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Chapter 10

DAMS AND WATER DEVELOPMENT FOR POVERTY REDUCTION AND REGIONAL DEVELOPMENT: ISSUES AND OPTIONS FOR GUJARAT STATE

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1. Introduction

The inter-linkages of large water resources development projects all over the world with human society have been subjected to a great deal of controversies on the issues like compatibility with sustainable development, involuntary resettlement, environmental consequences, technical problems like sedimentation, water logging, reservoir induced seismicity etc. Despite inherent benefits like carry over storage, hydro power generation, fisheries development, flood control, less submergence and cost per unit volume of water etc., and despite their contribution to national economies (Hoover to United States, High Aswan Dam to Egypt and Bhakra Nangal to India), the fact remains that considerations like social, economic, environmental sustainability and sustainable human development, at that point of time were not given enough weightage. For opponents of large dam projects, sustainable development is not 'top down' but 'bottom up' (Fisher, 1997). From the perspective advocated by these critics, large scale centrally controlled schemes are incompatible with sustainable development. The State's role as a guarantor of national and international capital interest makes it inappropriate as the guardian of the interests of the poorest people in the society. Critics of development from this perspective argue that since interventionist development efforts emerged from the existing structures of power, they necessarily serve to maintain and support those structures.

Environmental issues (like damage to river and estuarian fisheries, deforestation and soil erosion in the watershed and water logging and salinity in the command areas) and human rights concerns arising from involuntary resettlement are two primary reasons which lie presently at the heart of disagreements over large dams. The proponents of large dams insist that sustainable development is compatible with large scale ambitious, centrally controlled schemes which are capable of mitigating the effects of natural catastrophes and meeting the increasing needs of growing economy for food, water and energy. This dominant interventionist model of development based on manipulative view of sciences and techno managerial view of human welfare makes state and technology as two wheels of development chariot.

Water resources development is not an end by itself; it is a means to an end. The end is to alleviate poverty, improve quality of life and to maintain integrity of environment and ecosystems. Properly planned and managed water projects can also successfully reduce regional disparities and contribute to significant improvement in social well being. The aim of this paper is not to advocate that all large dams in India and in the world are justified. But the paper broadly delineates the present water situation in the State of Gujarat and an attempt has been made to explore the link between water scarcity, impoverishment and regional imbalances. The options for dealing with the water crisis like large dams (esp. Sardar Sarovar Project on river Narmada) and rainwater harvesting through check dams etc. have been comparatively weighed in the light of available statistics and past experience.

2. Water Situation in Gujarat

Gujarat State (located in western part of India), with 6.39% of the geographical area and 4.88% of the population of the country, is blessed with just 2.28% of country's surface water resources (Figure 1).

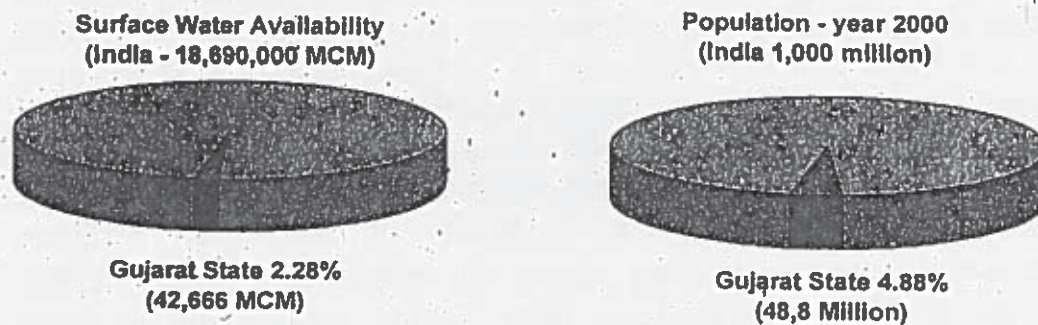


Figure 1. A comparison of Surface Water Availability as well as Population of Gujarat with India as a whole

Source: Narmada, Water Resources & Water Supply Dept., Government of Gujarat, 1998.

Out of 185 rivers, the state has only eight perennial rivers and all of them are located in Southern part. Around 80% of the State's surface water resources are concentrated in Central and Southern Gujarat, whereas the remaining three quarters of the State has only 20% of water resources. Average per capita availability of 980 m³/ year puts the State in "water scarce" category (as per the UN criteria). Intra-state variations in per capita water availability (1,570 m³ in South and Central Gujarat to 414 m³ in North Gujarat) is also striking (Figure 2).

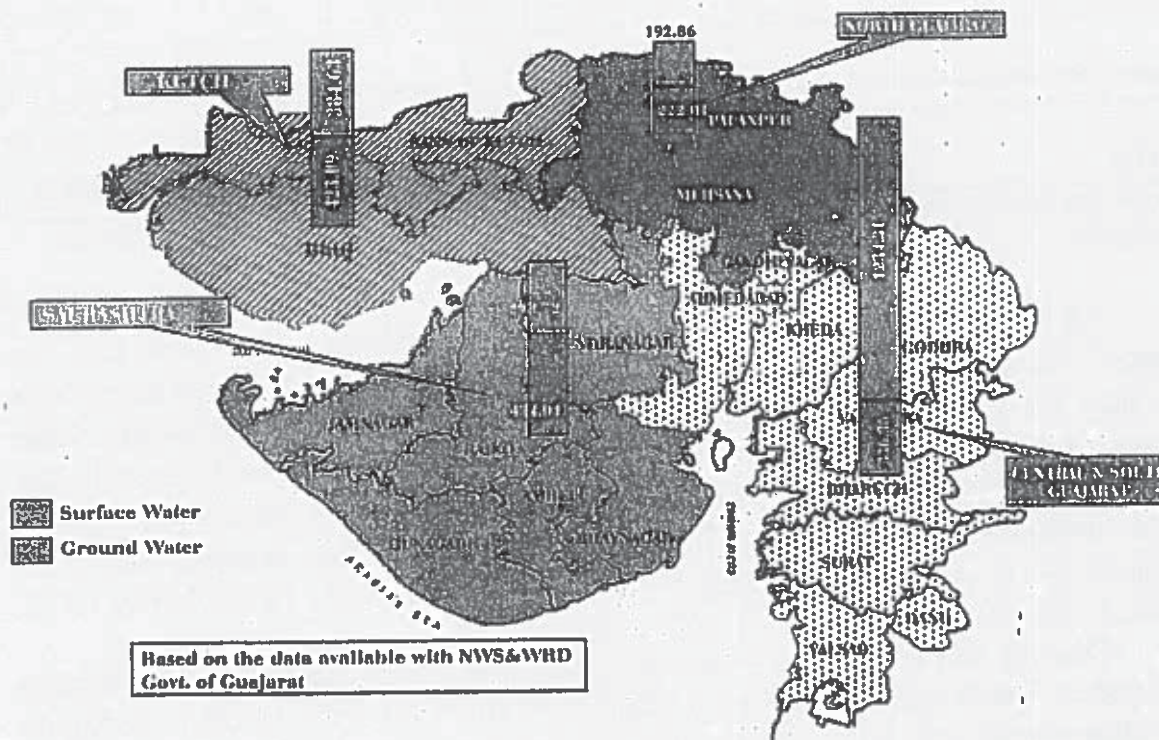


Figure 2. Per Capita Availability of Water in Gujarat

Gujarat has a tropical monsoon climate with temperature that is suitable for year round cropping. It is characterised by a low, uneven and unreliable rainfall with high coefficient of variance. The irony of nature is glaringly stark as far as the erratic behaviour of rainfall is concerned. On 11th September, 2000, as against a total storage capacity of 4,512 million cubic meters (MCM) all the dams of Saurashtra, Kutch and North Gujarat, the storage available was hardly 403 MCM (8.93%) (Table 1).

Table 1. Water Availability in Dams in Gujarat

Region	No. of Dams	Storage Capacity		Current Storage Available	
		(MCM)	(%)	(MCM)	(%)
North Gujarat	13	2,018	(13.48%)	96	(4.75%)
Saurashtra	113	2,229	(14.90%)	244	(10.95%)
Kutch	20	265	(1.77%)	63	(23.77%)
South & Central Gujarat	28	10,452	(69.85%)	4,660	(44.58%)
Total	174	14,964	(100.00%)	5,063	(33.83%)

Source: Narmada, Water Resources & Water Supply Department, Government of Gujarat, May, 2000

As many as 6,188 villages (34.3%) of total villages of Gujarat are "no source" villages i.e. they do not have any source to get water from anywhere and they have to depend on local authorities for water-supply to be provided through tankers. This really speaks volumes about the water situation in the State. On an average, three years in a cycle of ten years are drought years. After independence of India in 1947, these were the draught years of Gujarat-1951, 1952, 1955, 1956, 1957, 1962, 1963, 1965, 1968, 1969, 1972, 1974, 1980, 1985, 1986, 1987, 1991, 1999, 2000.

During last couple of years, the State had a very bad spell of droughts and about 5,645 million rupees (~US \$ 140 million) were spent to mitigate drinking water problem. During this period, the State had spent more than 600 million rupees (~US \$ 15 million) on temporary measures to provide drinking water (through tankers) which do not yield any permanent relief (Government of Gujarat, 2000a).

Pattern of surface water availability within three different regions of the state, is quite skewed from water abundant to totally water scarce regions. Surface water available through the Narmada basin is of substantial quantity-which underscores the state's dependence on Sardar Sarovar Project on river Narmada for its water requirements (Figure 3). As per a Report (Tahal, 1997) the effective storage of existing and ongoing major, medium and minor schemes including lift, check dams and percolation tanks is roughly equal to surface water potential. Therefore, no surface water is available for further exploitation except the Narmada waters.

