Chapter 1

Introduction

CHAPTER – 1

INTRODUCTION

1.1 Sardar Sarovar Project

The Sardar Sarovar Project is an Inter State multipurpose joint venture of four states – Gujarat, Madhya Pradesh, Maharashtra and Rajasthan. It is the largest water resources development project in India with the terminal major dam on river Narmada in Gujarat.

The plan for harnessing the river for irrigation and power generation in the Narmada basin was initiated in year 1946. Seven projects, including the Bharuch project, were identified during the initial survey and four projects viz Bharuch (Gujarat), Burgi, Tawa and Punas in Madhya Pradesh were given top priority for investigations. After the investigations the proposed dam at "Gora" in Gujarat with the fall reservoir level (FRL) 161 feet (49.80 m) was selected and the foundation stone was laid by the late prime minister Pandit Jawaharlal Nehru on the 5th April, 1961.

The Sardar Sarovar Project (SSP) is probably the only one of its kind in the world in terms of scale, physical dimensions and engineering magnitude. Its latent, unexplored potentials can only be imagined. The dam itself is one of the world's largest, standing 455 feet in height and 4000 feet in length. Its construction alone involves the casting of over 7 million m^3 of chilled concrete, the largest quantity of concrete to be placed in any dam in India. This amount is equivalent to concrete required to provide a one-lane road along the entire Earth's Equator.

1.1.1 History of Narmada Countdown

1931: The British government proposes a plan for development of Narmada valley.

1946: Government of Central Provinces, Berar and government of Bombay (Mumbai) requests Central Waterways, Irrigation and Navigation commission (CWINC) to take up investigations on the Narmada river system.

1959: CWINC (Now Central Water Commission and Central Electricity Authority), submitted a project proposal to the government of Bombay for its consideration.

1960: Bombay bifurcated into Maharashtra and Gujarat.

1961: Jawaharlal Nehru lays the foundation stone of the Sardar Sarovar Project (SSP).

1964: Khosla (A N Khosla) committee set up to resolve disputes between Madhya Pradesh and Gujarat. (According to the award of NWDT, the parameters of Sardar Sarovar Dam will neither be reviewed nor changed till 2025 A.D. after the notification of the award)

1969: The Narmada Water Disputes Tribunal (NWDT) set up to decide water sharing.

1974: At Indira Gandhi's behest, Rajasthan is given 1,325 million cubic meters (mcum) and Maharashtra 607.5 mcum out of a total of 68040 mcum water available from the Narmada, annually.

1978: Final orders of NWDT passed.

1979: The tribunal allowed Gujarat to decide water distribution within the state. The World Bank issues $10 million loan for project appraisal.

1985: Medha Patkar and other activists launch protests against dam construction.

1987: Narmada Bachao Andolan (NBA) holds first negotiating session with the World Bank, state governments and Union representatives, on the rehabilitation and resettlement (R&R) of the displaced villagers. The Union environment ministry clears the dam project.

1988: Planning Commission accords investment clearance to the project. The Gujarat government clamps the Official Secrets Act on 12 villages on October 18.

1989: In January, 500 activists protesting against the Official Secrets Act were taken into custody. More violence against activists perpetrated. Centre clears 2,500 hectares (ha) of forest land for resettlement of dam oustees. The act is finally removed on March 29, 1989 in the face of protracted protests. Massive demonstration in Harsud a town to be submerged by SSP-on September 28.

1990: World Bank clears Rs. 1,200 crore for the project, Japan suspends funding for turbines.

1991: World Bank forms the Bradford Morse committee to review the project.

1992: The Morse committee report calls for withdrawal of World Bank from SSP. The bank's board of directors clears the project on the condition that benchmarks are met by March 31, 1993.

1993: NBA announces referendum whether people in the areas that would be submerged want to be shifted or not. India suspends World Bank loan before the deadline set by the bank. The government announces

a five member government review committee (nominated by pro-and anti-dam activists) before Jal Samadhi (death by drowning) deadline of August 5.

1994: Madhya Pradesh government calls for a reduction in dam height. NBA files a comprehensive case against SSP in the Supreme Court of India. The review group submits its report, which was kept under wraps. July-September saw a major submergence in the valley. Despite protests, the government goes ahead with dam construction.

1995: Work comes to a stop due to failure of resettlement targets for the next year. The World Bank brings out its project completion report on SSP, virtually accepting the points railed by the Morse report. The final hearing of the case filed by NBA begins, and effective stay on the project is given by the court when it refuses permission to start construction.

1996: Asian Development Bank (ADB) announces a massive new loan to Gujarat. NBA fears it may be diverted for SSP, though ADB claims to the contrary. Renegotiation with Sumitomo Corporation and the Japanese government begins construction of turbines for SSP.

1997: Case referred to the constitutional bench. Supreme Court stays dam construction in May 1997. However, work on building canal and resettlement continues.

1998: A policy shift in R&R with Gujarat government declaring oustees can be resettled in Madhya Pradesh also, as against the earlier decision to resettle them in Gujarat.

2002: May 18, 2002. 5 meter height was raised (as per the Supreme Court directives).

2003: May 14, 2003. 5 meter height was raised (as per the Supreme Court directives).

2006: Dec 30, 2006. 2.31 meter height was raised (as per the Supreme Court directives).

2010: Feb 12, 2010 Central Government released fund of Rs. 5777 Crores for SSP

2010: April 02, 2010 Narmada Control Authority cleared the decks for raising the Narmada dam height from the current 121.92 m to 138.64 m which is the dam's reservoir level.

