Baseline Study of Coastal Villages affected by Salinity ingress
Saurashtra & Kutch Districts

May-07 to March-08

Reports of Districts

- **Amreli**
- **Junagadh**
- **Porbandar**
- **Jamnagar**
- **Rajkot**
- **Kutch**

Prepared by:
Saline Area Vitalization Enterprise Ltd. (SAVE)

Prepared for:
Coastal Salinity Prevention Cell (CSPC)

Baseline Study of Coastal Villages affected by Salinity ingress in Amreli District

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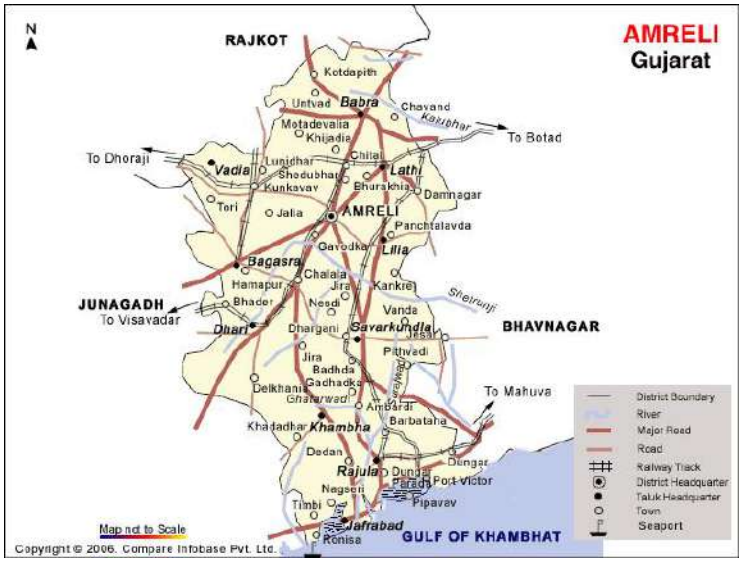
Amreli District

1. Introduction

Amreli district lies between 20° 08' and 22° 03' north latitude and 71° 27' and 71° 02' west longitude in the south region of Gujarat state in India. Amreli district derives its name from the town of Amreli, which is the head quarter of the district.



Located near the Gulf of Khambhat in Arabian Sea, the Amreli district is bounded by Bhavnagar dist. in the East, Junagadh district in the West, Rajkot dist. in the North and Arabian Sea in the south. There are 11 Talukas & 7 Municipalities in the district. It covers 7,381 sq. km Area. It has 1,393,295 persons residing in 617 villages.

2. The coastal area in Amreli district

Among eleven talukas in Amreli district, Rajula and Jafrabad talukas are located on the western coast covering 114 villages having geographical area 95,659.83 (ha.) i.e. 13% of the geographical area of the district. It covers 91 villages having population of 74,746 and 62,876 persons in Rajula and Jafrabad talukas respectively. These villages are divided by SIPC in to fully saline, partially saline and prone to salinity categories based on quality of drinking water. Socially, majority of the population belongs to general category with small population of schedule caste and tribes.

Table 1: Villages according to level of salinity

Village status	Rajula	Jafrabad	Category total-district	% of study villages in district
Fully Saline	11	11	22	24
Partial saline	9	14	23	25
Prone to saline	31	16	47	51
Total	51	41	92	100

3. Characteristics of coastal Amreli

The coastal block of Rajula and Jafrabad form southern part of the district is characterized by dry climate all round the year. The temperature ranges around 45 degrees in summer which reaches as low as 12 degrees in winter. The district receives an average rainfall of 550 mm during south-west monsoon during 35-40 rain-days between June and September. The numerous rivers draining from north brings water during monsoon in the coastal area. This area is endowed with aquifers of varying thickness formed by limestone known as miliolitic limestone. The coast line which runs NW-SE direction directly face sea which makes the coastal villages prone to cyclone before monsoon.

4. Physical features

4.1 Geomorphology

The coastline in this segment takes a NE-SW trend. From Gopnath to Methla, the coastline is free from mudflats and is characterized by a series of rocky headlands and crescentric sandy beaches. The beach at places is fairly wide with high water line marked by cliffs. The coastline from Jafrabad to Nawabandar is somewhat crenulated and comprises a rocky foreshore and backshore marked by discontinuous WSW-ENE trending sand ridges, oblique to the coastline. The Jafrabad creek has given rise to an almost 12 kms long and 2.5 kms wide extensive mudflats.