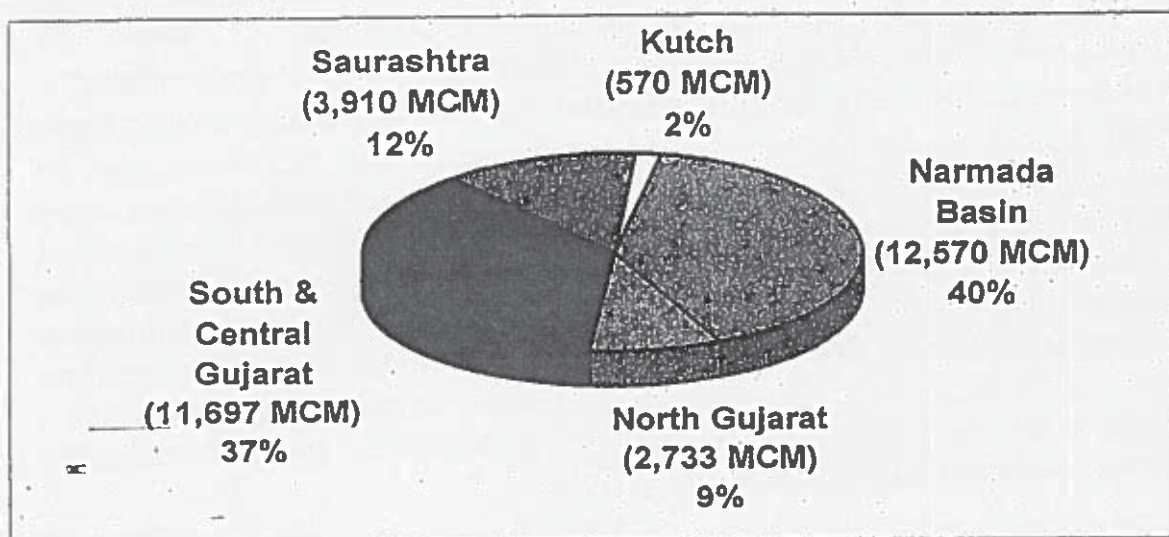


Figure 3. Utilisable Surface Water (31,500 MCM) in Gujarat
 Source: Narmada, Water Resources & Water Supply Department, Government of Gujarat, 1997.

An average rainfall of 25 cm to 200 cm with high coefficient of variance underlines State's dependence on dependable irrigation for agriculture. As a result of over extraction, groundwater tables are falling steadily.

In North Western Gujarat-Kutch, the epicentre of recent devastating earthquake, has always faced cruel vagaries of nature. Kutch has the lowest annual rainfall i.e. 35 CMS and that too is highly unreliable. Seven years out of last eleven years have been drought years for this district and this have had significant adverse impact on socio economic development of the area and the living conditions of its people. The harrowing tales of suffering of people of Kutch will be evident from the fact that out of 265 MCM of live storage capacity of 20 dams in this region, the available storage as on March, 2001 was less than 10%. With present acute drought situation and unprecedented loss of human lives and almost total destruction of economy in the recent earthquake, making irrigation and drinking water available to this district would be an essential component of the reconstruction process.

3. Relationship between Water and Poverty

The Human Development Index (HDI) developed by Human Development Report, 2000 (UNDP, 2000) measures the overall achievements in any country 'is three basic dimensions of human development-longevity, knowledge and a decent standard of living. It is measured by life expectancy, educational attainment (adult literacy and

While the HDI measures overall progress in a country in achieving human development, the Human Poverty Index (HPI) reflects the distribution of progress and measures the backlog of deprivation that still exists. HPI-I measures poverty in developing countries. The variables used are the percentage of people expected to die before the age of forty years, the percentage of adults who are illiterate and deprived in overall economic provisioning-public and private-reflected by the percentage of people without access to health services and safe water and the percentage of underweight children under five. The World Bank¹ also emphasizes upon availability of fresh water as an important constituent of World Development Indicators (WDI) (The World Bank, 1999). Therefore, there is an immensely powerful link between sustainable human development, and water, sanitation and hygiene (WSSCC, 2000). It is a practical experience that they constitute an entry point to poverty alleviation and all round human development. On a national scale, in India, the interrelationship between sources of drinking water and selected HDIs is reflected in Table 2.

Table 2. Interrelationship between Sources of Drinking Water and Selected HDIs

Village Variable	Per Capita Income (Rs)	(%) Population BPL	(%) Female Literacy	(%) Enrolment (female)
Piped Water	5,442	30.8	52.2	81
Other protected sources	4,336	39.2	41	64.3
Unprotected Water	4,230	39.2	34.8	59.5

Source: India Human Development Report: NCAER 1999

Therefore, the villages with better availability of drinking water report:

- Improved lifestyles,
- Better health,
- Higher productivity and income,
- Improved female enrolments for education

A significant correlation exists between poverty and water scarcity in Gujarat as well (Gariwala, 2001). Of the present around 50 million population, around 65% is rural, dependent on irrigation water, as their main economic activity is farming. There are around 5 million farmers, 3.5 million agricultural labourers and 0.5 million are engaged in animal husbandary/forestry. Therefore around 9 million people are directly dependent on water-based economic activity in 18,028 inhabited villages of Gujarat. The Govt. of Gujarat undertakes "Census of Families Below the Poverty Line", (BPL families) in Rural Areas. The data available from this census are analysed and placed in Table 3 and Table 4. Table 3 gives district wise data of BPL families in rural areas and out of this, how much belongs

to farmers' and agriculture labourers families i.e. BPL families related to water. Table 4 gives comparison of BPL families in rural areas for the 8th Plan and current the 9th Plan.

Table 3. GUJARAT-Census of Below the Poverty Line (BPL) Families in Rural Area (As of 1 April, 2000)

Sr. No.	District Name	Total No. of Rural families (in '000)	Total Rural Families (in '000)	%age of BPL families (4 to 3)	BPL families (in '000)			%age of BPL families related to water in total BPL families (8 to 4)
					Small & Marginal famrmers	Agriculture Labour	Total	
1.	Ahmedabad	298	79	26	9	61	69	87
2.	Amreli	188	51	27	9	33	42	82
3.	Kutch	221	73	33	10	61	71	97
4.	Kheda	298	109	36	38	67	105	96
5.	Anand	249	74	30	13	56	69	93
6.	Gandhinagar	161	35	22	11	18	29	83
7.	Jamnagar	176	80	45	23	36	59	74
8.	Junagadh	302	76	25	17	52	69	91
9.	Porbandar	59	18	30	4	12	16	89
10.	Dang	39	34	87	25	8	33	97
11.	Panchmahal	318	222	70	172	36	208	94
12.	Dahod	239	193	81	175	11	186	96
13.	Banaskantha	399	135	34	63	65	128	95
14.	Bharuch	214	110	51	25	81	106	96
15.	Narmada	89	73	83	23	47	70	96
16.	Bhavnagar	244	72	30	7	56	63	88
17.	Mehsana	238	47	20	10	35	45	96
18.	Patan	164	56	34	14	40	54	96
19.	Rajkot	260	78	30	20	49	69	88
20.	Vadodara	347	132	38	54	74	128	97
21.	Valsad	159	85	54	37	43	80	94
22.	Navsari	149	76	51	26	46	72	95
23.	Sabarkantha	335	146	44	101	39	140	96
24.	Surat	406	196	48	53	127	180	92
25.	Surendranagar	215	79	37	10	56	66	84
	Total	5,767	2,329	40	949	1,209	2,158	93

Source: Government of Gujarat, Rural Development Department. 2001

Total rural families in Gujarat as on 1st April 2000 were 5,767,000 (5.7 million), out of which 2,329,000 (2.3 million) families are below the poverty line. This conveys that 40% of rural population is below the poverty line in Gujarat at present. As per this census, there are 949,000 (0.94

million) BPL families of small and marginal farmers and 1,209,000 (1.2 million) BPL families of agricultural labourers i.e. total 2,158,000 (2.1 million) BPL families of farmers and agriculture labour who are attached to water-related farming activity.²

This analysis gives an astonishing condition that this 2158000 (2.1 million) BPL families of farmers and agricultural labourers form a whopping 93% of total BPL families in rural Gujarat. Out of 25 districts of Gujarat, 17 districts have above 90% BPL families in water related farming activities, 7 districts are between 70 to 80% and one district Jamnagar has 74% ratio of water-related BPL families, amongst the total BPL rural families in their district. In other words, it conveys that almost the entire rural poverty is based on water. The reason is obvious that Gujarat has been suffering from acute water shortages as we have mentioned earlier.

Now let us analyse Table 4 which gives comparison of BPL rural families in 8th plan period-1992 to 1997-and current 9th plan period for 1998 and 2000 as per this census.³ Here there are two different economic criteria for defining a BPL family. As per the current criteria, a family who has a total annual family income of Rs.15,250⁴ is considered as below the poverty line. As per Planning Commission, Government of India guidelines, an average family is consists of 5 members. Hence for a BPL family, the average per capita income per month comes to Rs.254/-(US\$5). As per the earlier criteria in 8th plan, this income limit was Rs.11,000 (US\$ 208) and hence the average per capita income per month was Rs.184/-(US\$4.5). As per World Bank criteria, a family having income of US \$ 1.08 per day or less is considered below the poverty line i.e. US\$ 395 per year. According to this an Indian BPL family having annual income of Rs.15,250 comes to about US \$325 at current exchange rate, which is much less than the international criteria.

Table 4. Gujarat-Comparison of Below the Poverty Line Families in Rural Area in 8th and 9th Five Year Plans.

Sr.No.	Gujarat State Particulars	Elghth Plan 1992-97	Ninth Plan 1997-2002		
		BPL Survey based on income upto Rs. 11000 per year (per capita Rs. 184 per month)	BPL Survey based on income up to Rs. 15250 per year (per capita Rs. 254 per month)		
			1998	2000	increase (+) decrease (-)
1.	Total Rural Families	4,804	5,588	5,767	+179
2.	Total Rural BPL families (No. in '000)	2,619	1,981	2,329	+348
3.	% of BPL families (2+1)	54	35	40	+5
4.	Total families of small & marginal farmers and agriculture-dependent on water (No.in '000)	2,278	1,818	2,158	+340
5.	% of BPL families related to water (4+2)	87	92	93	+1

Source : Rural Development Commissionate, Government of Gujarat.

4. Poverty Increases When Water Decreases

According to Table 3, there were 54% BPL families in rural Gujarat during 8th plan period of 1992-97. This was drastically reduced to 35% in 1998, the reason being very simple that the income criteria was raised from annual income of Rs.11,000 to Rs.15,250/-per BPL family. However, despite this accommodation, in the year 2000, this ratio increased from 35% to 40% in 2 years' time which is significant. This is perhaps because the year 1999 as well as 2000 were drought years. During 1999 drought, 8,666 villages (48% of total) were declared as 'affected'. The number rose to 12,240 villages (68%) in the year 2000. This proves the hypothesis that poverty increases when water decreases. This table shows that the total increase of 340,000 families in small and marginal farmers and agricultural labourers is almost equivalent to increase in total rural BPL families of 348,000. Therefore, it is this category of rural population which is impoverished due to water scarcity. This, undoubtedly, proves the directly proportionate relationship between the incidence of poverty and water scarcity in the State of Gujarat.

5. Water and Food Security in Gujarat

The sustainable development of water resources is critical to food security. This does not only mean sufficient agricultural production, but also it implies that (a) 'every individual has physical, economic and environmental access to balanced diets, including the needed micro-nutrients and safe drinking water, and to primary health care and education so as to lead a healthy and productive life' and (b) 'food originates from efficient, effective and environmentally benign technologies that conserve and enhance the natural resources base of crop and animal husbandry, forestry and inland and marine fisheries (Shah, 1998).

