish taxa particularly during summer season of low discharge. This would enable compiling information on the strategy to be adapted for revival of threatened endemic fish fauna from conservational perspectives. The survey may, however, be taken up by an Inter-State Fisheries Development Board, whose constitution is immediately required.
- Tree-felling plan should be executed prior to submergence. This would also enable smooth execution of exploitation programme.
- Identification of suitable sites for development of infrastructures required for execution of artificial propagation programme in respect of threatened fish fauna should commence right now. River ranching shall avail a good standing stock of the vulnerable fish taxa to the resulting reservoirs. Efforts should be initiated to develop rehabilitation methodology in respect of threatened fish taxa for which the same is not available.
- Pollution hazards should be monitored periodically.

Post-Impoundment Stage

- Reservoir fisheries development plan should incorporate an integrated approach. A holistic management programme shall be the ideal and lead to the conservation of endemic biodiversity to the maximum extent possible, which is of much concern in present context. The conservation of catchment area and rational use of agricultural inputs like fertilizers, pesticides should form

important part of this integrated approach. Public awareness regarding the judicious use of agricultural inputs should be propagated.

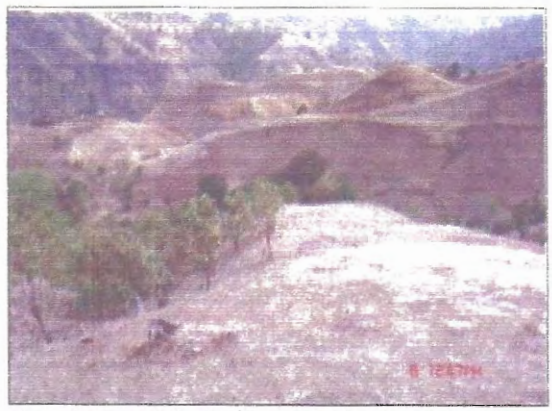
- Since SSP submergence falls in three States, an "Inter- State Fisheries Development Board" having representation from riparian states should be constituted to manage the reservoir. The board shall regulate all the management exercises, supervise and enforce the conservational measures for optimum sustained yield. The major measures are as follows:-
    - Multispecies stocking based on eco-oriented approach should be taken up. Efforts should be made to maintain a viable prey-predator ratio.
    - Stocking norms should be based on the potential of the resource.
    - Exploitation Quota based on M.S.Y. (Maximum Sustainable Yield) will have to be prescribed, for conservation of biota.
    - Regulation of mesh size of the gears.
    - Observation of Closed Season for allowing possible natural recruitment.
    - All negative/deleterious fishing operations like dynamiting, poisoning and over exploitation should attract prohibition and
    - Release of pollutants without treatment directly into the reservoir should be banned.
- The above measures have also relevance to other reservoirs coming up in the Narmada basin
- Hydro-biological monitoring should remain in vogue to scan the changes due to anthropogenic activities.
- An intensive stock augmentation programme will also have to be executed after the completion of dams. This is more important in respect of the threatened fish fauna.
- There is although remote possibility of development of weeds due to high water fluctuations in NSP and SSP but its monitoring is essential since these provide conducive environment for growth of vectors of a number of diseases.
- Revival of downstream fishery is based on the measures leading to salinity confinement or arrest to the desirable limits. Coastal aquaculture practices involving euryhaline texa may be taken up as a supplementary measure.



Pic 27. Fisheries development in Gujarat

Buffer Zone Nursery Work at Roshma, (Dhadgaon) (C.No.173), Year 2009

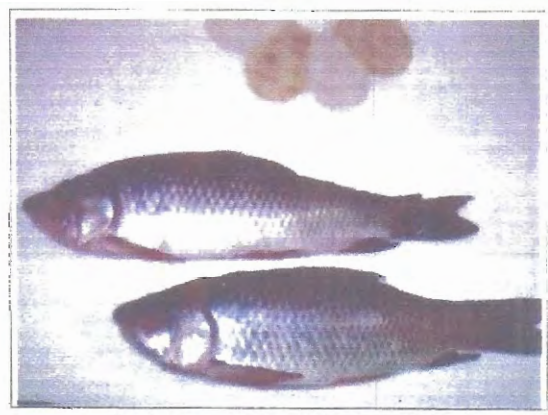
Buffer Zone Nursery Work at Roshma



Area Proposed for Buffer Zone Plantation, year2009, Roshmah(C.No.173), Dhadgaon

Fish species - *Catla catla*

Fish species - Mahaseer



Fish species – *Labeo rohita*

Source: Environmental Safeguard Measures in Maharashtra: A Status Report, Nov 2010

Pic 28. Some photographs of buffer zone plantations and fisheries development in Maharashtra

Felling of the Forest from the submergence area

Plans for felling of trees in the forest area coming under submergence to avoid the possibility of animals being trapped in the submergence area, prevention of Eutrophication, degradation of water quality, proliferation of disease vectors etc. were required for the areas in Gujarat, Maharashtra & Madhya Pradesh. Forest areas were required to be taken up for felling in a systematic manner to avoid any possibility of the trapping of the wildlife. Forest areas were taken up for felling in a systematic manner to avoid possibility of animals getting trapped during progressive filling of the reservoir and for prevention of Eutrophication and degradation of water quality.

Felling in forest area coming under submergence in all three states viz. Madhya Pradesh, Maharashtra and Gujarat is completed.

Summary of Status of Environmental Planning

Fisheries

The Governments of Maharashtra and Gujarat has undertaken programmes for fisheries development and conservation in the Reservoir located in their territory. Government of Gujarat has entrusted study to CIFRI for the preparation of Fisheries Development and Conservation including reservoir management from ecology's points of view. The Governments of Madhya Pradesh and Maharashtra are in process to entrust study to CIFRI in their territory for fisheries development and conservation including reservoir management from ecology's points of view.

Wildlife

Following table shows the achievements in managing the Terrestrial Environment (Wildlife):

Table 20. Summary of Environment Management: Terrestrial Environment (Wildlife)

Key Issues/Target	Achievements		
	Gujarat	Maharashtra	Madhya Pradesh
Survey of flora – fauna & assessment of carrying capacity	M.S. University, Vadodara, Report of 1992 on submergence and other impact areas.	Department of Environmental Sciences, University of Pune Report of 1994 for SSP areas in Maharashtra	SFRI, Jabalpur Report of 1993 and WLL Report of 2008 for SSP areas in Madhya Pradesh

Preparation and execution of plans as per recommendations of EIA Studies.	Identified plant species are being preserved at MS University's Botanical garden. e-herbarium have also been established in the University and the same was placed in public domain on 12.03.2016. The plan for the conservation of bio-diversity in Shoolpaneshwar sanctuary areas is also under implementation.	Buffer zone plantations covering 2500 ha is completed	Social forestry plan had been taken up to enhance fuel and fodder availability. Sixty islands to be formed at FRL of SSP Reservoir are to be left undisturbed.
Rehabilitation plan for the identified wildlife impacted by submergence.	The area of Shoolpaneshwar sanctuary located close to the dam was extended from 102 sq.km to 608 sq.km during 1989 to provide shelter to wildlife.	Sanctuary located close to the dam was extended from 102 km2 to 608 km2 during 1989 to provide shelter to wildlife. The Toranmal Forest has been declared as 'Conservation Reserve' by Government of Maharashtra in 2016.	A committee constituted by Government of Madhya Pradesh found that the proposed Kathiawara Sanctuary is located more than 30 kms from Sardar Sarovar Project (SSP) reservoir and there is no forested corridor linking it, and hence its declaration will not serve the purpose of rehabilitation of wildlife displaced by SSP reservoir. Committee directed State Forest Research Institute (SFRI), Jabalpur to prepare DPR for development of environment and wild life habitat in 5616 hectare of forest area known as Mathwad range adjacent to SSP reservoir. The SFRI came out with the detailed EIA study and formulated DPR and submitted to the Government of MP.

Chapter 6 Seismicity and Rim Stability

Introduction

The NWDT Report Vol – II, 1978 discussed the Geological and Seismological Aspects of Sardar Sarovar Dam. The Environmental Appraisal Committee had also examined 'seismicity' as one of the issues, based on the details supplied by project authorities. The Environmental appraisal of SSP was in context of the MoEF guidelines for EIA of RVP, in existence since January 1985. These guidelines included 'likely impact of reservoir loading on seismicity'. Accordingly, while describing the non-forestry activities the impacts expected on geological factors (e.g. seismic impact of reservoir loading) are required. The subject 'seismicity' was considered under environmental concerns related to 'likely impact of reservoir loading on seismicity'.