4.2 Hydro-geological situation

The segment between Talaja to Una represents the southern coast of the Saurashtra craton. The coastal area receive rain water through numerous network of stream from large basin having longitudinal shape (refer map-2 & 3). Geomorpologically this coastal segment is cliffy in nature and all along its shoreline miliolitics cliffs are present which are underlain by the Gaj beds. This segment is significant in the state since this coastal belt is known for its agricultural produce. The miliolite being highly porous, permeable and cavernous in nature has developed into an only potential aquifer system. The average depth of water table is in the range of 5-10 m, however deeper water-table of more than 20 m depth has been observed in the area around Jasapar and Jhanjhmer. The underlying Ghogha/Gaj beds being marine and dominated by clayey formations is rendered useless due to inherent salinity. Almost 60% tract of this coastal segment exhibit the salinity level of brackish nature i.e. TDS 3000 mg/l. The 30% area is influenced by higher level of salinity attributed to sea water ingress and an inherent salinity.

4.3 Geo-environment

From Talaja, the coastline changes its trend to SW-NE. The waves generated by the southwesterly winds strike the coast obliquely. The miliolitic substrate being uneven generates breakers at many places in the off-shore area and the wave generated energy is seen to bring about significant eastward long shore drift. The shoreline configuration is much more irregular and as a result, the projecting cliffy headlands are the sites of strong surf action and erosion. While the protected crescent bays provides area of deposition where the processes of beach development are predominant.

The coastal Amreli has become major destination for development of ports and cement manufacturing industries. The area has seen growth in industrial development in form of ports like Pipavav, port victor and cement industries majors like Ultra tech and Narmada cement. Jafrabad town is an important fish lending center since long.

The villages covered under current survey have population of 154,571 persons. The population density of the area is 214 persons which is the second densest coastal area after Junagadh. All classes and castes of the people live in these villages; however majority of population belongs to Other Backward Class (OBC) category having caste like Kolis, Rajputs, Charans, Ahirs, Rabaris and others. The majority of people as in other districts belong to OBC having high dependency on natural resources. Rajula taluka has higher amount of schedule caste (SC) and schedule tribe (ST) population which includes Harijans and tribal who have migrated from Gir forest to the coastal area. The population of general category is dominated by Patel, Rajputs and Muslims. The population includes 4,000 families living below poverty line.

Table-2 Population Details

Caste	Jafrabad	Rajula	Grand Total
General	7,687	12,698	20,385
OBC	52,985	53,790	106,775
SC	6,737	16,032	22,769
ST	507	4,135	4,642
Total	**67,916**	**86,655**	**154,571**

The coastal villages are located at a distance more than 10 Km from the coastline. The maximum numbers of villages are located within 5 Km from the coast as shown in table-3.

Table-3 Location of villages with reference to coast line

District	Block	1. Up to 5K.M	2. 5. 1 to 10K.M	3. Above 10K.M	Total
AMRELI	Jafrabad	22	12	6	40
	Rajula	21	20	9	50
	Total	**43**	**32**	**15**	**90**

The majority of all population categories live in villages located at a distance less than 5 Kms from the sea coast. The literacy level in villages with population 2000-5000 is between 40-60% while village having population less than 1000 persons have literacy level between 20-40%.

5. Occupation:

The coastal communities earn their livelihood through agriculture, fishery and animal husbandry. The development of industries in the region is providing some opportunities for wage employment and service sector activities. Majority of farmers have small land holdings who also carryout animal husbandry for their livelihood.

The coastal Amreli has many developed fishing centers. Jafrabad is one of the prominent fishing centers in coastal Amreli. Among the ports Pipavav, Victor and Chanch Bandar are important and growing ports in the coastal Amreli.

The salt manufacturing and limestone mining are two major industries in this area. The number of persons involved in various primary and secondary occupations is given in table below.

Table-4 Occupation details (No. of person)

Occupation Group	Jafrabad	Rajula	Total
Big Farmer	1,985	2,802	4,787
Workers	797	631	1,428
Small Business	441	250	691
Service	131	1,100	1,231
Misc.Labour	1,622	2,380	4,002
Small Farmer	2,104	4,594	6,698
Marginal Farmer	2,787	3,820	6,607
Agri.Labour	6,480	14,023	20,503
Fisher Men Group	335	353	688
Fish Processing	85	00	85
Animal Husbandry	3,604	445	4,049
Salt Workers	00	1,290	1,290
Total	**20,371**	**31,688**	**52,059**

The villages in Rajula taluka have more number of large farmers and agriculture laborers whereas small and marginal farmers are more in Jafrabad taluka. Apart from agriculture, people are earning their livelihood through migration to Surat and other parts of Saurashtra for diamond cutting and polishing business. Many farmers are migrating to horticulture belt in Junagadh, where they keep contract of horticulture crops like mangoes orchid and other fruits.