1.1.2 Narmada Basin

The total Basin area of the river is 97,410 sq. km. comprising 85,858 sq. km. in Madhya Pradesh, 1658 sq. km. in Maharashtra and 9894 sq. Km in Gujarat. The drainage area up to dam site is 88,000 sq. km. the mean annual rainfall in the basin is 112 cm. the annual runoff of the dam site at 75 percentage of dependability is 27.22 MAF. The World Bank computed the yield of 28.57 MAF while the yield computed in May 1992 by Central Water Commission of Government of India is of 26.60 MAF. The utilization of Narmada River basin today is hardly about 10%. Thus waters of Narmada continue to flow to the sea unused.

1.1.3 Main Features of Sardar Sarovar Project

Sardar Sarovar Project is a unique project of India in many respects. Main features of the project are as under:

A. MAIN DAM		
1.	Length of main concrete gravity dam	1210.00 m.
2.	Maximum height above deepest foundation level	163.00 m.
3.	Top R.L. of dam.	146.50 m.
4.	Catchment area of river above dam site.	88,000 sq. km.
5.	Live storage capacity 0.58 M. ha. m	4.7 MAF
6.	Length of reservoir	214.00 km.
7.	Maximum Width	16.10 km.
8.	Average Width	1.77 km.
9.	Spillway gates	
	Chute Spillway	7 Nos. 60'x55'
	Services Spillway	23 Nos. 60'x55'
10.	Spillway Capacity	84949.25 cumecs
B. MAIN CANAL		
1.	Full supply level (F.S.L) at H.R.	91.44 m. (300')
2.	Length up to Gujarat – Rajasthan Border	458.00 Km.
3.	Base width in head reach	73.01 m.
4.	Full supply depth (F.S.D.) in head reach	7.60 m
5.	Design discharge capacity.	
	(a). In head reach	1133 cumecs
	(b). At Gujarat Rajasthan Border	71 cumecs
6	Distribution system	
	1. Number of branches	42
	2. Length of distribution system network	66000.00 Km.
	3. Annual Irrigation	18.00 Lac. ha.
7.	Power Generation	
	(a). River bed power house	1200 MW
	(B). Canal head power house	250 MW
8.	Additional Annual Production	Rs. 2175 Crores.

1.2 Need of Sardar Sarovar Project

The total geographical area of Gujarat state is 196 lakh. ha. Out of this cultivable land is 1.24 Lakh. ha. Irrigation potential developed till June 2001 is 36.12 lakh ha against potential of 65 lakh ha The utilization is 28.50 lakh ha from all surface and ground water schemes, which is 23% of total cultivable land. Remaining 77% of cultivable land does not get any irrigation.

Geographically, Gujarat is divided into 3 regions namely, (a) Gujarat region comprising South Gujarat and North Gujarat (b) Saurashtra and (c) Kachchh. Three major inter state rivers, viz., the Narmada, the Tapi and the Mahi flow through Gujarat. Yet the state has received very limited annual dependable yields due to absence of proper allocation for its use. These rivers are flowing in Central and South Gujarat where average rainfall is 2000 / 2500 mm. On the other hand, in North Gujarat, Saurashtra and Kachchh, there are 168 rivers; but due to scanty rainfall of 400 mm or less annually, they remain almost dry and hence very limited ground water resources are available. As a result ground water table in these areas has been lowered beyond 1000 feet.

The 3rd major factor is the salinity ingress through 1500 Km. long coastline which has advanced to about 6 Km. from the coastline in all such areas of the state, as a result of which the ground water in the coastal area is saline.

Another important factor is the advancing of the desert in much of North Gujarat and Kachchh district. Because of advancing desert from the North, Mehsena and Banskantha district are slowly getting converted into desert lands and similarly the advancing of Rann of Kachchh and Little Rann of Kachchh are threatening to render barren Kachchh and Surendranagar districts.

The most important feature is the recurring drought in Gujarat every three years. Gujarat was formed in 1960 and in the last 50 years there had been 16 years of drought and in the last 76 years 23 years of drought. The year 1991-92 was a severe drought year in Gujarat in which 15 districts and

more then 15,000 villages were declared as drought affected and Government had to prepare a master plan of Rs. 5 billion as drought relief measures. Before this, there were 3 consecutive drought years from 1985-86 to 1987-88 during which Gujarat spent as much as Rs. 15 billion on drought relief measures and suffered loss of agriculture worth Rs. 50 billion.

The drought is such a menace that not only does it eat away billions of rupees but along with it, lack of surface and ground water resources, millions of cattle and shepherds have migrated. These are the major factors in considerations, which lead to the decision of implementing SSP.

1.3 Command Area of the Proposed Sardar Sarovar Project (SSP)

The Sardar Sarovar (Narmada Project) envisages construction of dam (Sardar Sarovar Dam) across river Narmada at Navagam with FRL 455'and a canal off taking on the right bank with its full supply level (at off take) at RL 300'. The canal, after traversing through middle and north Gujarat, reaches the common boundary of Rajasthan and Gujarat. The main canal and its branches would command a gross area of 34.29 lakh hectares (84.48 lakh acres) extending in part or wholly over the districts of Bharuch, Vadadora, Kheda, Panchmahal, Ahmedabad, Gandhinagar, Mehsana, Banaskanth, Kachchh, Surendranagar, Rajkot and Bhavnagar of Gujarat state.