Seismo-tectonics at the Sardar Sarovar Dam Location

The seismo-tectonic set up in the Narmada basin in the vicinity of SSP and Reservoir comprises a crustal area in Deccan-Trap province. The area lies within the Indian peninsular plateau, where tectonic Stresses/strains are not significantly large and which is considered as a stable continental region (SCR) within the Indian plate. The Indian plate boundary lies near Himalaya, where subduction of Indian plate is continuing under the Eurasion plate. Due to this postulated plate boundary movement, large earthquakes can occur there. Intra-plate discontinuities do exist in the Indian plate, like all plates. Due to the north-eastwards continental drift, strain build-up caused within a plate gets dissipated on such discontinuities, causing intra-plate earthquakes, which are of relatively smaller size. Conventionally in SCR, a value of magnitude 6.5 has been considered as the upper limit of even the 'native' earthquake. Following large events have taken place in the SCR during the last 10 years.

- The Latur earthquake of 30 September, 1993 with magnitude of 6.4 was a significant intra-plate event within the postulated range of events in the geo-tectonic set up. The Lower Terna dam located about 15 km from the epicentre, did not suffer any damage due to the earthquake.
- The Jabalpur earthquake of 22 May, 1997 with magnitude 6.0 was similarly within the probable range of events. Bargi masonry dam of 69 metres height, located 25 to 30 km away from the Jabalpur earthquake epicentre, did not suffer any damage due to it.
- The Bhuj earthquake of 26th January, 2001 with magnitude of 6.9 located much closer to the western limb of the plate edge, was disastrous from loss of life point of view. But it was located about 400 km away from the SSD.

Reservoir Induced Seismicity

Reservoir Induced Seismicity (RIS) is caused by waters seeping into lower discontinuous rock features lubricates the clayey or weak material occurring in such features and makes them prone to slip or slide against each other, triggering release of accumulated strains, simulating relatively small magnitude earthquakes. Their magnitude is smaller than that considered in design, which takes care of the native seismicity, dictated by the geo-tectonic setup. Loads imposed and stresses caused on foundations even by very large dams and reservoirs are relatively insignificant as compared to the seismo-tectonic strains that cause earthquakes and the released forces and stresses that cause ruptures in rock-mass at the deep underground focal locations of the earthquakes.

Studies

The likelihood of occurrence of earthquakes, their duration, magnitude, intensity, and vibrations, destabilising forces, accelerations caused by them are studied probabilistically and deterministically both, by applying scientific processes laid down in sciences/applied sciences of geology, tectonics and seismology. They together indicate the seismic status or 'seismicity' at the location of a dam and the reservoir behind it. Structural and Civil engineering design methods take into account such forces and ensure design and construction of dams and reservoirs to withstand them without significant distress, for their life time.

Studies of reservoir induced seismicity (RIS) and rim stability have been carried out by the Geological Survey of India (GSI), Central Water and Power Research Station (CWPRS), University of Roorkee and World Bank Consultants. 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.
- GSI 1981-82 and 1982-83. A Geotechnical Report on the Reservoir Competency Mypougations in Parts of Sardar Sarovar Area, Bharuch & Vadodara Districts. Volume I & II
- Shenoi et al. 1982. Shenoi et al presented at the New Delhi Conference on the significance of Seismotectonic Aspects on Reservoir Development.
- Balasundaram, M.S. 1982 Sardar Sarovar Project: A Geotechnical Report compiled and edited for the Government of Gujarat.
- MSU 1983, The Sardar Sarovar Narmada Project Studies on Ecology and Environment.
- NVDA published a Position Paper on Seismic Studies in January 1986.
- Krishna, Dr. J. 1989. Dams and Seismicity.

- GSI 1990, Study of the Rim Stability of the SSP.
- GOI 1993, Sardar Sarovar Project Seismicity and Sardar Sarovar Dam.

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 SSP are as follows:

1	Rajpardi and associated faults forming Eastern boundary of Cambay basin West Coast seismo-tectonic province	Shortest distance to the lineament from dam site is 55 km towards West
2	Barkhadi-Barwani fault	Shortest distance from site is 110 km East
3	Piplod fault	Shortest distance 12 km South of dam site
4	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 (1) & (2) 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 epicentre distance of 12 Km with a depth of focus of 18 Km 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.

Implementation

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 Magnitude 6.50 and as it is established that the levels of Reservoir Induced Seismicity have never exceeded 6.3.

The SSP is located in a zone where moderate seismic activity has been recorded in the past. The adoption of earthquake resistant design parameters has, therefore, been an essential part of the project design. These parameters are governed by a national standard which applies to all new dam and engineering structures and classifies the country into different zones according to the frequency and magnitude of seismic events.

To minimise risks to the dam, seismic design coefficients have been adopted for preliminary design followed by dynamic analysis to withstand the predicted maximum earthquake in the seismic zone occupied by the proposed dam structure.

Further all the nine seismo monitoring stations have been established to provide R&D inputs for future design philosophy. The location of these nine seismo-monitoring stations is shown in following image:

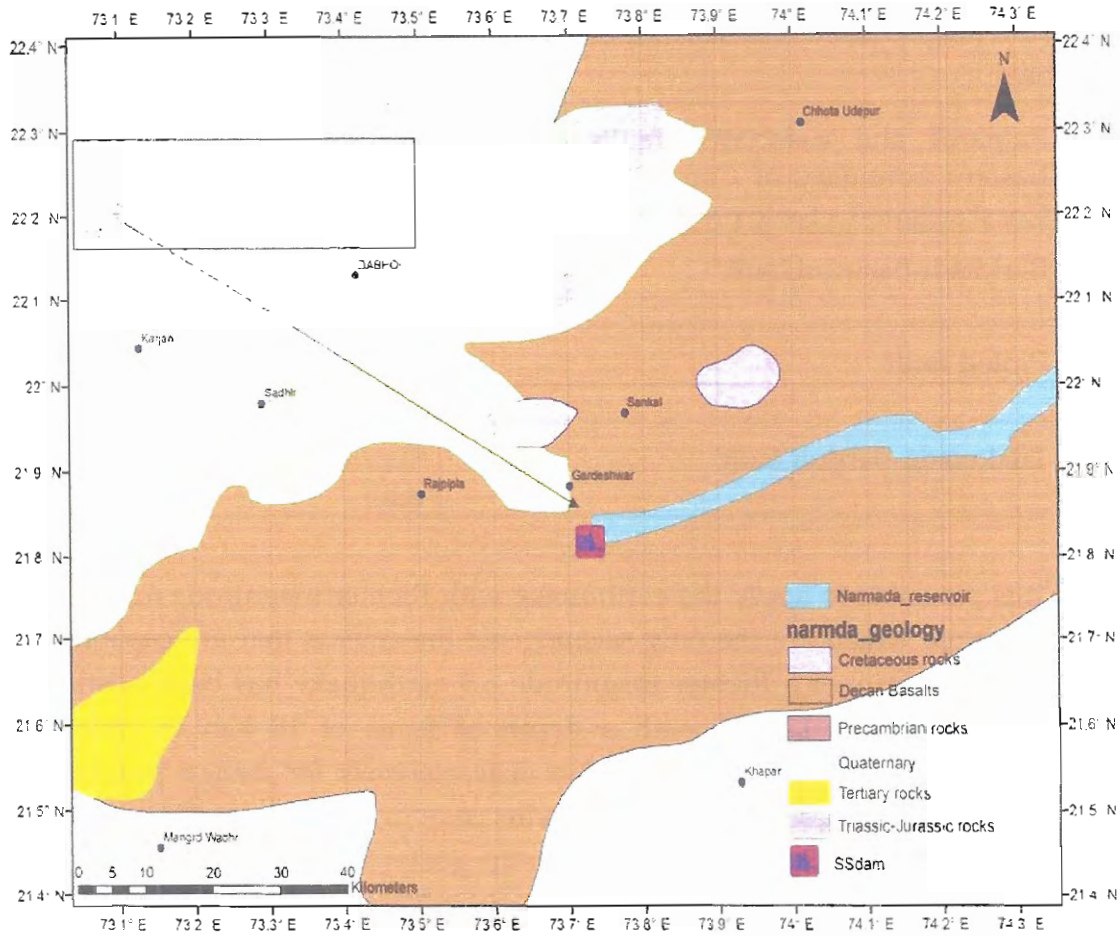


Fig. 40. Map showing geological setup near Sardar Sarovar Dam site

The details of the nine seismological observatories operated for data acquisition are given in following table.