Both the World Food Summit in 1996 and the World Water Vision have recognised that feeding the ever growing world population and solving the looming water crisis are inextricably linked. By 2025, about 3 billion persons-1.1 billion in Africa-will be living in countries so short of water that they would not be self-sufficient in their food production. In many countries the sustainable supplies of freshwater for irrigation have reached their limits coupled with over extraction of ground water.

The agricultural growth has remained almost stagnant during the last two decades in Gujarat (Gariwala, 2001). When the State was constituted in 1960, net area irrigated was 6,820,900 ha, which increased by almost five times by 1997. But still around 69 percent of Gujarat land lacks assured irrigation facilities. Groundwater has contributed to more than 80% of

irrigation in the State (Figure 4). At the ultimate irrigation potential of 6.85 M ha, 43% of it will be from ground water, 31% from surface water from the State basins, and 26% from inter-State allocations (Gujarat Agrovision, 2000).

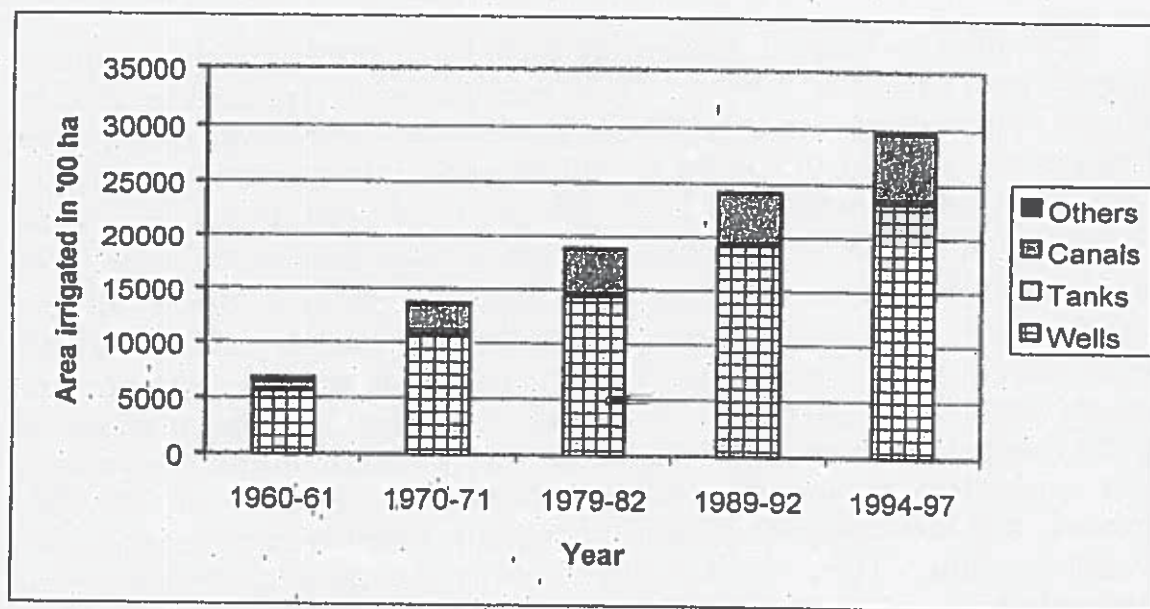


Figure 4. Sources of Irrigation in Gujarat State

Source: Based on the data available from Gujarat Water Supply & Sewerage Department

However, the State has had to pay heavily in terms of severe depletion of utilizable groundwater resources all over the State. Because of typical water intensive crop varieties and less awareness/experience of real value of water, the so-called water surplus regions of South and Central Gujarat have also experienced severe loss in utilizable groundwater as compared to water scarce regions (Table 5).

Table 5. Absolute change in Utilisable Groundwater

	South & Central Gujarat	North Gujarat	Saurashtra	Kutch	Total
Utilisable Groundwater (MCM/year)					
1984	6,783.95	4,216.87	5,682.07	682.51	17,365.4
1997	4,533.11	3,274.33	4,539.23	501.60	12,848.27
Absolute % change (1984-1997)	-33.18%	-22.35%	-20.11%	-26.51%	-26.01%

Source: Based on the data available from Gujarat Water Supply & Sewerage Department.

Having a planned target growth rate of 6.04% (Gujarat Agrovision, 2000) per annum for the next ten years, the agricultural water demands are

bound to shoot up. With an estimated rate of demand of 7,200 to 9,300 m³/ha, total demand at ultimate irrigation potential would be in the range of 46,728 to 60,357 MCM. Thus, by the year 2010, agricultural water demands may exceed the ultimate utilizable water resources (both surface water and ground water) (Tahal, 1997).

In 1998, total food grain production in the State was 5.7 million tons i.e. approximately 340 grams per capita per day. Thus, the State would need to raise food grain production to at least 6.95 million tons in 2021 to feed the projected population at the present rate. But the food grain production has barely increased by 0.5 million tons between 1980-81 (5 million tons) and 1998-99 (5.5-million tones). The reason of stagnancy in food production has primarily been the lack of adequate surface irrigation facilities.

The resultant effect of lack of irrigation water, stagnant crop-production, difficulty in even taking one-good crop in monsoon, drought once in every three years, with increasing prices of farm implements as a result of diminishing subsidies, has cruelly impoverished the small farmers and agricultural labourers. This has also reflected in share of agriculture in State Domestic Product (SDP). The share of agriculture in SDP, which was 41% in 1980/81, came down to 32% in 1990/91 and has further decreased to 21% in 1998/1993. The Bank credit to agriculture sector consistently going down is another factor indicating economic conditions of farmers. At the end of March 1995, there were 0.90 million agriculture-loan accounts, which has come down to 0.74 million accounts with reduction in outstanding credit amount (Dena Bank, 1995-99).

The agricultural credit sanctioned by 25,000 agricultural co-op. credit societies is also only Rs.1,597 crores at the end of March 1999 which comes to a meagre Rs.4,000 per farmer (i.e. less than US\$ 100 per annum). Even in public and private sector agricultural organisations, the employment created is decreasing from meagre 25,000 jobs in 1990 to 20,000 by 1998, as compared to 1.8 million jobs in industry and service sectors. All these indicators, exhibit the plight of farmers and agricultural sector dependant on water and further exhibit direct relationship between water development and poverty alleviation. This is also ominous from the point of view of food security in Gujarat state in next few years.

6. Water Scarcity and Regional Imbalances

The contrast in the availability of water in different regions of the State has had serious effects on the social development of water deficit region. Such intra-State regional imbalances have caused sound cultural and political problems detrimental to sustainable development of the State as a whole.

It is not a coincidence that the literacy rate in the water deficit districts is much less than the State average as compared to the water surplus districts, where it stands higher than the State average (Figure 5).

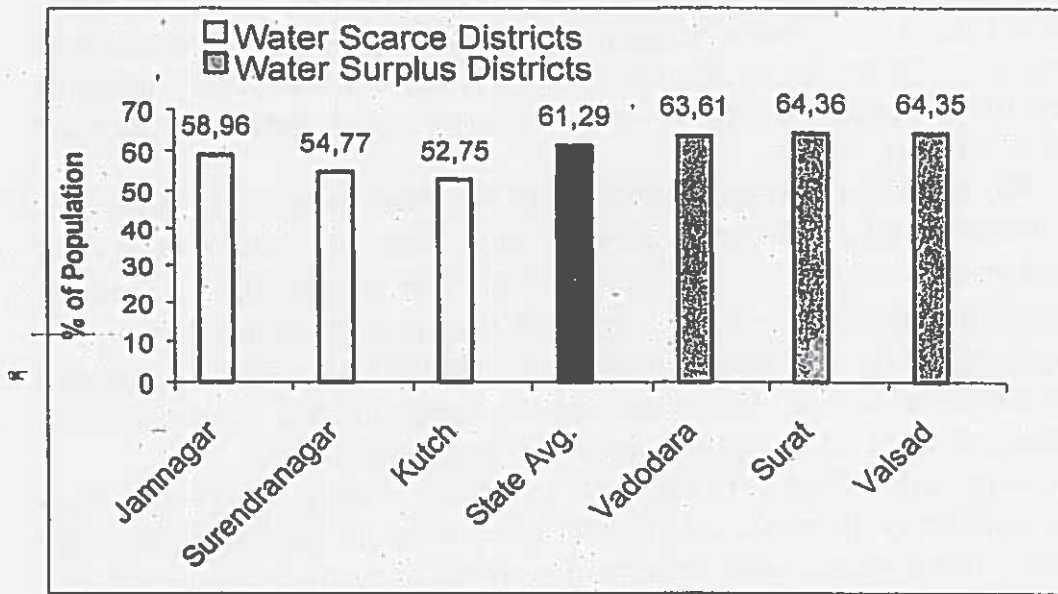


Figure 5. Literacy Rate in Gujarat
Source : Census Handbook, 1991

This may be attributed, inter alia, to the daily struggle for drinking water experience by millions of families in these areas, whereby the education of children does not remain a priority any more. The female literacy rates in Jamnagar, Surendranagar and Kutch are respectively 47.45%, 40.65% and 40.89% which is much less than the state average of around 49% again indicating that apart from other social factors, consistent struggle for water creates hurdles in female literacy in these areas. Lack of access to safe drinking water, time loss in collecting available water, effects of head loading on women's and girl children's health and the burden of women's household responsibilities-all have a detrimental effect on their health and general family welfare including their income earning abilities. A story of how poor people extract water in Vadhiar area of Kutch in scarcity when the water was too deep in the wells. The housewife will go deep in the well, along with a drum and when she will touch water and fill up the pot, she will play the drum to inform another person standing outside the well to pull up the water pot tied with a rope. This is their plight. Sometimes their whole day is lost in search of water like this.

Eventually developmental issues are inextricably linked. Higher literacy levels and educational attainments improve the access of people to other social services. Interlinkages between Health and Education sectors have always been acknowledged at the academic level. Greater literacy and

the spread of primary education increase the receptiveness of the population to improved health practices as well as demand for medical care. Ending illiteracy and expanding education among women is a goal of the development process as it expands women's capabilities and enhances women's ability to participate in and contribute to the process of development. It is essential to note that the relationship between education and development is a dialectical one. Educated women take better decisions about nutrition and health care for their families. They are also more receptive to the idea of family planning and having fewer children. A close association between the level of female literacy and the level of under nutrition in communities has been demonstrated (UNICEF, 1998; HPS, 1995). This is a good example of education being both an end in itself and a means to development. Therefore, poverty reduction appears to be closely related to literacy and health. Improved education and health mean expanded opportunities, better employment and higher incomes. Therefore, provision of clean water supply to areas in Gujarat would lead to an automatic improvement in opportunities for female education and thereby family health and income etc.