The command area lies between 21° 40' to 24° 40'N Latitude and 69° 33' to 73° 50'E Longitude.

1.3.1. Command Area Phase - I

The command area under Phase – I of the project, comprising about 7.91 lakh hectares (19.53 lakh acres) and covering parts of Bharuch, Vadadora, Narmada and Panchmahal districts, lies between 21° 40' to 22° 50 N Latitude and between 72° 30 to 73° 50 E longitude. It is bounded by the rivers Narmada and Mahi in the south and north respectively. The main canal in the east and the Gulf of Khambat in the west, form the other two boundaries of the command area.

The Narmada command area is characterised by wide diversity in agro-climatic features. The mean annual rainfall in the command area varies from 375 mm to 1000 mm. Even in terms of soil and drainage conditions and groundwater availability and its quality, there are wide differences from one region of the command area to another.

It was therefore considered necessary to identify more or less homogenous zones within the command area, in terms of intrinsic land quality and possible impact of irrigation development on cropping pattern and other variables. The 'rationalisation' exercise was carried out by the Operation Research Group, which divided the command area into 13 agro-climatic zones, on the basis of natural factors like rainfall; land irrigability class, ground water quantity and quality and drainage conditions (Table 1.1).

Table 1.1: Agro-climatic regions in Sardar Sarovar Project Command Area

Sr. No.	AGRO-CLIMATIC REGION	NAME
1.	I	Savli – Naswadi.
2.	II	Vadadora – Karjan.
3.	III	Amod – Bharuch.
4.	IV	Jambusar – Vagra.
5.	V	Gandhinagar –Kheda.
6.	VI	Ahmedabad – Mehsana.
7.	VII	Surendranagar – Ahmedabad.
8.	VIII	Surendranagar – Ahmedabad - Bhavnagar
9.	IX	Surendranagar – Rajkot.
10.	X	Ahmedabad – Surendranagar – Mehsana.
11.	XI	Mehsana.
12.	XII	Banaskantha.
13	XIII	Kutch.

1.4 Study Area

The first four agro-climatic regions, mentioned above fall within the Sardar Sarovar Project Command Area phase – I. The study area covers these four agro-climatic regions. The list of these regions with the names of talukas and the area covered by each region is presented in Table 1.2. They are geographically located in the Narmada – Mahi doab and cover an area of 7.91 lakh hectares, of which the culturable command area (CCA) is 4.71 lakh hectares. It may be noted that the total geographical area of SSP is 8.47 lakh hectares and the reported area is 8.34 lakh hectares. Out of this reported area islands and kharlands cover 0.43 lakh hectares which has been excluded from the study area.

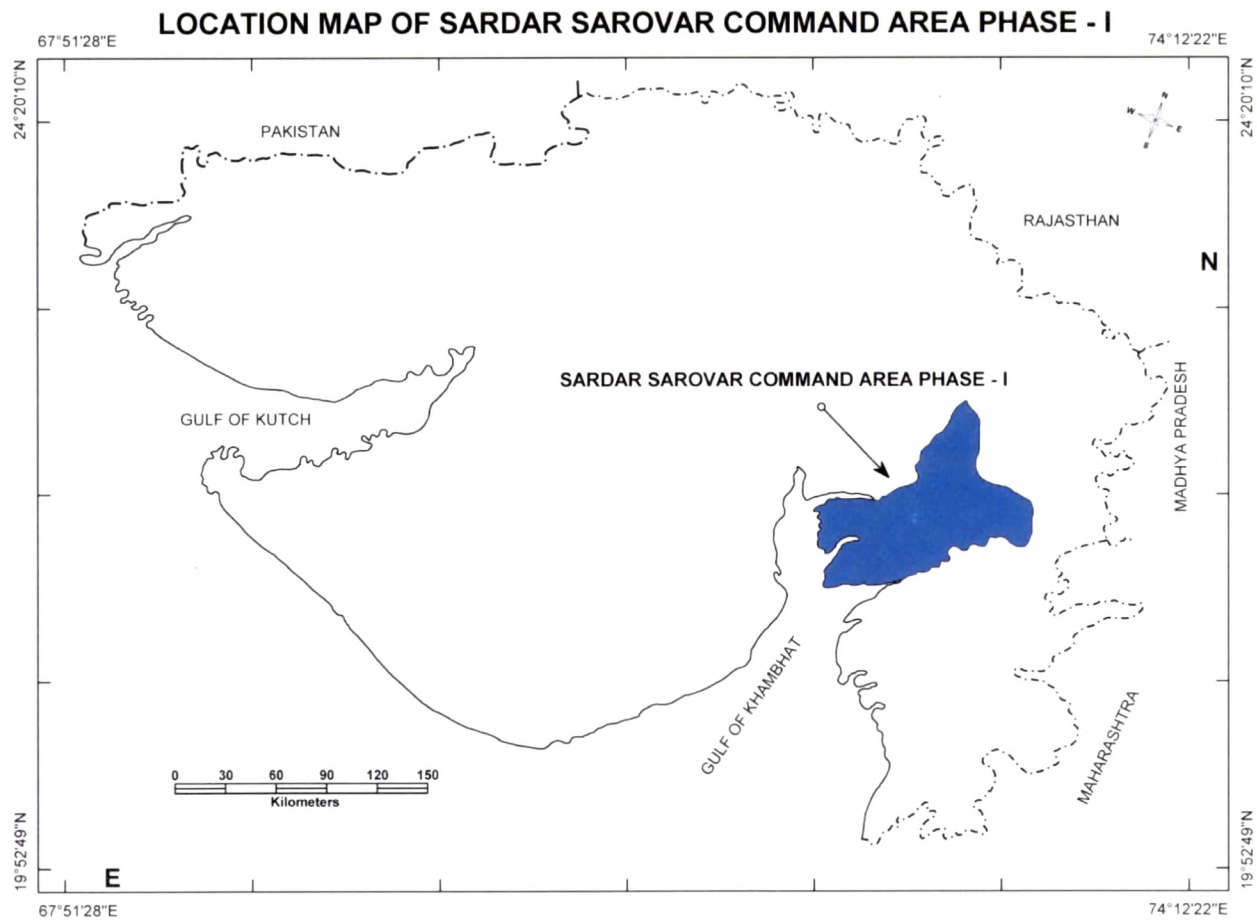
LOCATION MAP OF SARDAR SAROVAR COMMAND AREA PHASE - I
67°51'28"E
74°12'22"E
24°20'10"N
19°52'49"N
PAKISTAN
RAJASTHAN
N
SARDAR SAROVAR COMMAND AREA PHASE - I
GULF OF KUTCH
MADHYA PRADESH
GULF OF KHAMBHAT
MAHARASHTRA
0 30 60 90 120 150
Kilometers
E