Table 21. Details of the nine seismological observatories operated for data acquisition

Sr.	Station Installation (Year)	Lat (N)	Long (E)	Lithographic Foundation	Instrument	Comp-onent	Period
1	Kevadia Colony (1973)	21.88	73.71	Deccan Trap	Broadband Seismometer with digital recorder	Z,N,E	50 Hz-120 sec
					Strong Motion Accelerograph	Z,N,E	DC- 200 Hz

2	Naswadi (1990)	22.02	73.77	Sandstone	Broadband Seismometer with digital recorder	Z.N.E	50 Hz- 120 sec
					Strong Motion Accelerograph	Z,N,E	DC- 200 Hz
3	Jitgadh (1990)	21.82	73.54	Deccan Trap	Broadband Seismometer with digital recorder	Z.N.E	50 Hz- 120 sec
					Strong Motion Accelerograph	Z,N,E	DC- 200 Hz
4	Kawant (1990)	22.08	74.05	Deccan Trap	Broadband Seismometer with digital recorder	Z.N.E	50 Hz- 120 sec
					Strong Motion Accelerograph	Z,N,E	DC- 200 Hz
5	Alirajpur (1991)	22.29	74.17	Gneissic Granite	Broadband Seismometer with digital recorder	Z.N.E	50 Hz- 120 sec
					Strong Motion Accelerograph	Z,N,E	DC- 200 Hz
6	Barwani (1991)	22.03	74.92	Deccan Trap	Broadband Seismometer with digital recorder	Z.N.E	50 Hz- 120 sec
					Strong Motion Accelerograph	Z,N,E	DC- 200 Hz
7	Shahada (1993)	21.50	74.41	Deccan Trap	Broadband Seismometer with digital recorder	Z.N.E	50 Hz- 120 sec
					Strong Motion Accelerograph	Z,N,E	DC- 200 Hz
8	Sagbara (1999)	21.54	73.79	Deccan Trap	Broadband Seismometer with digital recorder	Z.N.E	50 Hz- 120 sec
					Strong Motion Accelerograph	Z,N,E	DC- 200 Hz
9	Kukshi (1990)	22.20	74.71	Deccan Trap	Broadband Seismometer with digital recorder	Z.N.E	50 Hz- 120 sec
					Strong Motion Accelerograph	Z.N.E	DC- 200 Hz

Rim Stability

Rim stability refers to the competency of reservoir base rocks to hold water. Under stable conditions, there should be no significant water loss to ground water within or out of basin. The Geological Survey of India carried out an in-depth study of the reservoir rim in Madhya Pradesh and Maharashtra which concluded that the reservoir rim is stable.

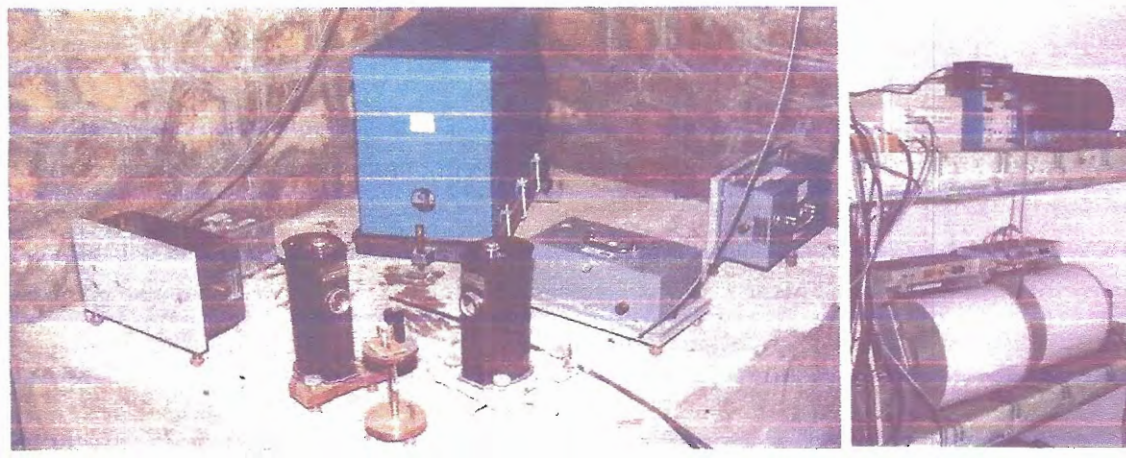
The various recommendations for modification of the dam design which have all been implemented are summarised as:

- Adoption of horizontal design coefficient of 0.125g 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 18m below the lowest riverbed.

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 M.P (Alirajpur, Kukshi and Barwani 1 in Maharashtra (Shahada) and 5 are in Gujarat (Kawant, Naswadi, Kevadia, Jitgaon and Sagbara). 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. As per report issued by SSCAC vide their analysed by letter 6th Feb 2014, the events recorded during the period 1984 to 2012 Institute for Seismological Research, Gandhi Nagar showed that on 84 occasions the recorded intensity exceeded $M \geq 3$ out of which on 5 occasions the value was $M \geq 4$ to 4.5



Pic 29. Instrumentation to record seismic activity in SSP

Status of implementation of seismicity aspects is summarised in following table:

Table 22. Status of implementation of seismicity aspects

Action	Status
Dam design modifications	Completed
GSI (Nagpur Division) Rim Stability studies	Completed
Tracer Studies by CWPRS	Completed
Monitoring stations	Rim stability studies have completed and well equipped 9 monitoring stations along the periphery of the reservoir are functioning
Results of analysis of data from monitoring stations	Received, analysed by the dam safety review panel of the SSP during October, 2001. Report for the period 1984 to 2012 by Institute for Seismological Research is available

Conclusion

Investigations to determine the seismic design parameters for Sardar Sarovar Dam have been carried out through established authorities of the country. National and international standards have been followed. The theoretical techniques of dynamic analysis as per state of the art technology are adequately deployed to assess the behaviour of designed dam section. Adequate advice of the consultants at National and

international level has been availed for the scrutiny and vetting of designs to ensure that the dam would serve the best interest of beneficiaries for centuries in even under the attack of earthquake.

The Sardar Sarovar Dam design and sections have been evolved and analysed meticulously by competent experts and debated in expert panels consisting of renowned and experienced professionals. All safety requirements are insured as per the requirements. Fears about adequacy of the dam design for a severe earthquake is ill-bounded and should not cause concern to anybody.

Chapter 7 Health Aspects

Introduction

The health is considered to be a state of complete physical, social and mental well-being and not merely the absence of disease and infirmity. The environment clearance order by MoEF refers to Health Aspects of project area people as one of the issues addressed by the Environmental Appraisal Committee (EAC) of River Valley Project (RVP). The EAC and NCA advised control of malaria and potential breeding sites for malaria vectors, besides monitoring the incidence of other water-related and waterborne diseases, with a view to prevent their establishment. Accordingly, each State was expected to take necessary measures to minimize the risk of these diseases that may result from implementation of the project.

- The availability of adequate water for drinking, washing, domestic, agricultural and industrial use will contribute to improve the health of people, due to better hygiene and nutrition.
- Drinking water drawn from very deep wells in water scarce area, may have high content of fluorides which is known to cause dental and skeletal fluorosis. The rise of water tables and also provision of safer water to such communities after better availability may prevent this disease.
- There are however, health risks resulting from improper control, transport and storage of water resulting in the occurrence of pools of standing water, during construction and operation of the reservoir. This may provide breeding sites for disease vectors.
- The epidemiological imbalance resulting from altered ecology and migrant labor and the diseases carried by them, may adversely affect the local population, which may have low immunity to such diseases.

Plans and their meticulous implementation are needed to provide health facilities and for controlling the disease vectors. These plans were not in place at the time of grant of clearance. Therefore states were directed by the statutory provisions for survey / studies, preparation and implementation of these plans.

Health Provisions for the SSP

Health provision in India is defined by the National Health Policy (NHP) and national disease programme 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 minimize 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.

Studies and Action Plans

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.

A large number of studies have been carried out on the health profile of villages in the three affected states. The key studies are summarized in following headings.

Survey and Studies

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

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- Immigrant construction workers may bring with them diseases or parasites, to which the local population may have low immunity.