The low level of economic activities in these water deficit areas of the State is reflected in the lower percentage of main workers vis-à-vis total population (Figure 6). It is very interesting to note that in water deficit areas of Gujarat, the percentage of females among non workers is more than the state average and of course more than similar percentage in water surplus areas (Figure 7).

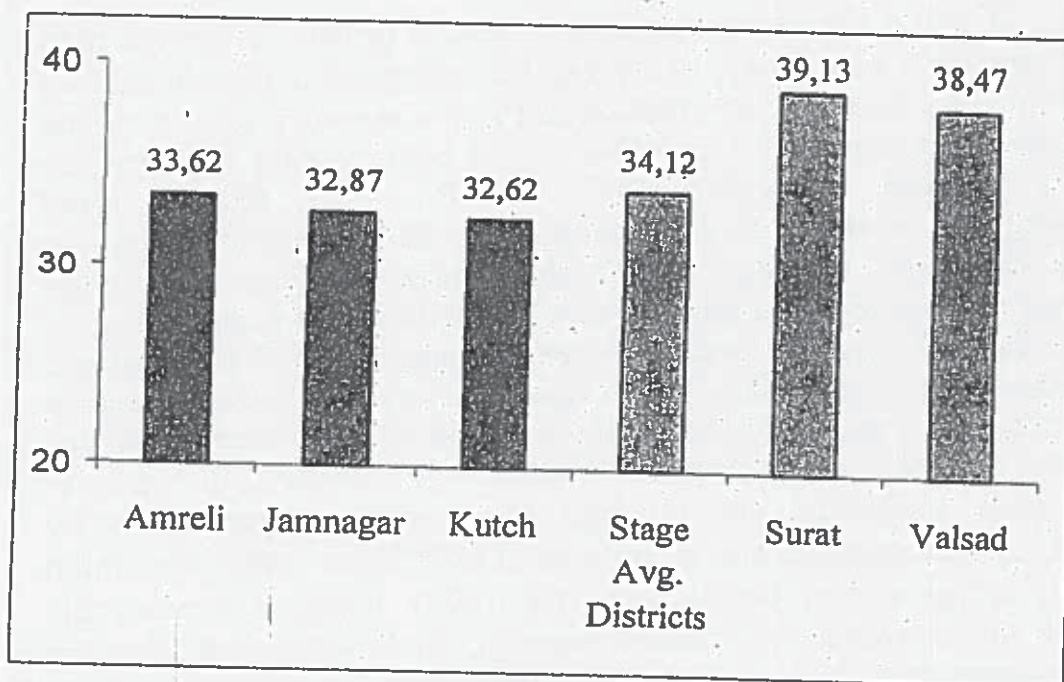


Figure 6. Main Workers in Gujarat State (as a percentage of total population)
Source: Report of Socio-Economic Survey, Government of Gujarat, 2000

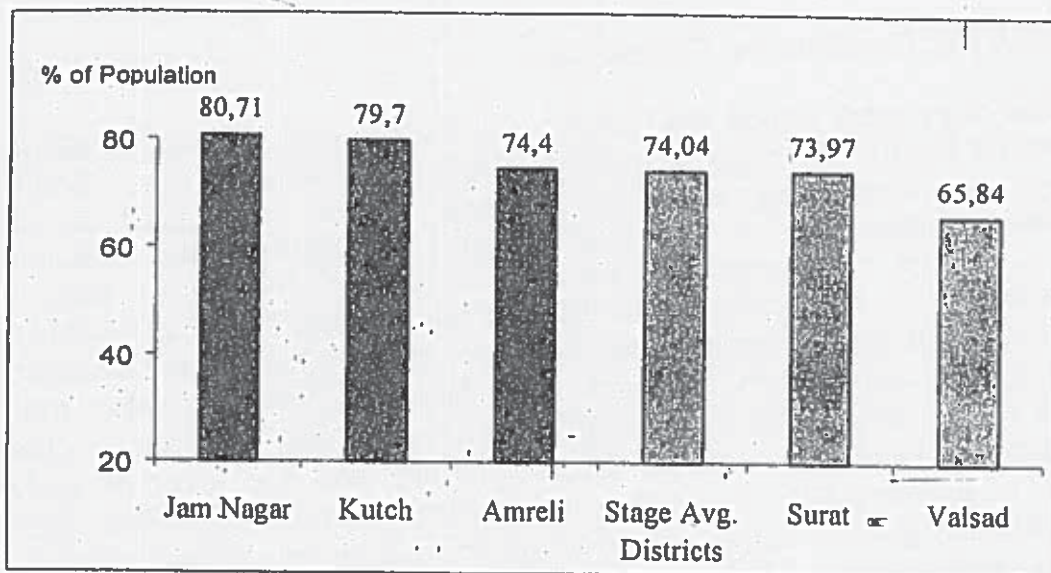


Figure 7. Non-workers (females) in Gujarat (as percentage of state population)
 Source : Report of Socio-Economic Survey, Government of Gujarat, 2000

This again points out to the fact that most of the productive energies of women in these areas are channelised in daily hunt for water. This is further buttressed by the fact that against the state average of 12.23% female workers the water deficit districts have much less percentage of marginal female workers (Kutch-6.99%, Jamnagar-7.29%, Surendranagar-11.25%), implying thereby that due to daily struggle for water, the women are not left even with the time to pursue marginal working activities to augment the family income.

State of Gujarat has registered rapid industrial growth. With less than 5% of the country's population, the State has achieved a growth rate of 6.55% in Net State Domestic Product (NSDP), at constant prices, over the past five years, and ranks third in NSDP in the country after Maharashtra and Punjab (Gujarat Agrovision, 2010; GIDB, 1999). Despite rapid industrial progress of the state in general the water scarce areas remain industrially backward whereas the water surplus districts are highly industrialized leading to more employment generation and higher level of economic activity (Figure 8). Availability of raw materials and physical and social infrastructure have attracted some water intensive industries like soda ash, fertilisers, rayon, dyes and chemicals etc. even in water scarce regions. Typical water requirements of various industries are compared in Figure 9. Many of these industries are meeting their water requirements by desalination, reverse osmosis etc. at the cost of US\$ 2 per 1,000 litre which is very high as per Indian situation (ICICI, 1997). Keeping in view the present and future trends of industrialisation, it is estimated that the industrial water demand will rise from its current level of 153 MCM/year to

about 281 MCM/year by 2021 (Tahal, 1997). This will further stress the available ground water resource, or make these industries economically unviable, causing unemployment and slow down of growth, unless fresh surface water supply is planned.

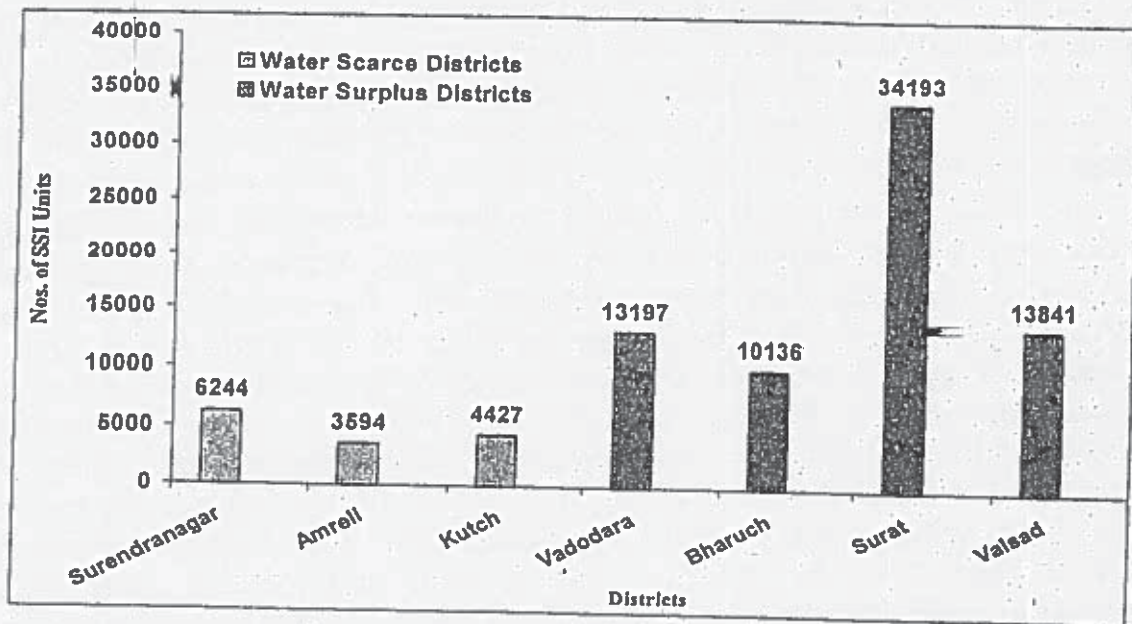


Figure 8. Small Scale Industrial Units in Gujarat, 1999
Source : Report of Socio-Economic Survey, Government of Gujarat

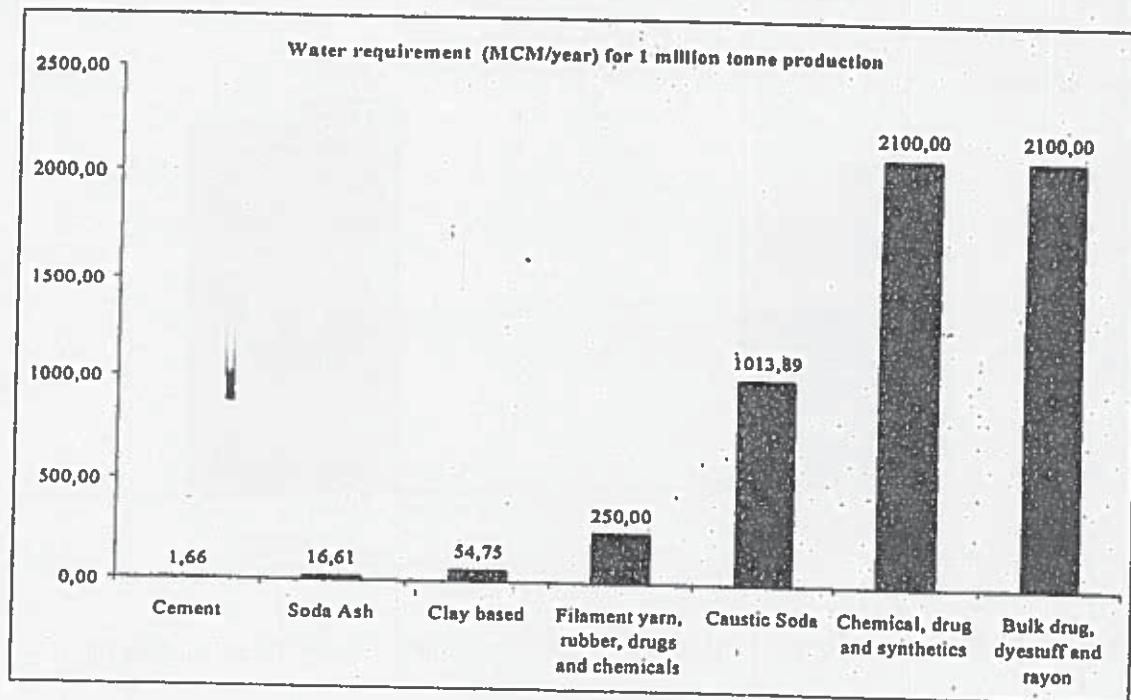


Figure 9. Industrial Water Requirements
Source: Based on the data available with Industries Department, Government of Gujarat