Figure 1.1

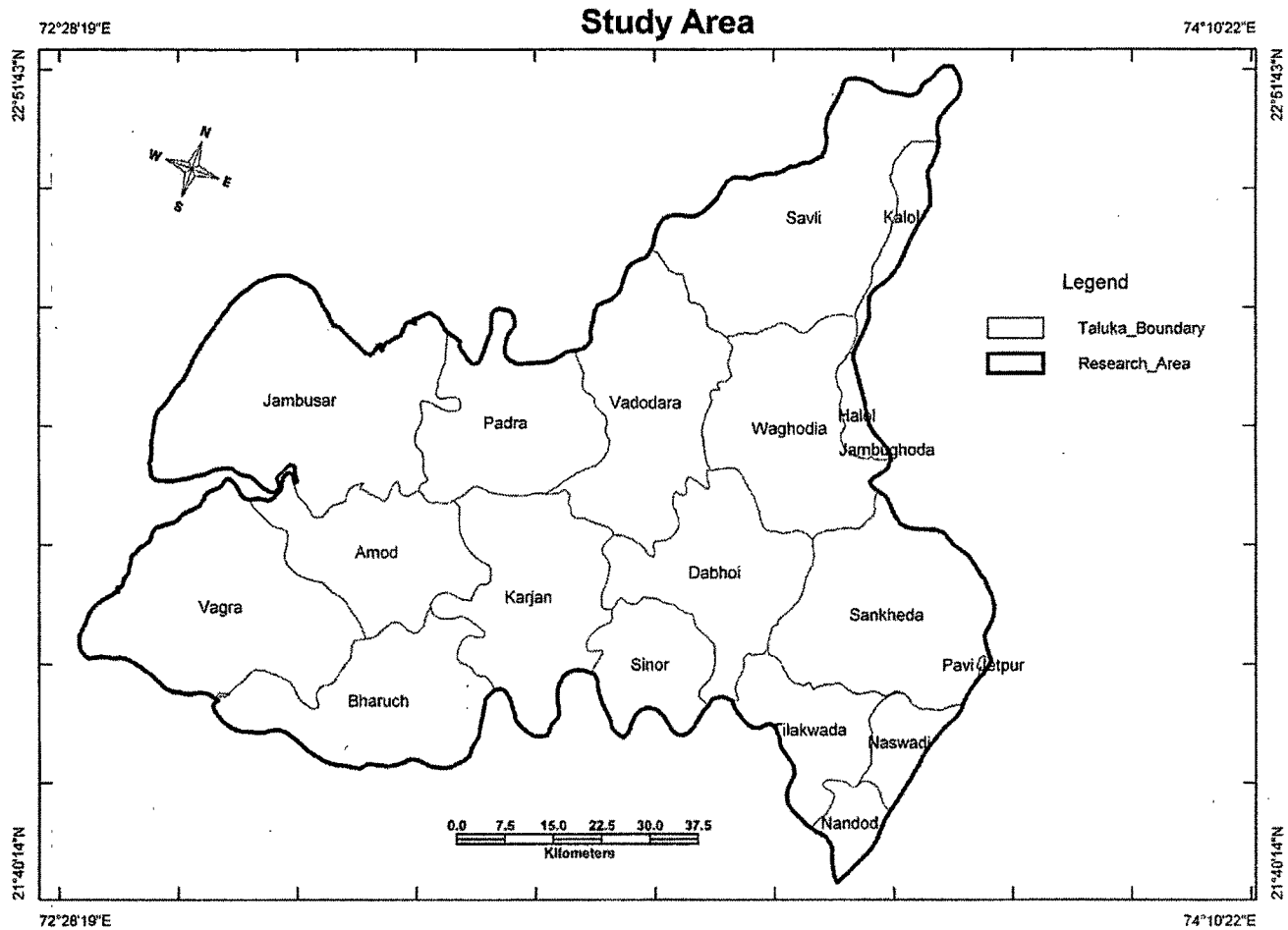
Study Area
72°28'19"E
74°10'22"E
22°51'43"N
21°40'14"N
N
W
E
S
Savli
Kalol
Legend
Taluka_Boundary
Research_Area
Jambusar
Padra
Vadodara
Waghodia
Halol
Jambughoda
Amod
Dabhoi
Vagra
Karjan
Sankheda
Sinor
Pavi Jetpur
Bharuch
Tilakwada
Naswadi
Nandod
0.0 7.5 15.0 22.5 30.0 37.5
Kilometers