6. Land use pattern

The 2/3rd of the total geographical area of around 50,000 ha. is agriculture land. Of the agriculture land, 12% has surface and ground water irrigation facilities. This area has 17% land not available for cultivation which includes marshy land and land under *gamtal*.

7. Natural resource

The coastal Amreli has both ground and surface water resources which are developed in form of ponds, check dams and *Bandharas*. The ground water resources which were once providing potable water have become saline due to over exploitation. The water levels in the well have become saline at 30 ft. depth.

The sandy and black soils are found in these coastal talukas which support cropping of Bajari, Tal, wheat and groundnut. Due to water salinity, soils have become saline and its productivity has reduced drastically.

8. Agriculture

As mentioned earlier, rain-fed agriculture is carried out in more than 90% of the area. The cropping pattern includes all varieties of crops like food, cash and horticulture crops. The major *kharif* crops of the region include groundnut, cotton and Bajara along with Tal, Moong, Moth and Udad. The maize and Jowar are cultivated for fodder purpose. The *Rabi* crops include wheat, onion and Jiru (cumin). The area is known for quality of its Bajara and Tal, however due to salinity problem the production of these two crops is gradually reducing. The present cropping pattern is given in table-5 below.

Table-5 Cropping pattern (area in hectare)

Crop type	Rajula	Jafrabad	Total	% of agri.
Food grain	2,545	3,279	5,824	20.30
Oilseeds	2,640	6,527	9,167	31.96
Cash crops	2,788	7,221	10,009	34.89
Horticulture	453	12	465	1.62
Vegetables	90	8	98	0.34
Floriculture	0	1	1	0.00
Forestry	0	2	2	0.01

Observations on agriculture

- All type of crops (grain, cash, horticulture etc.) is being cultivated in the area.
- Shift in cropping pattern in saline villages from grain and cash crops to horticulture crops like Sapota and fodder crops like Jowar.
- The area has observed changes in crops: People in 68 villages have changed food crops while in 43 villages have changed cash crops. Four villages have reported change in horticulture crops.
- The farming of Til and pulses has almost stopped and has been replaced by Bajari.

- The area under Cotton is increasing.
- The increased salinity has affected the productivity as well as quality of sown crop
- Agriculture in saline area demands high inputs and hence it is expensive.
- Seasonal and taluka-wise variation in productivity of wheat, Bajari, cotton and ground nut.
- Horticulture has impacts on quality.
- There are around 6,100 irrigation wells and other structures apart from about 100 sources like river, check dams, irrigation canal etc. The majority of wells are facing salinity problem.
- Use of irrigation systems like sprinkler and drip is not found in surveyed villages
- Nearly 5,300 farmers receive irrigation facility from these structures.
- Except adaptation of new seeds and water management practices no other major solutions are tried out by the farmers.

9. Livestock

The coastal belt has around 45,000 milch and draught animals apart from which around 54,000 sheep and goat population. On an average each village have 275-300 milch animals. In these villages buffalos are preferred for milk production. The ratio of buffalos to cows is almost double in Rajula. The average milk production ranges from 5 to 6 liters/day in summer to 12 liters/day in winter season. The increasing salinity is creating health problems in the milch animals. It is observed that the animals in the villages of Rampar and Kovaya once known for its animal rearing occupation has drastically reduced animals due to salinity and industrial development.

Table-6 Livestock population

Block	Cow	Buffalo	Bullock	Goat	Sheep	Poultry
Jafrabad	6258	6557	9508	12000	12,665	400
Rajula	5367	11067	7094	12855	16,497	880
Total	**11625**	**17624**	**16602**	**24855**	**29,162**	**1,280**

Observations on animal husbandry

1. The population of animals is showing declining trends. However, in villages where new water sources are established the number of animals has increased due to availability of green fodder. E.g. village Patwa.
2. Animal husbandry is carried out as supplementary income generation activity along with agriculture.
3. The Jafrabadi buffalos are local species and most preferred in the area.
4. Due to increasing salinity the health of the animals is deteriorating by consuming salt through fodder and water. The major animal diseases are related to kidney and digestive system.
5. Due to salinity problem, the animal rearers are changing breeds, shifting to rearing of small animal and adopting improved fodder management practices. These solutions are tried out in more number of villages in Rajula and Jafrabad.
6. The drinking water for animals is a major constraint in the coastal area. In the study villages animals are fed on water from creeks, rivers, cattle troughs and ponds. None of this sources last round the year. The situation in Rajula taluka is better than that in Jafrabad taluka. In Rajula taluka 50% of villages having cattle troughs have seasonal water supply for animals. In this situation majority of villages are dependent on more than one source for animal water needs.