A large number of studies have been carried out on the health profile of villages in the three affected states. The key studies are summarized below:

- **Report by Goodland, 1986** concluded that the Ratnagiri pocket was stable and that concerns expressed over the spread of schistosomiasis due to the SSP were unfounded. In 1985 the National Institute of Communicable Diseases (NICD)

survey of several Narmada submergence villages in Gujarat and Madhya Pradesh, several thousand urine samples were tested for parasite eggs, which yielded negative results. 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.

- **The M.S. University study of 1983** and other studies concluded that most of the major diseases in the Narmada Basin comprised malaria, scabies, dysentery and diarrhea. Of these diseases, only the threat of increased Incidence of malaria was the prime concern of the authorities. Occurrence of other diseases resulting from poor hygiene, poor sanitation and the lack of drinking water would be reduced by better water availability. According to the MSU report, filaria was confined to the coastal areas of Saurashtra and South Gujarat. Filaria was also reported in Surat, not very far from the reservoir site, but the study concluded that the disease was unlikely to spread to the reservoir area.
- **Disease Profile of Command Area by (SCHMS), Gujarat –1986:** This report was considered and discussed with the World Bank and GOI officials. Conclusions from these consultations were used in formulation of the work plan on health.
- **Health Statistics, Government of Maharashtra (GOM), 1987** focused on the health profile of 33 project-affected villages in Dhule District, Maharashtra. The report concluded that Schistosomiasis was only found in one village and was unlikely to spread because of the SSP. The influx of laborers, 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 drinking/washing etc. Filaria was not present in SSP areas but careful monitoring should be undertaken to ensure it does not enter the area.
- **The Sardar Sarovar Narmada Project "Studies on Ecology and Environment"** by Maharaja Sayajirao University (MSU), Vadodara 1983, were used to produce an assessment of the likely health impacts upstream and downstream of the dam site.
- **Studies by Malaria Research Centre (MRC)** and other data indicate that malaria occurs sporadically throughout the region from the Narmada source to its estuary. Levels of malaria are generally low although the anopheline mosquito vector has the potential to proliferate in the reservoir, draw down area and canals.
- **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. The 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. The disease has since been certified as eradicated from India, by WHO in February 2000.

- **Environmental Impact Assessment study (1995)** of Water Related Diseases in Sardar Sarovar Project command area, Gujarat, Volume-I & Volume-II, The findings indicated that malaria was prevalent as in all parts of Gujarat, while filaria was not a threat to command area. These vector borne diseases may be adversely influenced once water started flowing, for which a continuous surveillance was recommended. Some water borne diseases & scabies etc. were expected to decline once water was made available and personnel and food hygiene improves.
- **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: It provides data for subsequent monitoring of morbidity and disease patterns.
- **Several other studies** 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 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.
- **The Gandhi Medical College, Bhopal in its 6th and final report for Narmada Sagar Dam** observed that the total morbidity in the post impoundment area was higher at 9.46% compared to 6.19% in pre impoundment area. The increase in morbidity was contributed by diseases like malaria, dysentery and respiratory infection. They had a direct/indirect relationship with water.
- **The field visit to SSP area by health sub group undertaken during 2001** revealed that substantial work had been carried out to identify health risks and diseases within the SSP-affected area, particularly on the prevalence of malaria. For future, efforts are needed to follow-up the results of these studies and to take necessary management steps to protect temporary and permanent populations. In order to ensure health protection in the SSP area, the principal

task was firming up of the surveillance system for communicable diseases, which will equip the NCA with regular update on disease status.

Formulation of Action Plans

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, immigrant workers and residence of peripheral impact area
- Control of malaria and potential breeding sites for disease vectors
- Monitoring for the incidence of other water-related and waterborne diseases with a view of preventing their establishment
- Management of the potential health Impacts of the SSP required strategic prevention, control & establishment of the disease vectors which spread diseases especially 'water-based' and 'water-related diseases. The available information and studies undertaken reveal that the common diseases in the Narmada Basin are malaria, scabies, dysentery and diarrhea. Schistosomiasis will not constitute a serious health issue in the area. Filarial though has been reported in Surat, about 100 km from the dam site, was unlikely to spread to the project area.
- Drinking water proposed to be made available will need adequate treatment and bacteriological monitoring to ensure that the incidence of gastroenteritis, diarrhea or other water borne diseases remains under control.
- Malaria and other mosquito vector borne diseases may be influenced due to flow and spread of water in larger area. To avoid this, appropriate management of water and continuous vector and disease surveillance has to be maintained.
- The studies so far indicate the morbidity as point / period prevalent which may serve at best as a baseline. Distinct disease trends vis-à-vis the impact of the project in its various stages, cannot be precisely arrived at from the available information. The induction of epidemiological variables (agent, host and environmental) after commissioning of the project will depend on multiplicity of factors which will influence the disease patterns from time to time. This clearly highlights, the need of continuous surveillance of the diseases and epidemiological variables, rather than short-term studies, survey on entomological geographical reconnaissance and regular monitoring and reporting of health impacts

Health Management: Gujarat

SSP Health Management Plan April 1997

The plan covered villages within a 10 km radius of the reservoir including resettled populations and had provision for the monitoring, surveillance and control of malaria. Following were the main components of the plan.

- Establishment of hospital at Kevadia.
- Strengthening of laboratory facilities including establishment of mobile unit.
- Provision for laboratory technicians in existing Public Health Centers (PHCs).
- Expansion of malaria treatment depots.
- Proposal to establish Urban Malaria Scheme for centers over 40,000 anti- larval operations.
- Strengthening of state level health organizations to ensure monitoring of malaria, filaria, dengue and encephalitis,
- Strengthening of district level health organizations for monitoring and implementation of residual insecticidal spraying operations included in the plan.

Pic 30. Public Health Center in Garudeshwar, Gujarat

These plans and proposals were designed to coincide with the three-phase (17 year) implementation schedule of the irrigation component of SSP. The Action plan of 2000-2001 identified 3 major parts. However, the plan envisaged development of health facilities in the command area only after commencement of the irrigation.

- The project area (PHO and DMO)
- The resettlement sites and
- The command area (to be detailed after commencement of irrigation in the command).

A) Project area

Preventive Health Organization

The plan proposed, establishment of a prevent health organization at Kevadia Colony, comprising 36 posts of different categories. This organization was to function as a nodal agency for undertaking preventive and control measures to minimize the risk of vector born diseases particularly malaria. The main functions of the PHO enclosed coordination with Primary Health care system are as under. It was proposed to bring this organization under Medical cell of Sardar Sarovar Punarvasavat Agency

- Surveillance for case detection and treatment of malaria and other communicable diseases.
- Anti-larval measures (Identifying, eliminating / treating potential mosquito breeding places)
- Insecticidal spray (for control of adult mosquitoes / vectors in high risk and problematic villages.
- Entomological studies (to monitor vector prevalence, it's density and other entomological parameters.
- To undertake environmental sanitation methods for control of water related disease.
- Engineering methods of vector control through inter-sectoral coordination.
- Information Education and Communication to promote awareness in the community and to avail their participation.

District Malaria Organization

- Surveillance to detect and treat malaria cases.
- Insecticidal spray.
- Biological control. Entomological studies.
- Curative referral services by project hospital.

B) Resettlement sites: Medical cell under SSPA

In addition to Primary Health care delivery system and referral services through the network of PHCs and CICs, a separate medical cell headed by Dy. Director was started functioning since 01st May 1999 to provide the required health care (curative and preventive) to the project affected families. The planning and implementation at RR sites is being monitored by the R&R Unit of the NCA and therefore not included in this report.

C) Command Area :

The command area of SSP comprises 3393 villages spread over 12 districts. The state govt. proposed the following activities for control of malaria in the command area.

- Monitoring of malaria situation in the command area every month.
- Routine surveillance activities for Early Diagnosis and Prompt Treatment of malaria cases.
- Insecticidal spray of villages in the command area, which are eligible for spray as per Government of India criteria.
- Entomological studies to find out prevalence and density of vector mosquito.

Implementation of Action Plan

Following table shows the summary of the implementation of Health safeguards.