Figure 1.2

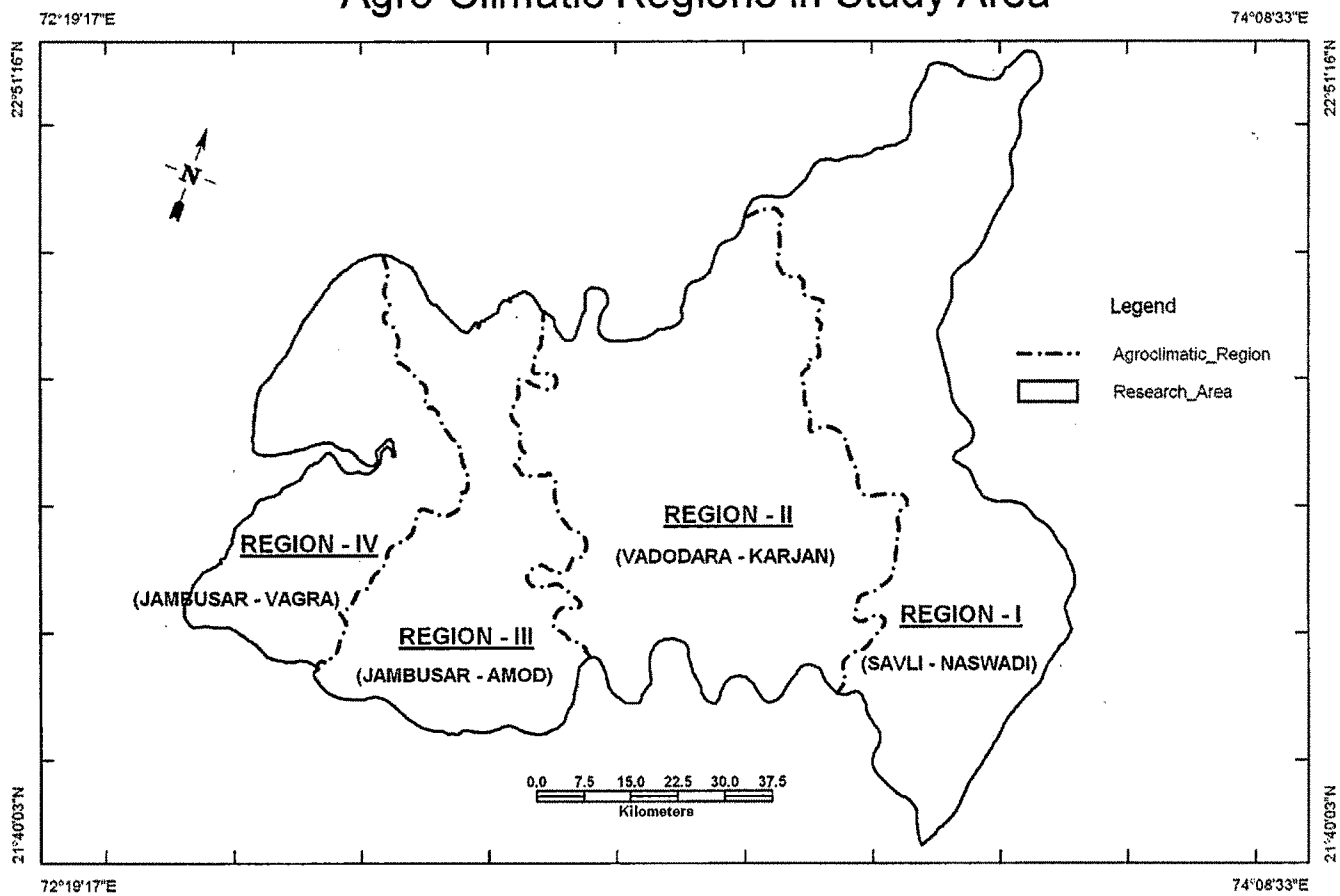
Agro-Climatic Regions in Study Area
72°19'17"E
74°08'33"E
22°51'16"N
21°40'03"N
N
Legend
Agroclimatic_Region
Research_Area
REGION - IV
(JAMBUSAR - VAGRA)
REGION - II
(VADODARA - KARJAN)
REGION - III
(JAMBUSAR - AMOD)
REGION - I
(SAVLI - NASWADI)
0.0 7.5 15.0 22.5 30.0 37.5
Kilometers

Figure 1.3

Table 1.2: Agro-climatic regions in Sardar Sarovar Project Area

Sr. No.	REGION	NAME	TALUKA	AREA (ha)
1.	I	Savli - Naswadi	NANDOD	253,000
2.			TILAKWADA	
3.			NASVADI	
4.			SANKHEDA	
5.			PAVI JETPUR	
6.			WAGHODIA	
7.			SAVLI	
8.			JAMBUGHODA	
9			HALOL	
10.			KALOL	
11.	II	Vadadora - Karjan	VADODARA	273,000
12.			DABHOI	
13.			SINOR	
14.			KARJAN	
15.			PADRA	
16.	III	Amod – Bharuch	BHARUCH	188,000
17.			VAGRA	
18.			JAMBUSAR	
19.			AMOD	
20.	IV	Jambusar - Vagra	VAGRA	77,000
21.			JAMBUSAR	
22.			AMOD	

Source: Operations Research Group:

1.5 Research Questions

The research questions that are basically being raised through the study are

1. To what extent the Sardar Sarovar project will help to improve the supply of water, qualitatively and quantitatively, within the command area.