10. Fisheries

The fishery is one of the major occupations in Jafrabad taluka providing employment to about 2,600 families. The production of fish is gradually reducing because of construction of *Bandharas*, salt pans and mining activities in near shore area which results in reduction in fish catch. The fishermen have to go for deep sea fishing, which results in increasing dependency of the fishermen on money lenders. The coastal area in Jafrabad and Rajula is ideal for shrimp culture however, at present no such activities are being carried out.

11. Irrigation

The information on irrigation sources shows that large number of population is using surface water. The ground water in Jafrabad is highly saline and hence many farmers have built farm ponds and check dams for providing protective irrigation to the crops.

As compare to Jafrabad the ground water condition is better in Rajula. The wells are used as a main source of irrigation however these wells do not yield adequate water. The wells which were yielding water for 8 to 10 hours every day are now yielding water only for 2-3 hours and hence the net irrigated area through wells have reduced as compare to a decade ago. The quality of ground water below 30-40 feet has become saline, however in absence of any other source, the farmers use well water for cultivation of salt resistant crops like Jowar and cotton.

Table-7 Irrigation structures types and No.s

Type	Jafrabad	Rajula	Total
River-Number of villages	9	17	26
Irrigation Pond	1	0	1
Village Pond	6	15	21
Farm Pond	96	4	100
Canal	2	3	5
Check dam	55	51	106
Bhandhara		2	2
Bore Well	3	521	524
Well	937	4251	5188

12. Drinking water

The availability of fresh and potable drinking water is a major concern in coastal villages in Rajula and Jafrabad. The existing local drinking water resources have become saline which do not yield potable water. The water contains high content of fluoride and salts harmful for the body. At present people are dependent on more than one type of water source. In Babarkot, Lotpur, Vandh, Khera and Patwa villages people face severe drinking water problem and they have to collect water from 2 to 3 Km.

Table-8 Source used for drinking water

Source type	Jafrabad	Rajula	Total
Rivers	7	9	16
Pond	57	52	109
Open Well	206	3,997	4,203
Tube Well	51	119	170
Hand pump	222	144	366
Pipe Line	3	13	16
Rainy Water Tank	47	106	153
Tanker	1	1,703	1,704

The findings of the survey shows:

1. Only 1/3rd of villages get adequate supply. The percentage is high in Rajula taluka.
2. Almost 50% villages in both talukas face drinking water problem.
3. Only 1/3rd villages have local water source which can be used for drinking purpose.
4. In 47 villages people purchase drinking water.
5. 50% villages in Jafrabad have no supply of drinking water.
6. Only 1/3rd villages are covered under pipeline project.
7. Only three out of 37 sanctioned schemes have been completed.
8. The state government has proposed 114 schemes for Rajula and Jafrabad taluka under group, individual and RO plants water supply schemes.

Table-9 Showing Type of drinking water problem faced in Rajula and Jafrabad.

Problem type	Rajula	Jafrabad	Total
Quality	15	3	18
inadequate supply	20	11	31
seasonal shortage	6	5	11
No supply	1	2	3
No source	4	19	23
Use of More than one source	4	0	4
Pipe line supply			
Covered	24	4	28
Not covered	26	27	53

13. Health and sanitation

The unsafe drinking water sources impact the health of the people. The stone in Kidney, skin diseases and joint pains are common complains among majority of villages in coastal area. The health condition of people in Jafrabad is severe due to lack of potable drinking water source. The Florosis impact is more visible in villages of Rajula taluka using ground water which contains fluorides up to 2 ppm. Many villages in Rajula have adopted water purifier at household level. The water born diseases are common in villages close to coast. The sanitation infrastructure is found only in few villages which accelerate the health problem caused by saline water.

14. History of salinity

The villages in these talukas are facing salinity problem since long, however, fourteen villages have reported salinity ingress in last five years. The information given by villagers indicates that the salinity has increased mostly during last 10 years. Before 10 years, there were only sixteen villages having salinity problem which has now increased to cover entire taluka in last ten years.

15. Salinity problem-Extent of salinity

In Rajula taluka villages up to 35 Km have reported salinity. The salinity is found both in soil and water. The soil salinity is increasing rapidly mainly due to increasing number of salt pans in the area and higher use of pesticides in agriculture.