Table 23. Summary of the implementation of Health safeguards in Gujarat

Particular	Action	Current Status
Baseline studies	• EIA studies for the project area	Initially in 1986 and subsequent EIA in 1993: Completed
Preparation of State Action Plan Health Aspects	• Initial plan in 1986 • Action plan updated for 2000-2001 prepared by Commissionerate of Health & Medical Services, Gandhinagar	Action plan for the command area was promised commensurate with development of command area: Awaited
Project site (Kevadia)/ around		
Screening of work force	• Dispensary by M/s. Jai Prakesh Associates & through PHC's.	Established & ongoing
Govt Hospital Kevadia	• 50 bed hospital at Kevadia including a malaria unit • Provides outdoor and indoor curative services at project site • Malaria Clinic and small preventive units	Established & ongoing
Public Health Centers	• Centers at Boria, Jetpur, Garudeshwar and Zaria	Established & ongoing
Services of specialists once a week	• By Dist. Hospital Rajpipla (22km away)	Established & ongoing
Specialist and super specialist services	• By SSG Hospital at Vadodara (90Km away)	Established & ongoing
Regional health services	• Houses entomological cell besides, Narmada District, services Narmada Command(Phase-I)	Established & ongoing
District Malaria Organization / Preventive Health Organization	• DMO to function until PHO takes over • PHO (with staff of 12) to become functional for undertaking entomological studies in the project area and Command jointly with MRC	Progressing

	& other state agencies	
R&R sites		
Preventive Measures and Health facilities by SSPA	• Reinforcement proposed in the plan	Monitored by R&R Sub-group as per their direction, control and provision of NWDTA
Peripheral villages		
Peripheral villages	• Establishment of health facilities Peripheral villages	Progressing
Epidemiological Surveillance		
Disease monitoring and responsibility	• Has been entrusted to State Council of Health & Medical Services. • Surveillance of communicable diseases. • Entomological surveillance for vector borne diseases: • Bacteriological surveillance of drinking water. • Malaria and vector borne diseases surveillance. • Epidemiological surveillance studies as per IDSP and NRHM norms	Progressing
Command Area		
EIA studies by SCHMS	• Preliminary report on water related diseases based on morbidity and mortality submitted in 1993. • Detailed report based on Institutional data submitted in 1995	Complete
Vertical Anti Malaria unit for every 5 lacs population to supplement existing health infrastructure	• At Jambusar, Sankheda, Dabhoi, Mehemdabad, Viramgaon & Dholka at an estimated expenditure of 2521.64 lacs. • To carryout malaria control • Vector control • Maintenance of data on morbidity and mortality • Entomological and parasitological studies for development of early warning system	Progressing
Health Monitoring cell	• Health impact assessment studies with progressive development of the Command area and associated ecological and environmental changes with the help of SCHMS and Malaria Research Centre	Progressing

Health Management: Maharashtra

Action plan of 1991

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

- Provisions for strengthening of state and district health facilities in existing villages and in resettlement areas.
- Establishment of a monitoring and laboratory cell at the Rural Hospital.
- Strengthening of the existing Primary Health Centers
- 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.

According to the revised plan of 2007-2008, total number of families residing in 33 villages was 4,163 out of which 3,083 families were to be rehabilitated. A total of 9 rehabilitation sites were identified for resettlement in Taloda Akkalkua & Shahada Taluka. According to the information received 2,331 families were resettled in these locations. Action plan provided arrangements for health facilities

- For residents of the peripheral villages
- For residents at the rehabilitation sites.

The original work plan 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. This plan was recently revised as plan of 2007- 2008. Accordingly modified disease management measures required financial support of 21,52,000/- for additionalities proposed in the plan. Similarly a plan for providing health facilities at the 9 rehabilitation sites was also proposed, requiring additional manpower and funds.

- A Rural Hospital, the first level health service is established for every 5 Primary Health Centers. The laboratory and X-ray facilities are made available in the hospital along with indoor capacity of 30 beds. Ambulance Services are also provided. 4 Rural Hospitals are functioning in Akkalkuva (3) and Dhadgaon Talukas(l).

- One PHC for 20,000 population / 25 kms. area being remote & tribal area. Accordingly 9 additional Primary Health Centers at village Jangathi, Vadfali, Mandava, Urmilamal, Kakarda, Telkhedi, Bilgaon, Roshmal, Katri are proposed in the revised plan. The PHC is expected to address programs of malaria eradication, control of blindness, control of T.B. & Goiter, eradication of Leprosy, immunization programme, female welfare programme. Besides water borne diseases, control of epidemic, health education programme, conduction of deliveries and treatment of minor ailments.
- Sub-center is established for a population of 3000 which is the final extension of health package in rural areas. Female health worker looks after the health care of mother & child and family welfare programme whereas male worker attends to National Health Programme including control of communicable diseases, spraying activities and National Malaria Eradication programme. Accordingly, 111 sub-centers were also proposed
- Two Floating dispensaries have been pressed into service to provide health services to all the 33 villages. Additional funds and manpower are proposed.
- 25 rescue camps with 3 attendant medical officers are provided in impacted Talukas.
- Malaria Control Programme
    - Collection of blood slides from fever cases and giving presumptive treatment.
    - Examination of blood slides.
    - T/T of positive cases.
    - Insecticide spraying and anti-larval measures.
- Impact area of 10 km belt : Out of 9 newly created PHC's 3 are located on the banks and the remaining within 10 km belt. 11 Medical officers are attending these PHC's.
    - 1 Fiber launch was proposed for inter connectivity in the interior area.
    - Wireless connectivity is also proposed.
    - Additional funds were proposed for immunization and mobility.
    - Continuation of IEC and NSV plan were proposed.

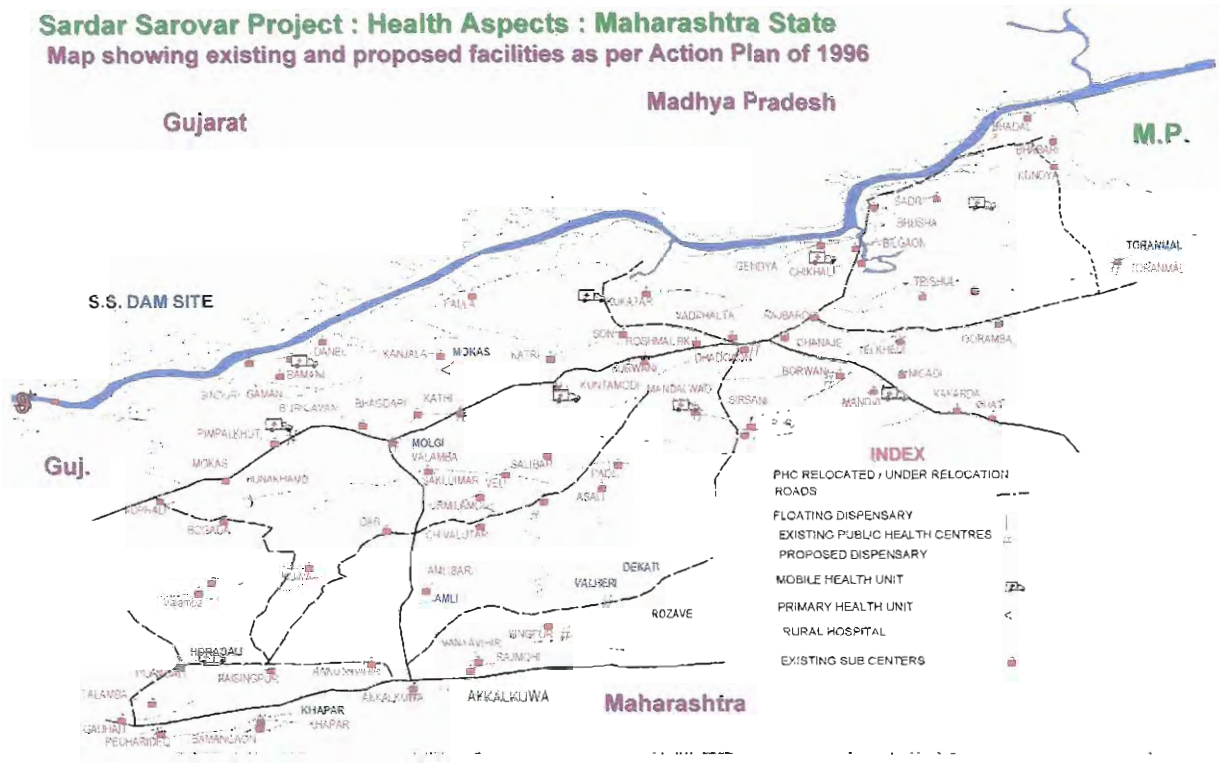
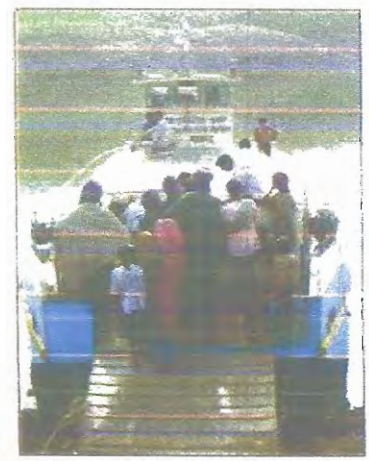


Fig. 41. GIS Map of impact areas in Dhule District, Maharashtra showing health facilities to be provided to mitigate negative impacts arising out of submergence caused by SSP

Tribal people of village Bhusha, Dhadgaon visiting floating dispensary



Medical Officer giving treatment to patient on Barge

Source: Environmental Safeguard Measures in Maharashtra: A Status Report, Nov 2010

Pic 31. Some photographs of implementation of Health Action Plan in Maharashtra

Pic 32. Rural Hospital, Water Testing Laboratory and Biomedical Waste Disposal Pit in Dhadgaon, Rajasthan

Implementation of the Action Plan

Summary of the implementation of Health safeguards for the Sardar Sarovar Project in Maharashtra is given in following table.