7. Water Scarcity and Migration

Although migration is common to both developed and developing countries, its frequency and extent is more visible in developing agrarian economy basically due to uncertainties in on-farm employment. It can be looked upon broadly in two theoretical ways (Gill, 1998). While it is considered as a strategy for utility maximization at individual or household level (based on wage differentials and diversification of income sources) by some neoclassical economic theories; it has also been viewed as a strategy of survival or sustenance of subsistence level of migrants (Connell et al., 1976). It is the second view, which is relevant in case of drought induced migration of large number of people in Gujarat. While in depth study and analysis into who migrates, where, for how long and under what kind of coping up strategy may require detailed survey, the existing evidence on migration based on census data has been analyzed with fair accuracy and very significant conclusions have been drawn (Shah, 1996). While the all India percentage of male in-migrants as a percentage of total male population has declined significantly, for Gujarat it has remained more or less same and much higher than all India average (Figure 10). This suggests that Gujarat is an important destination for migratory movement from relatively backward region both within and outside the State. The inter-district migration increased from 8.9% in 1971 to 11% in 1991 and rural to rural male migration exceeded the rural to urban migration (The ratio between the two on all India basis is 1.45 as against 2.12 in Gujarat) (Figure 11).

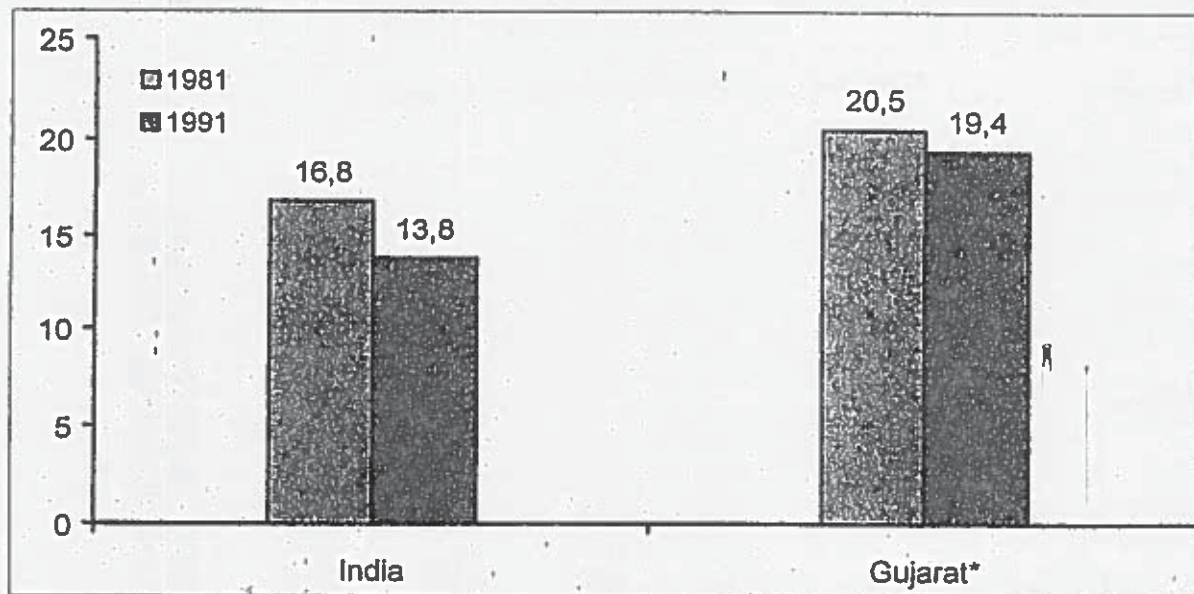


Figure 10. Migration due to Water Scarcity

* The State ranks fourth amongst the major States in the country Source: Census of India, 1991

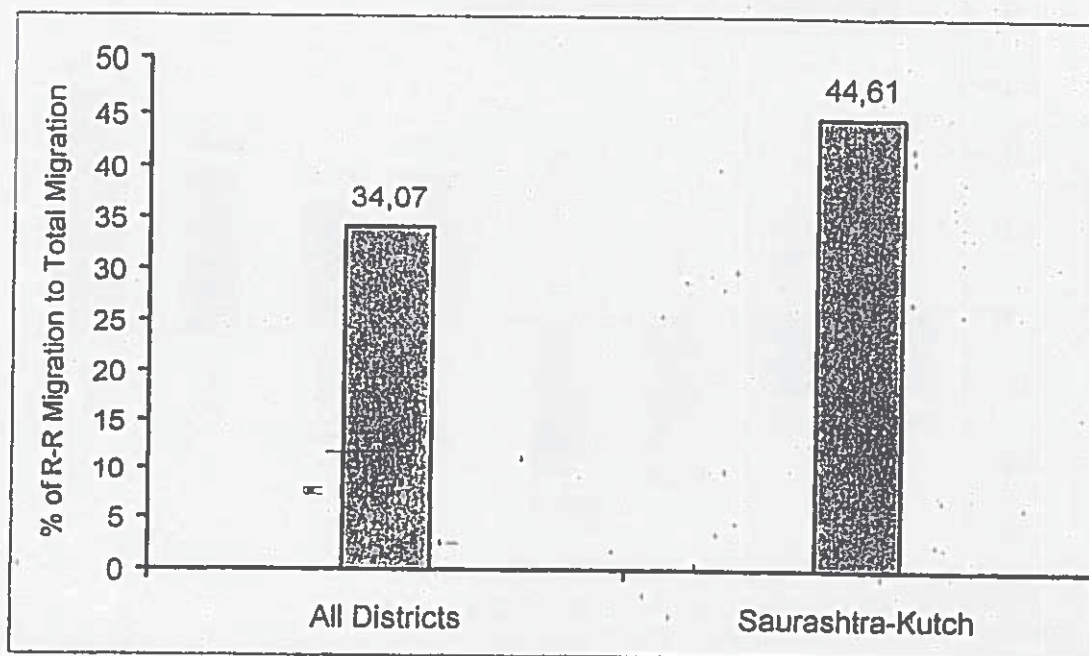


Figure 11. Migration Pattern in Gujarat
Source: Census of India, 1991.

Therefore, in terms of intra-State migration, there has been a clear pattern of significant out-migration from the drought prone regions like Saurashtra-Kutch (western and south-western Gujarat) and eastern tribal belt to the central and south regions of the State having better water resources endowment as well as higher level of industrialization. In 1981 (for which estimates of net out-migration can be worked out at district level), the top districts having net out-migration were some of the drought prone areas like Amreli, Surendranagar, Bhavnagar, Rajkot, Panchmahals and Mehsana. A similar pattern had continued in 1991, which is reflected by the fact that most of the districts in south-western Gujarat along with water scarce districts of North Gujarat have significantly lower incidence of male (in-migration) than the State average. Conversely, most of the districts in central-south regions have relatively higher incidence of in-migration, suggesting thereby that people from water-scarce regions have generally moved out to water surplus areas.

While a part of this migration might have been induced by better pursuits of economic opportunities in the industrial sector, a major proportion of this is likely to be of distress nature and linked with water scarcity. This is reflected by the fact that there has been a shift of livestock from the drought prone districts in Saurashtra and Kutch to the districts where availability of water is somewhat better. The estimates for livestock census suggest that between 1981 to 1992, livestock population had declined even in terms of absolute number in Saurashtra and Kutch, whereas the remaining parts of Gujarat (except Banaskantha) had registered an increase in livestock population (Figure 12).

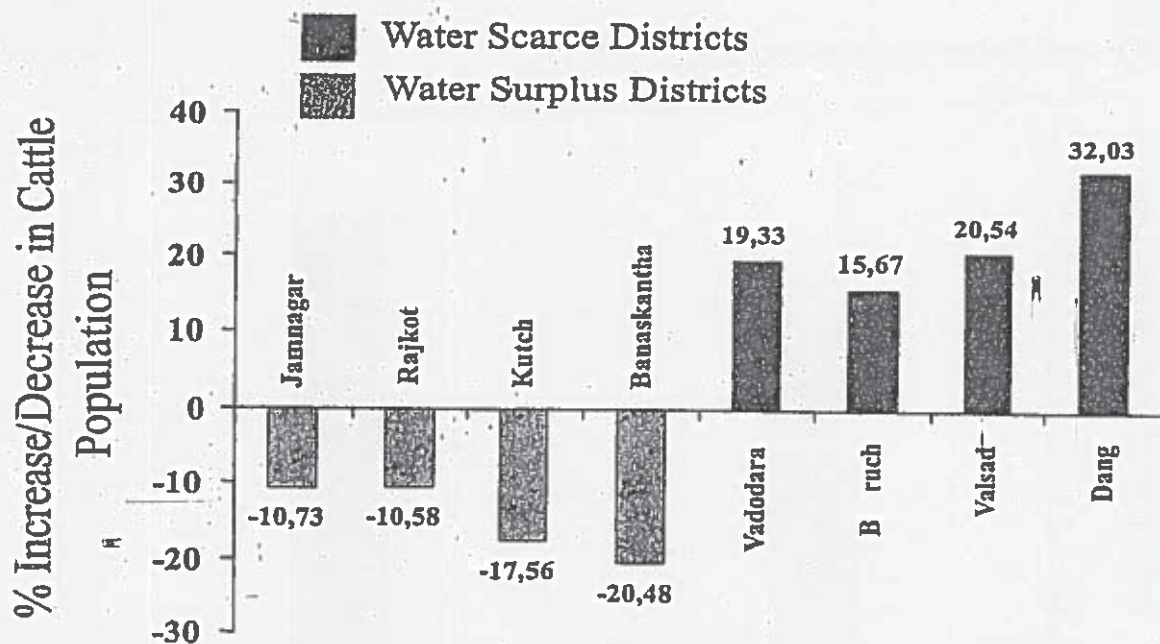


Figure 12. Livestock Population growth between 1982 and 1992

Source: Agriculture Statistics, Directorate of Economics & Statistics, Government of Gujarat, 1996.

The combined effect of the migration of human as well as livestock population has resulted in relatively lower population growth in all districts in western and south-western Gujarat vis-à-vis the State average of 2.12% per annum between 1981 and 1991 (Figure 13).