The Total Geographical area affected is 65,000 ha.

- 25% is fully saline
- 25% is partially saline and

- 50% is probable saline area.
- 62% soil of study area has become saline.

The salinity has affected 1.47 lakh people and 24,500 households hampering access to safe/adequate drinking water and reducing income sources.

16. Reasons for salinity

The reasons for increase in salinity identified by the people include, natural as well as human induced factors. Majority of people believe that human induced reasons have dominated the natural reasons.

The major reasons for increasing salinity ingress are

- Increase in ground water draft for irrigation-Rajula & Jafrabad
- Droughts and change in rainfall pattern
- Excavation of sand from river bed
- Limestone mining.
- Saline winds due to increase in salt pan area
- Change in geological formation after earthquake.

The salinity ingress in majority of villages have occurred due to more than one reason, however the main reason is over use of ground water by farmers as well as by industries. The second reason for increasing salinity is reduction of flow in the river caused by construction of dams on the river. This has pushed sea water inside the river bed up to 5 to 6 Km. which has polluted ground water in areas away from the coastline.

17. Impacts due to salinity problem

The salinity problem impacts the life and livelihood of the coastal communities. While on one hand the communities expenditure on availing basic needs like drinking and health are increasing at the same time the income from their primary occupation in decreasing. The detail socio-econ9omic impact is shown in table below.

Table-9 Impacts of salinity on coastal communities in Amreli district.

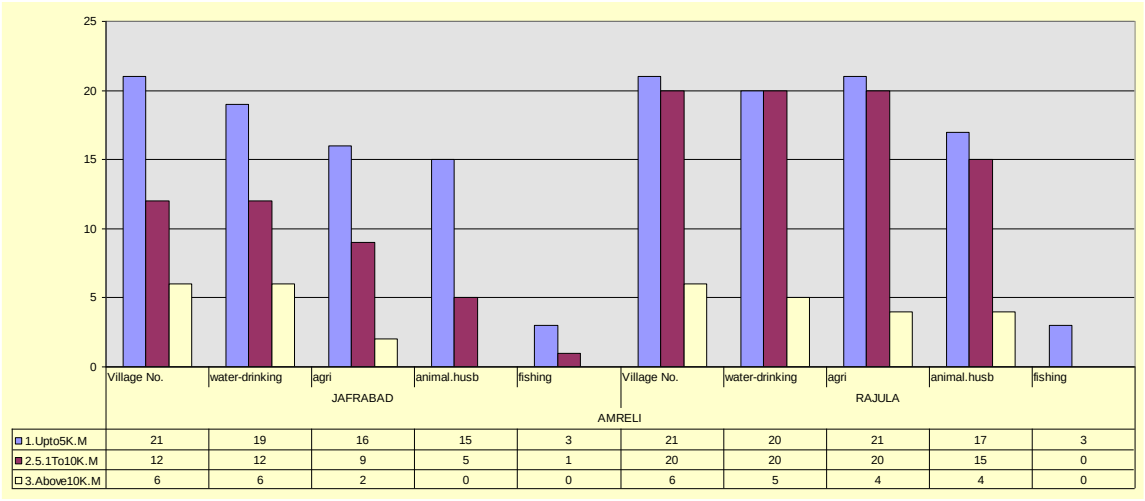
Impacts on	Nature of Impact
People	1. Reduction in income 2. Diversity in income source becomes essential. 3. Increasing unemployment among youth.
Occupation	1. Reduction in employment in farm sector. 2. Reduction in No. of farmers and animal reaers. 3. Increase in migration to Surat and Bhavnagar for diamond business. 4. The farmers work as contractor in horticulture area in Una, Kodinar and Porbandar.
Land and water	1. Use of saline water turn soil saline. 2. Reduction in productivity of land. 3. Land becomes hard creating difficulty in tilling. 4. The crop demand higher amount of seeds and fertilizer. 5. Once land is irrigated with saline water, even grass does not grow on this land.