Table 24. Summary of the implementation of Health safeguards in Maharashtra

Item	Action plan	Current Status
Baseline studies & Survey of existing facilities	• Initial report submitted during 1986	Complete
Preparation of state Action Plan	• Original Action Plan was submitted in 1987 and subsequently revised in 1991 and 1996. A revised health action plan 2007-08 was received recently	Complete
Project site & peripheral villages		
Mobile dispensaries / Rescue camps	• Two Floating dispensaries • 25 rescue camps with 3 attendant medical officers. Additional funds and manpower are proposed • One fiber launch for visit to interior Padas due to loss of road connectivity • Wireless communication facility proposed	Established and Progressing

	• NSB plan and IEC activities to be undertaken	
Rural Hospital 4 Nos. (One for every 5 Primary Health Center).	• Establishment of a monitoring and laboratory cell at the Rural Hospital • 4 Rural Hospitals 3 in Akkalkuva and 1 in Dhadgaon Talukas. • The laboratory and X-ray facilities are made available in the hospital along with 30 beds. • Ambulance Services	Existing 4 nos. would require one more after construction of 9 additional PHCs
Primary Health Centre (26) One for 20,000 population / 25 kms. being remote & tribal area	• Strengthening of the 17 numbers of existing PHC. • 9 additional Primary Health Centers at village Jangathi, Vadfali, Mandava, Urmilamal, Kakarda, Telkhedi, Bilgaon, Roshmal, Katri are proposed in the revised plan	Progressing
Sub-centre. (population of 3000)	• 111 sub-centers were proposed. • Male worker to attend to National Health Programme including control of communicable diseases, spraying activities and National Malaria Eradication programme. • Female health worker to look after the health care of mother & child and family welfare programme	Work on 40 sub-centers started59 existing and work progressing in 12
Epidemiological surveillance	• Phase-I of the report has been submitted by Topiwala National Medical College, Mumbai • Phase-2 studies by Medical College, Dhule, report available	Progressing
Disease monitoring and responsibility	• PHC are expected to address surveillance of water borne diseases, control of epidemic, health education programme, conduction of deliveries and treatment of minor ailments programs of malaria eradication, control of blindness, control of T.B. & Goiter, eradication of Leprosy, immunization programme, female welfare programme. • State Health Department : reported only for diarrhea & dysentery from existing PHC only	Progressing

Health Management: Madhya Pradesh

Action plan of 1990

Detailed work plan for the Health aspect and water quality was submitted during 1988 and updated thereafter during 1990. This plan included two tier (macro & micro) mechanisms for monitoring of water quality parameters through State Pollution Control Board. The plan detailed the methods of monitoring which included conventional laboratory and Environmental & Ecological methods. The plan envisaged data processing, analyzing, reporting & coordination among the various agencies. It was proposed to develop information system, data bank research. NVDA was not to

rest contented with mere maintenance of just a status-quo but in order to restore the water quality in the valley to its original pristine purity was to look ahead to set the aims and targets higher to achieve the positive improvement through the plan. The plan detailed the following:

- Parameters for chemical, agricultural, industrial, biological, bacteriological and special tests to achieve objectives.
- The plan contained specific provisions for containing water borne & water related diseases such as Malaria, Guinea worm, Goitre, Filaria, Schistosomiasis, Gasto Enterities / Cholera & other diseases.
- The plan proposed strengthening of existing primary health care infrastructures and construction of a new 30 bedded hospital at Nisarpur.
- One mobile unit equipped with x-ray & laboratory facilities for screening of the labourers on the site was proposed.
- A cell for monitoring and evaluation purpose was also proposed.
- The plan also assured control of epidemic through additional efforts through the Department of Preventive & social medicine.
- The plan also laid down change of sites of existing health institutions and strengthening of Sub-health centers / primary health centre / community health centre / civil dispensaries and mini PHC's.

The plan was to be implemented in a phased manner.

- The first phase was to provide immediate services through dispensaries & hospital, mobile unit, establishment of laboratories, evaluation cell for control of epidemic.
- The second phase proposed building of hospitals, & residential quarters, completion of supply of equipment & manpower.
- The third phase was to ensure completion of all facilities in every aspect with a view to provide continued treatment to rehabilitated population.

NVDA during 1991 provided additional details concerning the provision and training of health care staff, numbers of specialist staff required, funding and responsibilities for management.

Fig. 42. GIS Map showing location of proposed sites for health facilities in MP

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.

In addition, studies on limnological aspects were entrusted to three Universities. The area of SSP was to be studied by Vikram University, Ujjain.

Revised Action Plan – 2003

GoMP has submitted revised Health Action Plan of August 2003. The plan focused additional emphasis on the following:

- General Public Health Problems for settlement.
- Monitoring, supervision and executing the actions (forming monitoring cell) and addressing surveillance of communicable diseases.
- Provision of preventive and curative services & strengthening of existing facilities.

The plan mainly provided financial implications to the tune of 848 lacs on establishment of facilities towards the following

- Establishment & monitoring cell at NVDA, Water testing, training for water sampling, mobile Public Health Laboratory & its operation, time frame and

financial implications, Action by P.H.C. Department, promotional activities on Health Education and Strengthening of existing health delivery system

- A total of 42 sub-centers were to be affected by the submergence, which are proposed to be reconstructed. In addition 22 Ayurvedic Dispensary to provide medical facilities and training to them for collection of data on communicable diseases.
- A total of 4 PHC's were to be affected by the submergence which are required to be reconstructed.
- Nutritional status of the population is required to be provided. The plan stressed education on health and provision of minimum basic needs & coordination & control of the diseases.
- The revised plan focused on the following:-
    - Vaccination
    - Nutrition
    - Prevention of major diarrhea disorders,
    - Provision of treatment,
    - Provision of care to old and handicapped.
    - Provision of RCH services which include reproductive child health services,
    - Coordination of activities with PHC, CHC and District as well as mobile unit though all its functions are direct responsibility of Health Dept. but benefits were to be provided to the rehabilitated population and it was proposed to orient the staff and impact through training. Accordingly additional expenditure for the following items were proposed:-
        - Training,
        - Supplement of Health Educational Material
        - Provision of preventive medicine like ORS, chlorine Tables.
        - Provision for sufficient money for purchasing kerosene oil for sterilizing equipments (arrangements may be done through the pay-packet to each MPW female directly).
        - Mobility to the female workers were also proposed an assistance for carrying equipments.
    - Control of Arthropod Borne Diseases:- To control malaria, filarial, dengue and other viral diseases including Kalaazar. The plan assumed an API >2 and proposed action to control the same.
    - Nisarpur and Dharampuri hospitals.
    - Primary Health center
    - Disposal of Bio-Waste Incinerators.

- Operational Research. Plan proposed geographic reconnaissance by Malaria Research Centre. Studies on health delivery system, local sanitation, nutrition and creation of monitoring cell.

Implementation of Proposed Actions

Summary of the implementation of Health safeguards for the Sardar Sarovar Project in Madhya Pradesh is given in following table.