2. Whether irrigation provided through the canals of the project will help to increase crop production and bring about changes in cropping pattern
3. How the implementation of the SSP will facilitate micro-level planning and bring about changes in the economic and social conditions within the command area.
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1.6 Significance of the Study

The present study of Sardar Sarovar Project Command Area – Phase I is an attempt to understand and interpret the changing relationship between man and environment. The study would, therefore, bring to light the little known land use practices of the area as no intensive geographical study of the area has been made till this date. The Narmada Planning group conducted a variety of studies in the Narmada Canal Command Area, of which this area is part. Extensive soil, rainfall and cropping pattern surveys have been completed, but all were done from engineering and planning points of view. The Department of Geography of The Maharaja Sayajirao University of Baroda conducted a land use survey and mapping of Narmada Command Region IV (A & B). But that study was to understand the land use situations over a period of three years (1979-80, 1980-81 and 1981-82) of which the average was worked out, and large-scale maps were prepared. The study was aimed at understanding the present trends and the future prospects when

Narmada Canal would be commissioned, and the area would be getting sufficient water at its disposal.

The study area is geographically a problem area. Its climatic conditions, particularly rainfall, are quite erratic. It is observed that almost every third year is a year of scanty rainfall. The ground water table is not much deep, and the aquifers are useless for drinking and irrigation as they have very high ratio of salt, especially in agro-climatic regions 1 and 4.

Looking into the nature and scope of this study, it can prove to be of great significance in view of the current emphasis on rural development planning. All planning exercise starts from knowledge of the present condition and from appreciation of the existing trends of development in its various manifestations. The present study will give a factual account of the existing land use and agricultural situation of the area, which will serve as a solid background for physical planning in general and land use and cropping planning in particular. The study of the changes in the land use and cropping pattern during past twenty years will indicate the trends in land use and agriculture. The planner may take a clue from this and plan the strategy accordingly checking or changing the undesirable trends in land use and giving a push to the desirable ones. This way, the present study will be of great significance for the planners and administrators concerned with the development of rural areas of Gujarat. Besides, it may also serve as a guide to planners in similar saline areas along the western coastal belt of Gujarat, and Maharashtra and similar areas elsewhere in the country.

1.7 Choice of the Study Area

The study area is interesting from the geographical viewpoint. The environmental determinism has for long been a matter of hot debate between the various scholars of different schools of thought in the western world as well as in India. Many merits and demerits of this concept have been noted, and many arguments for and against the project have been extended. A host of possibilistic measures have been adopted to minimize and/or nullify the influence of determinism in different parts of the world, and also in India. But these measures have not been equally distributed all-over and equally enjoyed by all sections of the society. Certain areas, even in the highly developed states, have been reeling under the adverse effects of development project on the environment even in this modern period of man's increasing control over nature.

Bara Tract, as perceived by the present researcher, is one of such unfortunate area of the progressive state of Gujarat. The Narmada Planning Group (N.P.G.), in their schematic zoning of the Narmada Canal Command Area, have placed this area in region IV-B and have categorized it as a "Problem Area".

Having visited the area under severe rainless situation, acute shortage of drinking water and helpless condition for the inhabitants, the researcher developed an interest to take up the task of studying the dynamism of the area's rural land use within the constraints of the natural environment, and the human inter-action with it. The study acquires added significance in view of the fact that the land use of the area is likely to change drastically with the commissioning of the long awaited Narmada Canal.

1.8 Objective of the Study

The present study is confined to Sardar Sarovar Command Area Phase - I, which is sub-divided in 4 regions based on agro-climatic pattern. The study area has been the target of the furies of nature and considerable apathy of the planners.

It is therefore aimed to do an intensive study of the environment in the area at two points of time and find out the changes that have taken place in land use as well as of the shortcomings of the present uses of land and the possible changes likely to take place once irrigation facility is made available. The study also aims at providing suggestion to correct the prevailing systems so that better advantages may be reaped from the inputs applied. It is also aimed to prove how a student of Geography, using the geographic techniques, can help in changing the face of such problems in the region.

In this process, attempts will be made to test the following assumptions:

Judicious use of water resources can increase the yield and variety of crops grown

Over-irrigation will lead to increased salinity and thereby reduce yields

The cropping pattern and crop combinations will have to be decided on the basis of soil quality, water availability, irrigability conditions and socio-economic conditions

The broad objective of the study is, therefore, to assess the impact of the SSP on the land use changes, changes in cropping pattern and resultant alterations in the social and cultural environment within its command area.

1.8.1 Specific Objectives of the Study Area

1. To assess the existing quality, quantity and consumption pattern of the water resources.
2. To investigate the climatic variations for identifying water surplus and water deficit areas at the micro level.
3. To study cropping pattern in order to estimate the water requirement for agriculture in the existing agricultural practices
4. To study the physical and socio-economic environment responsible for the existing cropping pattern.
5. Suggest an optimum cropping pattern for different agro-climatic zones within the region based on land, water and soil resources and the cost structure of major crops.
6. To predict the possible future changes in level and quality of ground water, soil characteristics and crop productivity that may occur once irrigation facility is made available thought out the year.