Impacts on	Nature of Impact
Drinking water	1. Water is saline below 100 feet. No potable water. 2. Drinking water source became saline. 3. Large No. of villages are no source villages. 4. Emergence of drinking water markets. 5. Increase in water born diseases like kidney stone, Florosis and skin. 6. Dependency on tanker supply increased.
Agriculture	1. Cultivation of ground nut, onion, and til stopped. 2. 50% to 75% reduction in crop production using saline water. 3. Quality deterioration in coconut and chickoo crops. 4. The horticulture crops are up rooted. No new horticulture plantation is taking place.
Livestock	1. Reduction in No. of milch animals. 2. Health problem 3. Reduction in milk production. 4. Death of animals within 3-5 years due to drinking of saline water.
Fisheries	1. Industrial pollution has reduced catch in near shore areas. 2. Increase in dependency of small fishermen on the boat owners for fishing.
Health	1. Diseases like stone in Kidney, skin and Florosis become common. 2. Reduction in immune capacity. 3. Increase in No. of cases of miscarriage during pregnancy.
Other	1. Reduction in life of RCC constructions. 2. Non-availability of milk in many villages.

Table-10 Number of villages affected showing impact on resource

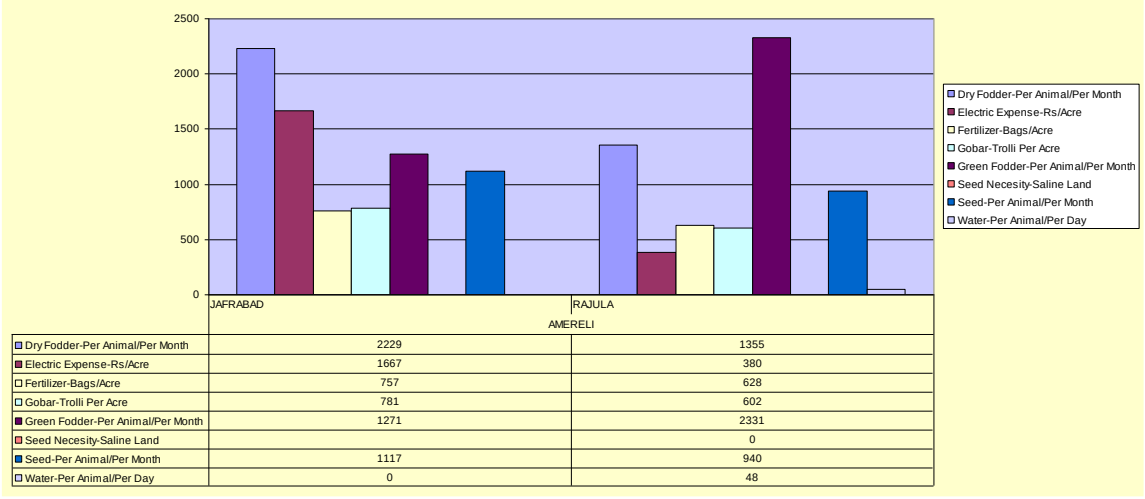
Block	Data	1. Upto 5K.M	2. 5.1 to 10K.M	3. Above 10K.M
Jafrabad	No. of Village	21	12	6
	Drinking Water	19	12	6
	Agriculture	16	9	2
	Animal Husbandry	15	5	0
	Fisheries	3	1	0
	Cottage Industry	1	0	0
	Industries	2	0	0
Rajula	Village	21	20	6
	Drinking Water	20	20	5
	Agriculture	21	20	4
	Animal Husbandry	17	15	4
	Fisheries	3	0	0
	Cottage Industry	1	1	0
	Industries	2	1	0

Graph: 1 Taluka wise number of villages reported impact on drinking water, agriculture, animal husbandry and fishing.



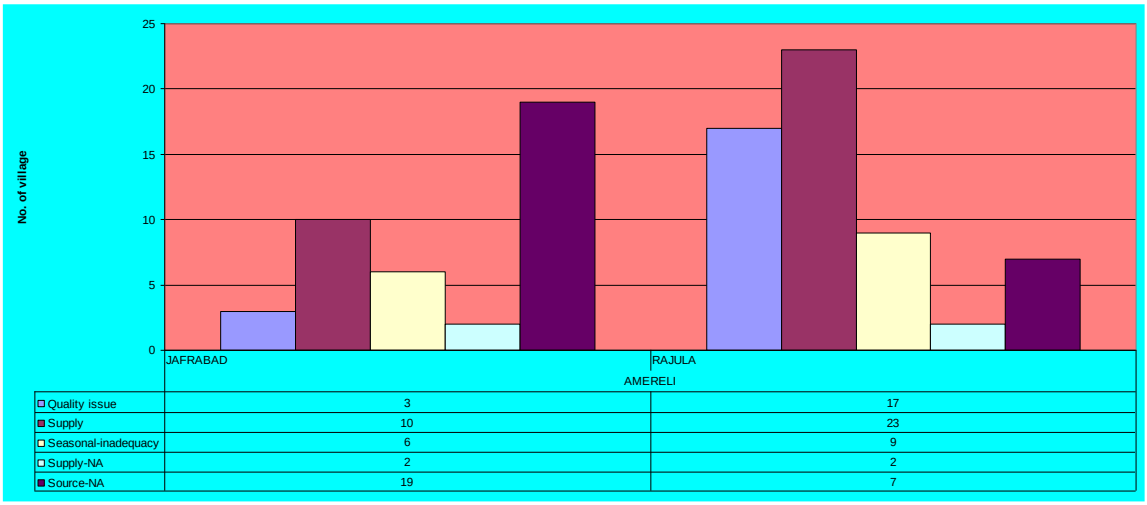
1.Upto5K.M	21	19	16	15	3	21	20	21	17	3
2.5.1To10K.M	12	12	9	5	1	20	20	20	15	0
3.Above10K.M	6	6	2	0	0	6	5	4	4	0