Table 25. Summary of the implementation of Health safeguards in Madhya Pradesh

Parameter	Action points	Status
Baseline studies	• Health profile during pre-impoundment stage	Complete
Preparation of state Action Plan	• 1) For water quality monitoring 2) Project sites screening. 3) For peripheral villages 4) For resettlement sites 5) Epidemiological surveillance	Original Action Plan was submitted in 1986 and then revised in 1990. Cost details were incorporated in the Final Action Plan in 1996. The plan was revised in August 2003. The requirement of funds for incremental health facilities was placed at Rs.848 lacs
Water quality monitoring plan	• Monitoring of identified parameters towards chemical, agricultural, industrial, biological, bacteriological and special tests	Awaited
The first phase: To provide immediate services through dispensaries & hospital, mobile unit, establishment of laboratories, evaluation cell for control of epidemic		
One Mobile Public Health laboratory	• One mobile unit equipped with x-ray & laboratory facilities for screening of the labourers on the site	Provision is made
The second phase proposed building of hospitals, & residential quarters, completion of supply of equipment & appointment of manpower		
Provision of incremental health facilities and functionality in peripheral villages	• 30 bed hospital at Nisarpur	Made functional
	• Community centre at Dharampuri	Made functional
	• A total of 42 sub-centers were to be affected by the submergence, which were proposed to be reconstructed	Awaited
	• 22 Ayurvedic Dispensary to provide medical facilities and training for collection of data on communicable diseases	Awaited
	• A total of 4 PHC's were to be affected by the submergence which were proposed for reconstruction	Awaited

Evaluation and monitoring cell in health Deptt/ NVDA	• Monitoring, supervision and executing the actions in the field and addressing surveillance of diseases	Started functioning recently with appointment of Subject Matter Specialist. Reports awaited
The third phase to ensure completion of all facilities in every aspects with a view to provide continued treatment to rehabilitated population		
Provision of health facilities and functionality at R&R sites	• 58 Dispensaries were proposed at rehabilitation sites	21 Dispensaries are completed and handed over to Ayurved Department 10 dispensaries are completed but not yet handed over to Ayurved Department. 15 dispensaries work is under completion and 12 dispensaries construction is yet to start. However most of these remained non functional for various reasons.
Sanitary latrines	• To keep the cases of Gastro diseases in check	Progress awaited
Appointment of specialists and staff	• It was suggested by the Sub-group that staff can be appointed on contract basis to meet the incremental requirement created by the SSP. No progress is reported so far	Progress awaited
Epidemiological surveillance for comprehensive picture on all the schemes of Central & States under implementation in the project areas	• Strengthening of data collection from impacted sub-centers in acceptable formats. NVDA proposed existing formats being used under IDSP / National Rural Health Mission (NRHM). • Gandhi Medical College, Bhopal was entrusted with epidemiological surveillance studies. Final report is received. • Geographic reconnaissance by Malaria Research Centre.	Information on strengthening of impacted sub-centers for disease surveillance on periphery of the reservoir awaited. Evaluation Cell established by NVDA, under Subject matter Specialist (Ex Director Health Services, GOMP) Report awaited. Work progressing, reported awaited
Implementation of guidelines of MoEF on disposal of Biomedical waste	• Provision of disposal of biomedical waste	Report awaited
To take-up IEC activities	• To educate people through training / workshops / literature, etc.	Work entrusted to MINR of ICMR and progressing satisfactorily

Summary of Health Management Measures for Sardar Sarovar Project

Following table shows the state-wise current status of health management measures for Sardar Sarovar Project:

Table 26. State-wise status of health management measures for Sardar Sarovar Project

Action	Government of Gujarat	Government of Maharashtra	Government of Madhya Pradesh
EIA studies	By State Council of Health and Medical Services (SCHMS), 1994	By T.N. Medical College Mumbai and Medical college Dhule district.	By Gandhi Medical College Bhopal and ICMR New Delh
Action Plan	Action plan of 1986 and draft plan of 1996	Action Plan of 1987 revised in 1991, 1996 and 2007	Action Plan 1988 revised in August 2003.
Diseases monitoring in impacted areas of SSP	Through SCHMS and routine district wise surveillance under IDSP or NHRM of Govt. of India.	Routine surveillance under IDSP or NHRM of Government of India.	Dedicated surveillance studies through NIMR of ICMR besides routine surveillance under IDSP or NHRM of Govt. of India.
Establishment of health facilities at Dam site/ Peripheral villages.	Progressing	Progressing	Progressing
Vector control measures	As per plan of 1986	As per plan of 2007	As per plan of 2003

Chapter 8 Archaeology and Anthropology

Introduction

The Sardar Sarovar Project has necessitated a fresh look at the archaeological and cultural heritage available in the Narmada valley. The Government of India recognizes the value of such cultural sites and has enacted a series of laws to maintain and protect them from decay, misuse or development activities. 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 nor State-protected but which are considered to be an Important part of cultural heritage

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

Fig. 43. Map showing historical monuments / mounds in Sardar Sarovar Project

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

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

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

A survey was carried out by the State 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

The State Department of Archaeology and Museum 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 paleo-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.

Action Plans and Implementation

Gujarat

The Action Plan for two temples, i.e., Shoolpaneshwar and Hamfeshwar was prepared and implemented by GoG. Shoolpaneshwar temple which was on the border with State of Maharashtra is relocated to a distance of 15 kms downstream of the SSP in village Gora. Relocation work is already completed. Photographs of old and new temples are shown below:

Pic 33. Shoolpaneshwar Temple; Before v/s After

Pic 34. Hamfeshwar Temple; Before v/s After

Hamfeshwar Temple has been relocated at higher elevations within the same village. Construction of Temple is complete.

Maharashtra

No work was required to be done in the State of Maharashtra.

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.

Pic 35. Photographs of rock-cut caves in Maharashtra

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)

GoMP prepared an action plan in 1993. The plan was updated / revised in 1997. This plan identifies the relocation of 13 monuments and 5 mounds by State Department of Archaeology & Museum (SDA&M). This plan also includes the relocation of 10 monuments and 6 mounds by Archaeological Survey of India (ASI). This plan also includes the four mounds of 1993 plan. Presently all the 38 structures are being relocated/excavated by the state Department of Archeology & museum, Madhya Pradesh. The status of implementation is summarized in the following table:

Table 27. Status of implementation for relocation of monuments / mounds in MP

Chain age	Name of Monuments	Village	Tehsil	District	Status
Monuments / Sculptures					
84425	Shiv Mandir	Roligaon	Alirajpur	Jhabua	Completed
117037	Koteshwar Mandir	Kothara	Dhrampuri	Dhar	Completed
125876	6 tombs	Bheelkheda	Barwani	Barwani	Completed
128181	Neel Kantheshwar Mandir	Chikalda	Barwani	Barwani	Yet to be shifted

128181	Pashumatesh war Mandir	Chikalda	Barwani	Barwani	Yet to be shifted
131667	Shiv Mandir	Chhoti Kasrawad	Barwani	Barwani	Completed
171594	Jalaleshwar Mandir	Khujawa	Dharampuri	Dhar	Completed
173427	Vilvamriteshw ar Mandir	Dharampuri	Dharampuri	Dhar	Completed
173427	Nageshwar Mandir	Dharampuri	Dharampuri	Dhar	Completed
194757	Kanjleshwar	Semalda	Manawar	Dhar	Completed
111551	Narmadesh-war Mandir	Dehar	Kukshi	Dhar	Completed
132581	Shiv Mandir	Bodhwada	Kukshi	Dhar	Yet to be Shifted
143553	Shiv Mandir	Bada Barda	Manavar	Dhar	Completed
171594	Shomeshwar Mandir	Khujawa	Dharampuri	Dhar	Completed
171594	Big statues	Khujawa	Dharampuri	Dhar	Completed
171594	Bhawani Mata Mandir	Khujawa	Dharampuri	Dhar	Completed
171594	Shiv Mandir (S.No.1)	Khujawa	Dharampuri	Dhar	Completed
171594	Shiv Mandir (S.No.2)	Khujawa	Dharampuri	Dhar	Completed
171594	Shiv Mandir (S.No.3)	Khujawa	Dharampuri	Dhar	Completed
171594	Rock-cut caves	Khujawa	Dharampuri	Dhar	Completed
180432	Rock-cut-sculptures	Pipaldagarhi	Dharampuri	Dhar	Completed
180432	Shiv Mandir (Mauni Baba Ashram)	Pipaldagarhi	Dharampuri	Dhar	Completed
199939	Baneshwar Mandir (Shiv Mandir)	Navadatoli	Kasarawad	Khargone	Completed
Mounds					
114903	Mound	Jangarwa	Barwani	Barwani	Completed

122523	Mound	Khapar-kheda	Manawar	Dhar	Completed
129228	Mound	Kheda	Manawar	Dhar	Completed
138982	Mound	Kavathi	Manawar	Dhar	Completed
139286	Mound	Utawad	Barwani	Barwani	Completed
143553	Mound	Chota Barda	Thikri	Barwani	Completed
152697	Mound	Kirmohi	Thikri	Barwani	Completed
160012	Mound	Navadakhedi	Thikri	Barwani	Completed
167327	Mound	Brahman-gaon	Thikri	Barwani	Completed
199939	Mound	Navadatoli	Kasrawad	Khargone	Completed
120999	Mound	Katnera	Kukshi	Dhar	Completed
138982	Mound	Ekalwara	Manawar	Dhar	Completed
162755	Mound	Maru Chichali	Thikari	Barwani	Completed
165193	Mound	Kalyanpura	Manawar	Dhar	Completed
183480	Mound	Khalghat (Khalkhurd)	Dharampuri	Dhar	Completed

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 Pipaldagarhi, Khujawa, Dharamapuri and different other villages. These are displayed at District Museum in Dhar district.