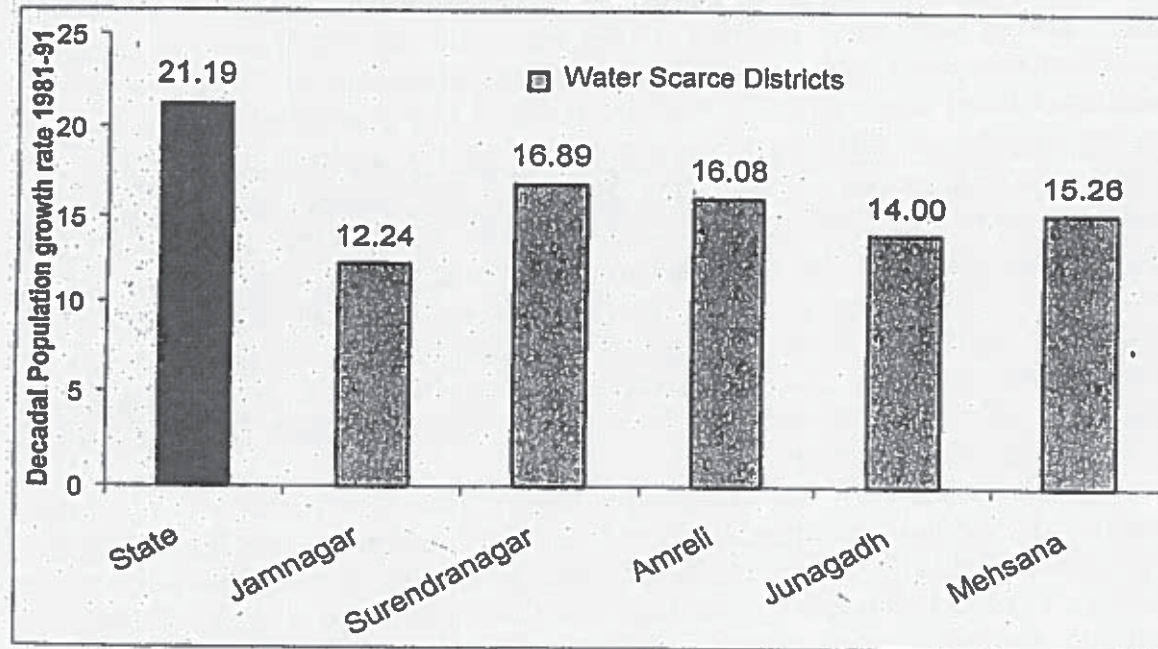


Figure 13. Decadal Population growth rate 1981-91

Source: Budget Publication No. 30, Government of Gujarat, 2000.

Another very important demographic change related to water scarcity is the shifting of prime workforce from drought-prone districts to water surplus districts. As per 1991 census, 57.7% of State's male population was in the age group of 20-59 years. For water scarce districts this percentage was lower and for water surplus districts it was higher than the State percentage (Table 6).

These trends clearly establish that perennial water shortages have led to migration of hundreds of thousands of people dislocating them economically, socially and culturally. Therefore, it is clearly that poverty and regional imbalance in Gujarat are getting accentuated because of increasing water scarcity.

Table 6. Prime Work-force in Drought-prone and Water Surplus districts of Gujarat

More than State average (Water surplus areas)		Less than State average (Drought prone areas)	
Vadodara	60.9%	Banaskantha	52.7%
Bharuch	59.8%	Amreli	54.7%
Surat	61.4%	Kutch	54.5%
Valsad	60.9%	Surendranagar	55.8%

Source: Socio-Economic Review, Gujarat State, 2000

8. Poverty and the Environment

The relationship between poverty and environment is not easy to generalise. However, the fact remains that poor are both victims and agents of environmental damage. The cause of deforestation in many parts of the world has been found to be the practice of shifting cultivation by poor farmers (Reardon and Vosti, 1995). A World Bank study in Mexico suggested that poverty was directly associated with higher levels of deforestation (Deninger and Minten, 1996). During 1980s about 19 million hectares were deforested in Mexico, at an annual deforestation rate of about 2.9 percent. The above study used socio-economic and physiographic data for 2,400 municipalities to examine the factors behind the higher rate of change in forest cover. And it was found that municipalities with higher levels of poverty lost a greater proportion of their forest cover during the 1980s.

In Kutch area of Gujarat, the non-availability of water has caused advancement of desert, environmental degradation and national security issues due to long Indo-Pak border in this area. The out migration of people from Kutch is leading to thinning of population in border areas facilitating

infiltration activities from across the border. Lower percentage of dense forest in water deficit districts and higher density of forest as compared to State average in water surplus districts adequately proves the detrimental effects of water scarcity on the environment (Figure 14) and indicate some kind of relationship between increasing poverty and environmental degradation.

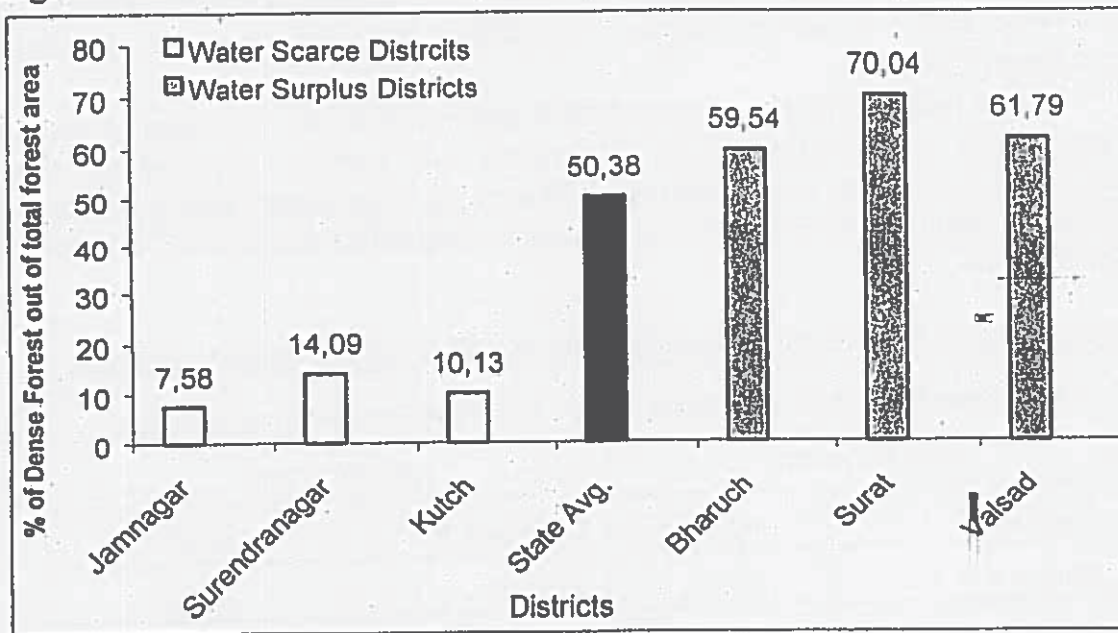


Figure 14. Density of Forest in Gujarat

Source: Forest Survey of India, Government of India, 1997.

In south-western Gujarat (Saurashtra), due to over exploitation of ground water resources, the natural balance between the sea water and ground water level has been disturbed and salinity ingress has become a major problem. A study has indicated that the area affected by salinity will be 23% by 2,010 (Gujarat Ecology Commission, 1998).

In Gujarat, due to ground water mining, studies have shown that the density of soluble minerals has been consistently increasing. As a result of this the problem of fluoride contamination has also become acute. In concentrations of 0.5-0.9 ppm it is beneficial to human health and protects teeth against decay.⁵ *Dental* and *Skeletal fluorosis* has been endemic in more than 2,800 habitations (out of total 18,000) in the state causing mottled enamel of teeth of children, resulting in early ageing, permanent disability and restrained economic activity of large number of people. Information regarding water fluoride level in different parts of the state has been compiled by many studies and it has been found that there is a wide range of water fluoride level from 0.2 to 18.0 ppm. Epidemiological study of endemic fluorosis has been carried out in tribal areas of Vadodara district. Observations were as follows:

Table 7. Fluoride situation in selected areas of Gujarat

Water Fluoride level was 0.5-4.0 ppm	
Percentage of Population	Symptoms
18.2%	Backache, joint pain and stiffness
35.3%	Dental Fluorosis
38.1%	4.0 ppm Urinary fluoride level
71.%	Radiological changes

Source: Department of Health, Government of Gujarat.

Dental fluorosis, urinary fluoride level and radiological changes showed significant association with water fluoride level. Dental fluorosis was maximum in adolescent group. Therefore, the young generation is worst affected due to fluorosis. A recent health check-up programme of school going children during 2000-2001, revealed that sixteen districts out of nineteen are affected by fluorosis (Table 8).

Table 8. Fluorosis amongst Gujarat children

Sr.No.	District	Number of Cases	Municipal Corporation	Number of Cases
			Urban Area	
1	Ahmedabad	2,305	Ahmedabad	1,157
2	Amreli	994	Vadodara	185
3	Banaskantha	6,853	Surat	469
4	Bharuch	259	Rajkot	259
5	Dahod	32	Jamnagar	12
6	Gandhinagar	24	Bhajanagar	2,028
7	Jamnagar	220		
8	Junagadh	51		
9	Kheda	1,470		
10	Kutch	2,143		
11	Mehsana	1,922		
12	Rajkot	286		
13	Sabarkantha	857		
14	Surat	936		
15	Surendranagar	3,149		
16	Vadodara	898		

Source: Epidemic Cell, Commissioner of Public Health, Government Of Gujarat, 2000

Banaskantha, Surendranagar, Kutch and Mehsana districts are the worst affected. These are precisely the water scarce districts of the state, where quality of drinking water poses serious threats to the future of younger generation. The most pertinent question here is about their right of survival, right of protection, right of development and right of participation, as enshrined by the UN Convention of the Rights of Child, the most widely ratified human rights instrument!

9. Large Dams in Gujarat

As per ICOLD (International Commission on Large Dams) definition there are 541 'Large dams' in Gujarat State. However, the ICOLD definition for 'Large Dams' includes dams with height greater than 15 m and other smaller dams with height between 10 to 15 m with certain special design features. The height considered is the height of the dam from the lowest foundation level to the crest. The definition of ICOLD deals with the design and safety considerations and therefore as per the ICOLD definition for 'Large dam' the list also includes smaller dams of Village Panchayats (local bodies) with a meagre storage capacities of about 1 to 10 MCM.

It is strange that for the purpose of classification, in addition to the above, the factors like foundation conditions, special design features etc. are also given equal weightage. Most of the large dams in Gujarat, are nothing but slightly larger versions of check dams with very small storage capacity.