1.9 Choice of the Time Frame

It is necessary to explain the reasons behind the choice of the time frame of the study. The base year for the study is taken as 1980-81. This year marks the beginning of Sardar Sarovar Project; while 2001 is the last year for which census data is available that can enable assessment of the changes that have taken palace in 20 years after the implementation of the project.

1.10 Source of Data

The General information of SSP was collected from the office of the Chief Engineer's, Canal –I of SSNNL, Vadadora.

To procure first hand information for the socio-cultural status, from experienced and knowledgeable farmers, a questionnaire based field work was conducted for the rehabilitated people affected by the project.

The soil data was colleted from Soil Survey Organisation of Sardar Sarovar Narmada Nigam Limited and the present researcher had participated in this survey and named it "The Reconnaissance Soil Survey". The soil survey has been carried out in Phase – I, during the period 2002 to 2004. The base map of 1:50,000 or 1:63,360 has been used. The soil distribution, associated soil series, Land irrigability classification, soil texture, soil depth, soil water holding capacity, soil permeability, soil salinity, soil alkalinity maps are based on the results of this survey.

Details regarding hydrology and irrigation needs were collected from State Water Data Center (SWDC), River Gauging Division, Gujarat Water Resources Development Corporation (GWRDC) and Anand Agriculture University (AAU). The data were used for estimating rainfall quantity, runoff, water quality, sub-surface water levels and estimating crop water needs for different crops in the study area.

The general and cropland use data for the chosen points of time, 1980-81 and 2000-01, have been collected from Directorate of Agriculture, District Panchayat Office. The percentage difference of the data of both general and crop land use for the two points of time have been drawn, analysed and mapped

1.11 Methodology

Keeping in view the nature of the area, and the degree of availability of required data, a simple methodology has been employed for the work. Secondary data were collected from various government departments and analysed and mapped using various cartographic techniques. Computerised Geographical Information System (GIS) has been utilised for the mapping and analysis of data. The details of the methods used, statistical techniques adopted and GIS softwares used, have been discussed in the respective chapters where they have been applied.

Field work was carried out to collect water and soil sample from the study area and these were analysed by the researcher in the laboratory. For collection of socio economic data, field surveys were conducted using a structured questionnaire. Final analysis of data was done using various statistical and mapping techniques.

1.12 A Brief Review of Literature

Research on general land use and cropland use are not new. Many writers and research scholars have worked on the various aspects of land use, of the remote past, as far as they would collect the information from archeological and other sources.

The land-man relationship developed the very day Man came on the earth. Much is not known about that period, but it may be conjectured that an organized primeval system of land use might have started when Man learnt the art of gathering food, fishing, hunting and finally domesticating animals, raising crops from the soil and then making shelters for habitation.

The old text books deal with the spatial distribution of settlement, agriculture crops, mono or multiple cropping patterns, the cattle and livestock raising, etc. These aspects have been undergoing changes with the passages of time and with Man's increasing awareness of his environment.

The changeable character of land use has been looked into by different scholars from different angles. Chisholm (1889) saw it from economic and commercial viewpoint. Early geographers have shown the correlation between agriculture and physical as well as biotic factors, which provided a guideline for further researches in this field. Later geographers attempted to improve the old techniques and methods of research in agricultural geography. The geographers of early twentieth century introduced the regional and areal approaches in such studies. The western European geographers took the lead in this direction, and later it diffused to the U.S.A and elsewhere. Ratzel (1891) and Holms (1892) pioneered the studies in land use and cropland use from geographical viewpoints. This required field survey and data collection for general land use and cropland use, soils and related factors, and their depiction on large scale maps (Dolge 1911, Sauer (1915)

Though comprehensive work on land use started during the early days of the modern period of Geography, more progressive and systematic work started only after 1920's. Baker (1924) prepared the American agriculture atlas, and divided North America into agriculture regions. Whittlesey (1936) produced the map of the world agriculture regions.

However the task undertaken by Sir. Dudley Stamp to survey every inch of the land of England and Scotland within 2 years from 1931 – 1933, was a landmark in land use surveys and research. He is belived to have

systematized the methodology and studies on land use. His monumental publication – " Land of Britain, its use and misuse", and its summarized version " The land of Britain and how it is used", were efforts that ultimately resulted into the organization of the world land use surveys under the aegis of which a numbers of researches were carried out, the world over and several papers and monographs were published. Coppock (1964) explained the importance of physical and historical factors to reach to some results in the absence of data and socio-economic aspects in agriculture dynamics. Kostrowicki (1968) prepared a model for land use in combinations between the points of time. Coppock (1962, 1968, 1977), Clausan (1972), Champion (1974), Fraser Hart (1976), Best (1981) laid grater emphasis on structural, organizational, institutional and practical changes that have been taking place in their respective areas of study. Conkling and Yeates (1976) have seen the rural land use changes in the light of population growth, innovation and improvement in transportation, advances in production techniques and increase in real income. Kohl Heep (1986) discussed the agriculture problems of Latin America and suggested the strategies of change in the traditional methods, so as to meet the growing demand of food and nutrition. He suggested the measures for improving production of cash crops for increase in export. Many more works in land use and cropland use covering various aspects have been done by foreign scholars.

Studies in the trend of agricultural regionalization present varied facets. The study of crop combination regions was introduced by Weaver (1954). With a cumbersome calculation, he divided the middle west of the U.S.A into

different crop combination regions and prepared the maps. He gave new line in agriculture research, which focuses on crop combination analysis.
Doi (1957) improved upon this method and made it easy to calculate by adding the table of critical values, Helburn (1957) introduced eleven criteria for the delineation of agricultural regions.