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. Following is the list of museums for display of sculptures:

- Narmada Park and Museum at Lalbagh at Indore
- Museum at Kasrawad is completed by NVDA and handed over to the State Department of Archaeology & Museum, Government of MP. Statues and models are displayed. Development and beautification work under progress.

- Construction of a section on 'Narmada Vithika' in the museum at Bhopal has been completed and inaugurated.
- 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 Survey & Studies

Anthropological salvage plan for Narmada Valley: A two week salvage operation conducted in February 1992 with focus on Harsud area of Khandwa under submergence of Indira Sagar Project was conducted by the Anthropological Survey of India. Surface scanning of the anthropological sites of 17 villages was completed and 424 specimens taken. In this plan the Udaipur Branch of the Anthropological Survey of India has collected information and specimens from 19 villages in Gujarat.

Anthropological Survey of India has decided to conduct extensive exploration in Central Narmada Valley between Jabalpur & Handia and to carry out explorations at Hathnora on the right bank of Narmada a fossilized partial scull and right collar bone of the solitary known early age man in South Asia was discovered. This was named as skull of Homo floresiensis or Hobbits. A systematic and large scale attempts is being under taken by the Anthropological Survey of India. However, the areas under study fall outside the submergence zone of the Sardar Sarovar Project. Photographs of mound excavated and excavated ruined evidences are shown below

Pic 36. Excavated mounds and remains

ANNEXURES

CLEARANCES ACCORDED TO SSP

CLEARANCE FROM ENVIRONMENTAL ANGLE TO SSP & ISP BY MOEF

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 tc 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 :

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.

No. D-372/83-FC
GOVT. OF INDIA, MINISTRY OF ENVIRONMENT & FORESTS.
NEW DELHI

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 13385.45 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

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.

contd..../2

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.

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.

(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) he 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 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 into 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, segment wise, 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.

Contd....2/

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.

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

No. 8-29/89 - FC
Govt. of India
Ministry of Environment & Forests
Lodi Road, New Delhi – 110 003

July 20, 1990.

To

The Secretary (Forests)
Govt. of Maharashtra,
Bombay.

Subject : **Diversion of 2700 ha. of forest land for rehabilitation of Sardar Sarovar Project affected persons.**

Sir,

I am directed to refer to your letter No.1688/CR 329/F-10 dated 28.12.88 on the above mentioned subject seeking prior approval of the Central Govt. in accordance with Section-2 of the Forest (Cons.) Act, 1980.

After careful consideration of the proposal of the State Govt., The Central Govt. hereby conveys its approval under Section-2 of the Forest (Cons.) Act, 1980 for release of 2700 ha. of forest land for rehabilitation of persons affected by Sardar Sarovar Project in Dhule District subject to the condition that compensatory afforestation be done by the Government of Maharashtra. The Government of Maharashtra is requested to identify the land for raising compensatory afforestation and send a detailed report along with a scheme for raising compensatory afforestation before 30.9.1990.

The original proposal of the State Govt. was for diversion of 2583.42ha. of forest land, whereas 2700 ha. of forest land are being diverted by this order. The State Govt. is requested to send the details of survey number etc. along with map showing the additional area being diverted by this order.

This issues in relaxation of condition No.(iii) * (vii) of this Ministry's letter No.8-372/83-FC dated 8.9.1987.

Yours faithfully,

(**BHAGWAN SINGH**)
Asstt. Inspector General of Forests.

Copy to :

1) Principal Chief Conservator of Forests, Govt. of Maharashtra, Nagpur.
2) Regional Office (Western Zone), Bhopal,
3) Regional Office (HQ), New Delhi.
4) Guard file.
5) Secretary of Govt. of India, Ministry of Water Resources, Shram Shakti Bhawan, New Delhi.

(**BHAGWAN SINGH**)
Asstt. Inspector General of Forests.

No. 225/92 - FC
Govt. of India
Ministry of Environment & Forests
Lodi Road, New Delhi – 110 003

Dated the 21st February, 1994.

To

The Secretary,
Forest Department
Government of Maharashtra,
Bombay.

Subject : **Diversion of 1500 ha. of forest land for rehabilitation of Sardar Sarovar Project affected persons in Dhule District.**

Sir,

I am directed to refer to your letter No.FLD-1692/CR-239/F-10 dated 11th February, 1994 on the above mentioned subject seeking prior approval of the Central Government in accordance with Section-2 of the Forest (Conservation) Act, 1980 and to say that the proposal has been examined by the Advisory Committee constituted by the Central Government under Section-3 of the aforesaid Act.

2. After careful consideration of the proposal of the State Government and on the basis of the recommendations of the above sanctioned Advisory Committee, the Central Government hereby conveys its approval under Section-2 of the Forest (Conservation) Act, 1980 for diversion of 1500 ha. of forest land for rehabilitation of Sardar Sarovar affected persons in Dhule district subject to the following conditions :

i) The felling of trees on the proposed forest land shall be done in phases as per requirement of land for rehabilitation.

ii) The amount realized by the felling of trees in 1500 ha. of forest land shall be transferred in favour of Forest Department in the special fund created for compensatory afforestation as an additionality for afforestation and allied activities.

iii) Compensatory afforestation to be raised over equivalent non-forest land which will be notified as protected forest under Indian Forest Act.

Yours faithfully,

Sd/-
(INDER DHAMIJA)
Asstt. Inspector General of Forests.

No.15/94/90-PP
Ministry of Water Resources
Govt. of India
***

Shram Shakti Bhawan,
Rafi Marg, New Delhi,
The 8th July, 1992.

To

The Chief Secretary
Government of Rajasthan/MP/Maharashtra/Gujarat,
Jaipur, Bhopal, Bombay, Gandhinagar.

Sub: Catchment Area Treatment of Reservoirs.

Sir,

Committee of Secretaries in their meeting held on 3.7.92 at 4.45 P.M. in the Committee Room of Cabinet Secretariat have discussed catchment area treatment of reservoirs and decided as under:

a) In view of the differences in the geographical situations around the different reservoirs, it would be difficult to provide for any standardized package for treatment of the watershed around the reservoir rim for improving their carrying capacity. The proposals will have to be looked into on a case to case basis and settled in consultation with the Ministry of Environment & Forests at the time of clearance of the project. But the objective would be to keep this treatment to a reasonable extent and not to unduly burden the project with general land improvement activities as such.

b) The Planning Commission in consultation with the Ministry of Agriculture and the Ministry of Environment & Forests should separately review the provisions required for improving the degraded lands in the different basins. These provisions and the programmes thereof need not be tagged with any specific project in reservoir basin as such.

c) The works necessitated on account of the immediate and direct adverse impact of the project during the construction phase along with the work on the direct draining sub watershed for improving the carrying capacity of the degraded/ highly degraded lands along the reservoir should be carried out pari passu with the construction programme of the project and provided for in the cost estimates of the project.

You may accordingly take further necessary action in the light of the above decision in respect of Environmental Action Plan with regard to catchment area treatment of Sardar Sarovar and other projects in your State.

Yours faithfully,
Sd/
(B.S. AHUJA)
Joint Commissioner (PP)

Copy to :
1) Member (WP), CWC
2) Vice Chairman / Secretary, SSCAC.
3) Vice Chairman, SSNNL.
4) Executive Member, NCA.