Graph: 2 Impact of salinity on livelihood activities



Dry Fodder-Per Animal/Per Month	2229	1355
Electric Expense-Rs/Acre	1667	380
Fertilizer-Bags/Acre	757	628
Gobar-Trolli Per Acre	781	602
Green Fodder-Per Animal/Per Month	1271	2331
Seed Necesity-Saline Land		0
Seed-Per Animal/Per Month	1117	940
Water-Per Animal/Per Day	0	48

Graph: 3 Impact on Drinking water



Quality issue	3	17
Supply	10	23
Seasonal-inadequacy	6	9
Supply-NA	2	2
Source-NA	19	7

Graph: 4 Impact of salinity on drinking water in villages located at various distance from coastline.

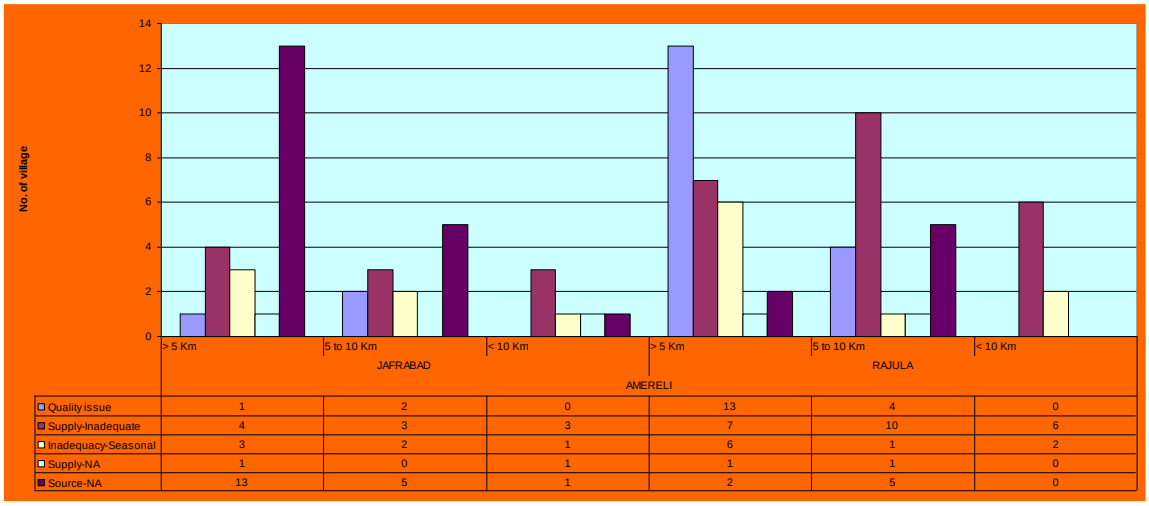


Table-11 Impact on livestock rearing

		No of villages		
Block	**Details**	**1. Upto 5K.M**	**2. 5.1 to 10K.M**	**3. Above 10K.M**
Jafrabad	Village-Area	19,487	9,505	3,487
	Productivity issue	3	1	0
	Quality issue	1	2	1
	Reduction in Production Period	0	0	0
	On Health	11	3	1
	Reduction In Animal	3	3	1
	On Fodder	1	1	0
	No Impact	4	1	3
	Inability to carry out animal husbandry	0	0	0
Rajula	Village-Area	12,838	9,107	9,333
	Productivity	9	3	0
	Quality	7	3	0
	Reduction Production Period	7	3	0
	On Health	8	5	1
	Reduction In Animal	7	2	0
	On Fodder	14	10	2
	No Impact	4	7	3
	Inability carry out livestock rearing	1	0	0