However, the classification of dams, using Planning Commission, Government of India criteria, is based on benefit consideration and is different (Table 9).

Table 9. Planning commission classification for Large Dams

Sr. No.	Type of project	Culturable command area in ha.
1.	Major	Above 10,000
2.	Medium	2,000 to 10,000
3.	Minor	Below 2,000

According to this criteria, out of 541 'so called Large dams', the State has only 21 major projects including Sardar Sarovar Project. Further, out of these 21 projects only 5 projects viz. Dharoi, Dantiwada, Kadana, Ukai & Sardar Sarovar are of the size of national importance.

The storage capacity of Ukai dam alone is around 45% of the total capacity of all the existing dams in Gujarat put together. This means that the rest of the dams have very little i.e. 0.1% average storage capacity. Thus, it can be seen that there are not many mega irrigation projects in Gujarat. The

actual irrigation potential achievement through all the major and medium water resources projects in the State during last 40 years is only 1.4 million hectares, whereas Sardar Sarovar would alone provide irrigation facilities to 1.92 million hectares. Hence, Sardar Sarovar dam would surely make a lot of difference in tiding over drought conditions prevailing frequently in Gujarat State and adding to the total irrigation capacity of the State.

9.1 Sardar Sarovar Project

(1) (Sardar Sarovar Project on river Narmada is a multi-State, multi-purpose river valley Project, borne out of deliberations of a constitutional body, following the principles of 'Equality of Right' and 'Equitable Utilization' of the whole course of an Inter-State River. This unique project is planned to irrigate 1.905 M ha of land, increase the agricultural production by 8.7 million tons per annum (worth US \$ 430 million), generate environment friendly hydropower with installed capacity of 1,450 MW, supply drinking water to 8,215 villages and 135 urban centers of Gujarat (around 20 million population), generate 1 million jobs-mostly in rural areas, and prevent rapid processes of desertification, salinity ingress and rural to urban migration being experienced in many parts of Gujarat. The command area and drinking water supply areas of the Project are exactly the worst water scarcity-hit areas of the State.)

The vast command area would be irrigated by the 532 km long concrete lined main canal, its 42 branches and thousands of kilometer long network of distributary canals. For judicious, timely and equitable distribution of water, ensuring the rights of the tail-enders in the command area (even 700 km away), consisting of 92% small and marginal farmers, the "Controlled Volume Concept of Operation by Computer Aided Remote Monitoring and Control System" is adopted. To ensure participation of the beneficiary farmers, irrigation water will be supplied on volumetric basis to the *Water Users' Association (WUA)* of each Village Service Area (VSA) (200-500 ha), who will also be involved in preparation of *Rotational Water Supply (RWS) calendar*, ensuring just and equitable water distribution.

9.2 Rain Water Harvesting vis-à-vis Large Dam

Harvesting the rain water through micro structures like check dams, percolation tanks, retention basins etc. has many a times been projected as a viable alternative to eliminate water scarcity in Gujarat. From technical considerations like dependability, carry over storage, flood control, power generation, submergence, evaporation, life span (serviceability) and social

considerations like equity in distribution; regional transfer of water by Sardar Sarovar Project has practically no alternative. Typically small tanks of around 40 to 100 ha. size, inundate almost as much and as they irrigate, around 0.9 of a hectare for every one hectare irrigated, usually irrigating one crop only, whereas large dams irrigate much more than one, apart from also providing power. Thus, even if it were technically possible (which it is not), to find enough small tank sites, to hold the same amount of water, the land lost due to inundation, could well be over 1.0 M ha. against 37,000 ha. for Sardar Sarovar Project (World Bank, 1990). Absence of regular, adequate and dependable rainfall which is common in most of the Western India, makes it difficult to tackle water scarcity by rain water harvesting alone. Rain or water harvesting on any State is only possible if and when the rain falls. No rains, no rainwater harvesting (Verghese, 2001). An analysis clearly shows that for the worst scarcity hit districts of Saurashtra region, even if we try to harvest the rain water to its maximum potential, the per capita availability remains much less than 1,000 m³ per year (Table 10). In these calculations, 50% area has been conservatively considered to be effective in rain water harvesting, which otherwise remains 30% to 40% normally (Frederick, 1995; Seckler et al., 1998). Similarly, the evaporation losses after storage have been assumed to be 50%. But in reality for the storages with depth less than 2 m it could be around 60% or more (Prabhu, 2000). Further, the calculations are based on the normal rainfall values, but the data of last ten years show that its reliability is in the range of 20 to 40% only (Figure 15,16, 17,18).

Table 10. Rain Water harvesting (Based on rainfall data from Government of Gujarat)

District	Normal rainfall	Area	50% Effective area	Volume	50% net considering evaporation loss etc.	Projected Population (2001)	m ³ Per capita per year
	(mm)	('000 sq.km)	('000 sq.km)	(Mm ³)	(Mm ³)	(million)	
Jamnagar	497.2	14.1	7.0	3,505.2	1,752.6	1.77	987.32
Rajkot	621.2	11.2	5.6	3,478.7	1,739.3	2.85	609.58
Surendranagar	507.0	10.5	5.2	2,661.7	1,330.8	1.37	969.24
Amreli	540.0	6.8	3.4	1,836.0	918.0	1.42	645.50

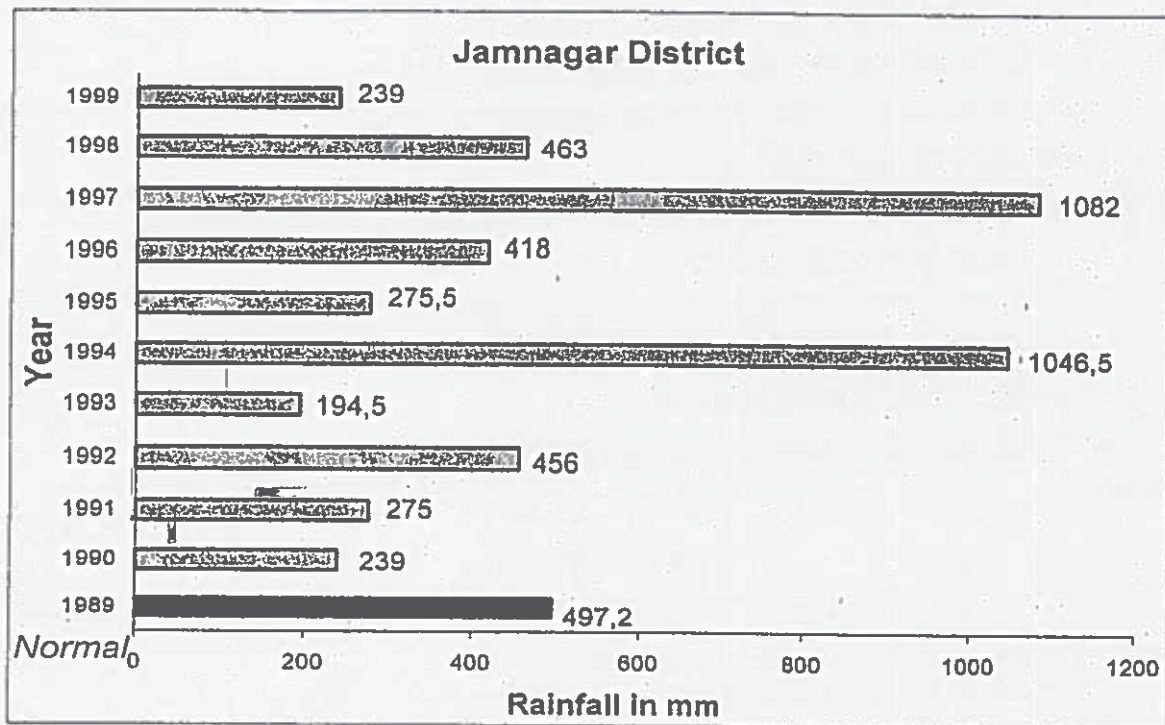


Figure 15. Rainfall pattern in water deficit regions
 Source: Directorate of agriculture, Gujarat state, 2000

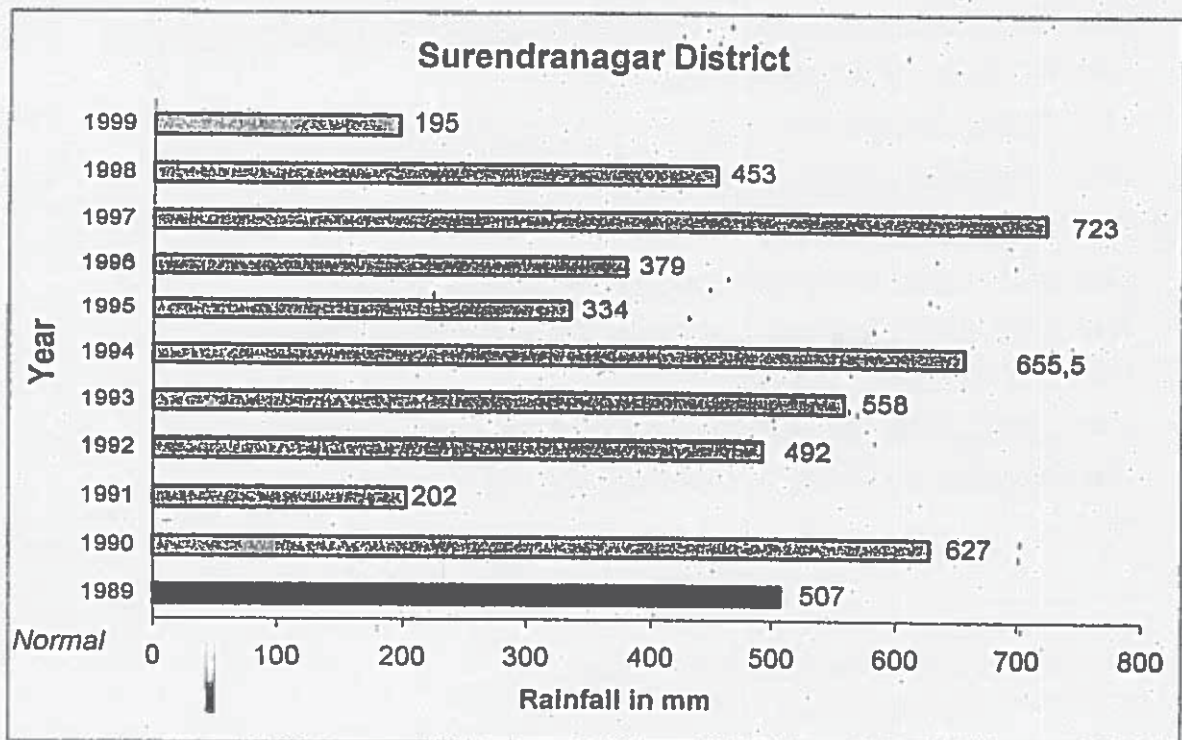


Figure 16. Rainfall pattern in water deficit regions
 Source: Directorate of agriculture, Gujarat state, 2000