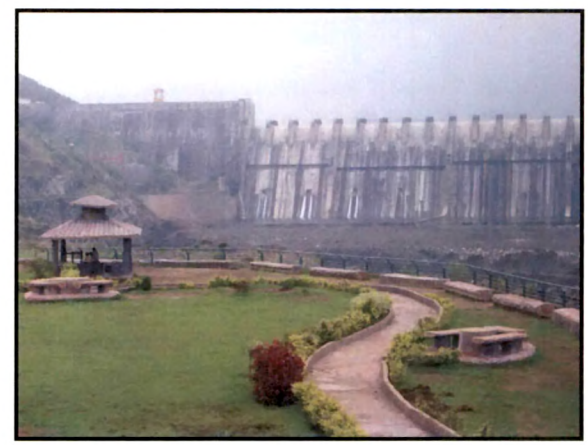
In India the work on land use synchronizes with the period of L Dudley Stamp in England. Prof. S. P. Chatterjee of Calcutta University worked on the land use of 24-Pargana in West Bengal. Ali S M (1939) did his PhD on the land use in Alaknanda river basin. Since the early fiftees a tempo of this type of studies got accelerated when Calcutta University and Aligarh school took lead in this direction. Piles of books and research articles, papers were produced since then by the Indian Geographers belonging to different universities and institutes of higher studies.

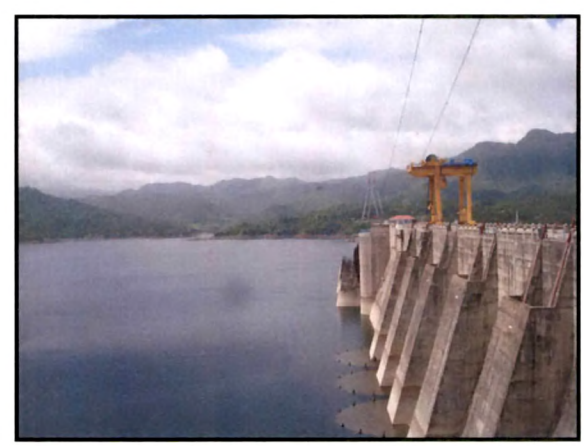
Shafi (1960) studied the land utilization in Eastern Uttar Pradesh and developed the soil crop relationship and identified change in cropping pattern. Sinha (1963) identified the influence of climate cycle on the agricultural rhythms in a canal irrigated area of Patna district and also noted the perception of the local people in this regard as expressed through local proverbs. In another paper (1965) he looked into the existing land use patterns in the same area as evolved with the introduction of canal irrigation.

More work in India has been done on various aspects of agricultural land use than in general land use. Ahmed (1966) studied the agricultural change in the light of the crop yields while Singh (1966) analysed the changes in crop associations through the replacement of rice, maize, potato, etc. by indigo, millets and barley. Amani (1968) made a comparable study of

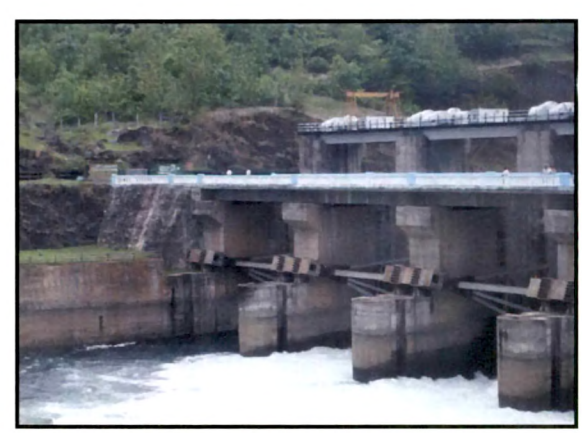
Narainpur over a period of 40 years and noted the change in the pattern of land use of that village as a consequence of long processes of interaction between physical and socio-economic factors. Dubey (1969) observed the changing pattern of cropland use in Madhya Pradesh owing to the increasing pressure of population. Ahmed (1969) studied the changing cropping pattern of Rohilkhand and established a high correlation between rainfall and cropland use. His hypothesis is applicable to all those areas where even today high degree of environmental determinism prevails as a dominating element. Saxena (1970) correlated the changing cropping pattern of a village in Badaun with climatic, edaphic and demographic factors; and Malhotra (1970) identified the changes in land use and cropping pattern brought about in Ganganagar by the Rajasthan Canal. (now Indira Gandhi Canal). Sharma (1970) noted the replacement of the traditional crops by marketable crops in Assam. Singh (1972) studied the dynamics of land use and cropping pattern of Uttar Pradesh and identified the influence of economic factors. Das Gupta (1972) from Orissa and Shingarey (1972) from Maharashtra also worked on the same theme. Nand (1972), using Doi's method, divided Rajasthan into simple crop combination regions and noted changes over time. Sharma (1983), applying Kostrowicki's method, identified the agriculture types and noted the changes in land use pattern in Rajasthan through the influence of population pressure, industrial development, and government policies. Rizvi and Bhatt (1984) identified the changes in the cropping pattern of village Rustampura in Gujarat on the basis of the return flow of the Mahi canal waters, which enhanced the prospects of irrigation in the village.

GLIMPSES OF SARDAR SAROVAR DAM





CATCHMENT AREA



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GLIMPSES OF SARDAR SAROVAR DAM