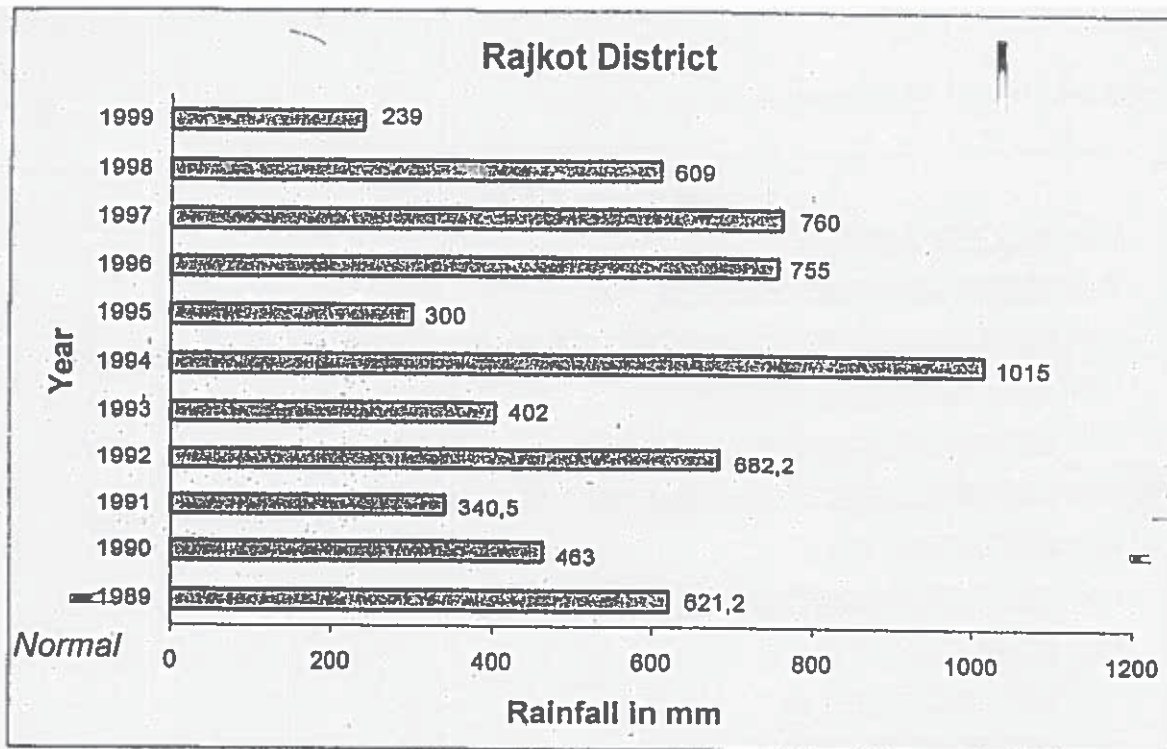


Figure 17. Rainfall pattern in water deficit regions
 Source: Directorate of agriculture, Gujarat state, 2000

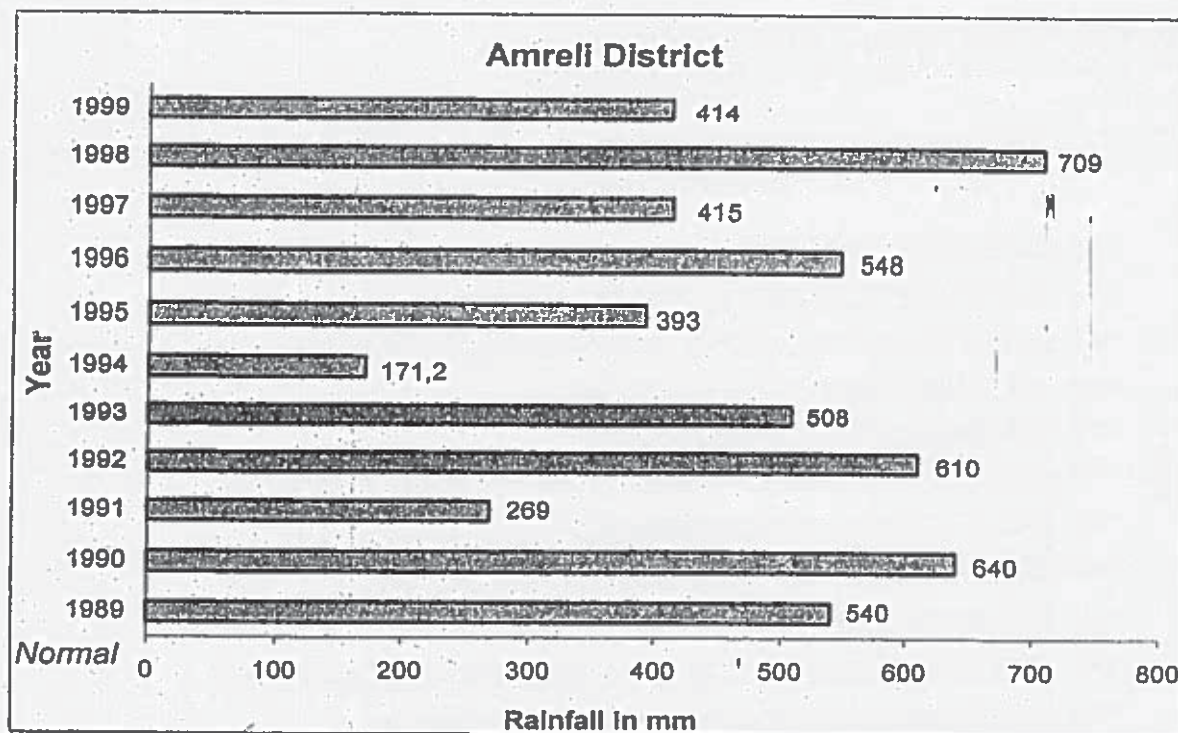


Figure 18. Rainfall pattern in water deficit regions
 Source: Directorate of agriculture, Gujarat state, 2000.

However, this does not mean that this alternative of water management is ineffective or impractical. Many scattered attempts of rain water harvesting with the help of some voluntary organisations specially in Saurashtra region of the state have met local water needs and sustained agricultural production, thereby contributed to poverty reduction. In Gujarat, water harvesting structures like check dams, percolation tanks, safe stage works, etc. are constructed under micro watershed development programme by agriculture, rural development and water resources development schemes of the State Government with a great deal of local participation by voluntary organizations and village representative bodies. So far a total of 22,697 such structures have been constructed to harvest 1,047.62 MCM of water 2,250 works are under progress, which will store approximately 100.32 MCM of water (Table 11 and 12). However, due to failure of monsoon the existing 1,047.62 MCM storage created at the cost of Rs. 4008 million (US\$ 100 million) has not been effective in solving the drought conditions in the water scarce regions.

Table 11. Water Harvesting Structures Constructed in Gujarat

Sr. No.	Type of works	Nos.	Approx. Storage (MCM)	Cost (Rs. million)
1.	Check dams	4315	183.41	911.2
2.	Percolation tanks	3847	272.53	987.3
3.	Safe stage works	3827	216.90	988.4
4.	SPPWCS* (Checkdams)	10,708	374.78	1,121.6
	Total	22,697	1,047.62	4,008.5

*Sardar Patel Participatory Water Conservation Scheme

Source: Narmada Water Resources & Water Supply Department, Government of Gujarat, 2000

Table 12. Water Harvesting Structures under Construction in Gujarat

Sr. No.	Type of works	Nos.	Approx. Storage (MCM)	Cost (Rs. million)
1.	Check dams	335	14.23	197.8
2.	Percolation tanks	260	18.42	154.0
3.	Safe stage works	387	21.94	144.4
4.	SPPWCS* (Checkdams)	1,268	45.73	152.0
	Total	2,250	100.32	648.2

Source: Narmada Water Resources & Water Supply Department, Government of Gujarat, 2000

Thus, in Gujarat, both the alternatives of water management, micro as well as macro, have to be considered as complementary to each other and the experience has shown that these are in no way mutually exclusive solutions for poverty reduction.

It has been the most controversial aspect of Sardar Sarovar Project. The aim of this article is not to analyze the merits and demerits of resettlement and rehabilitation strategy. But the fact remains that impoverishment risks (Mathur and Marsden, 1998) like landlessness, joblessness, homelessness, marginalization, food insecurity, loss of access to common property and services, social disarticulation, etc. have to be carefully analysed while resettling the project affected people. The recent developments have indicated a shift from *property compensation approach* to *people centred development focus*. Inter agency synergies have also been built up between synergies between existing programmes of integrated rural and tribal development with resettlement and rehabilitation efforts. The financial resources to address these problems are not lacking. Author's personal experience is that what is most often in short supply is the adequate human resources capability to deal with the complexities and magnitude of resettlement issues. Professionals possessing such ability are not willing to reside in these outlandish locations for long duration. Frequent transfers of good staff to more attractive locations also hamper the continuity and quality of intervention.

10. Conclusion

The water situation in Gujarat has been deteriorating rapidly and there is a causal relationship between water scarcity, impoverishment and regional imbalances. While rainwater harvesting through check dams, percolation tanks etc. can act as a supplementary source, the magnitude of problem is so vast that it is clear that a situation has developed in Gujarat which puts a question mark over the existence of more than twenty million people in this region without the regional transfers of Narmada waters. The issue of resettlement of people as a result of construction of dams is an important consideration and needs to be dealt with in a human way. But equally important is the acute deprivation of a far larger number of people. Water development will certainly act as an engine to development and most importantly to emancipation of women from daily drudgery. Improving lifestyle of the people promoting equitable regional development and conserving the environment are main objectives of water resources development in this case.

Notes

- 1 The main sections of World Development Indicators (WDI) laid down by the World Bank are People, Environment, Economy, States and Markets and Global linkages (World Bank, 1999). The environment section mentions land use and deforestation, protected areas and biodiversity, energy use and fresh water use. The last of these incorporates per capita fresh water resources, annual fresh water withdrawals, fresh water withdrawal by agriculture, industry and domestic use, percentage of rural and urban population with access to safe water. Therefore, water becomes a cardinal constituent for development.
- 2 In India, the federal government and the state governments follow the *five year development plan system*.
- 3 Presently, 1 US\$=50 Indian Rupees (rounded off).
- 4 In 1992, 1 US\$=40 Indian Rupees.
- 5 The WHO standards permit only 1.0 ppm in drinking water as a safe limit for human consumption, whereas US Public Health Service Drinking Water Standards allow up to 1.7 ppm.

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