Graph: 5 Distance wise status of Banking scenario in Amreli District

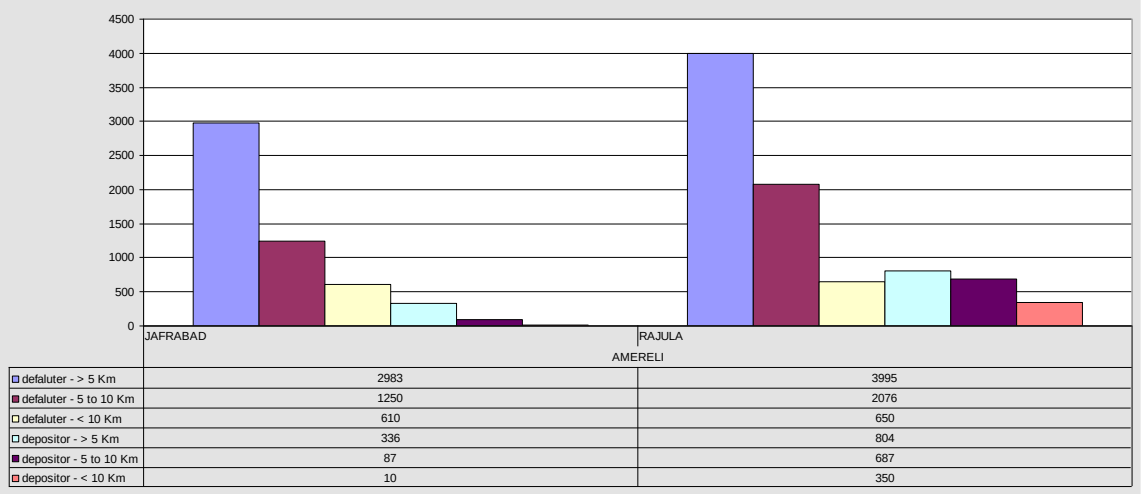


Table: 12 Economic conditions

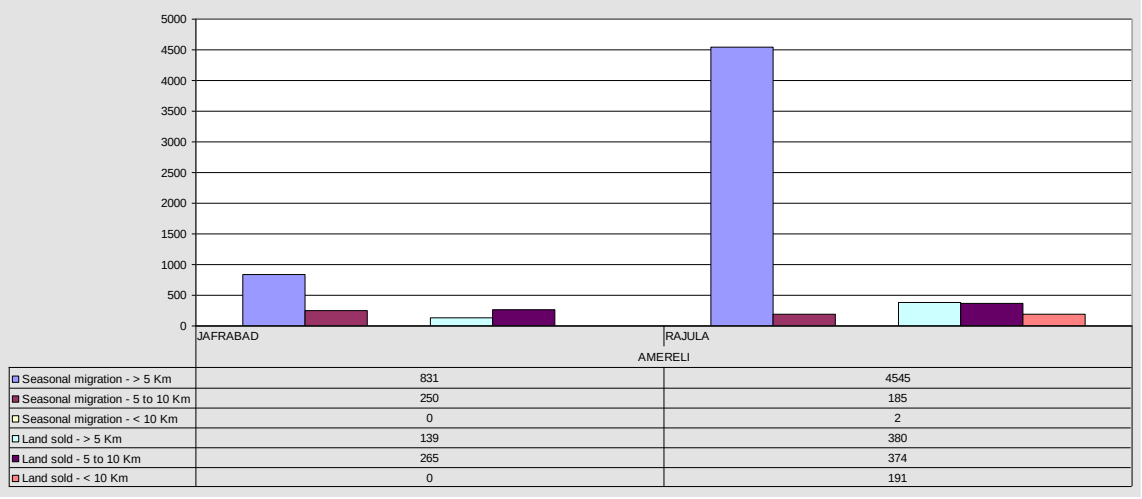
Description	Jafrabad	Rajula	Total
Bank creditor	4,950	7,324	12,274
Motor Boat-Fisherman	27	15	42
Conventional Boat-Fisherman	250	80	330
Cottage Industry		68	68
Bank defaulters	4,843	6,721	11,564
Bank-Depositor	433	1,841	2274
Agri. Loan	4,705	6,656	11,361
Animal Loan	53	455	508
Seasonal Migration	1,081	4,732	5,813
Land Selling Farmers	404	945	1,349
Land Purchaser Farmer	124	295	419

Findings

1. The purchase of agriculture land by industries has increased the land rates. Many farmers have sold their land to the cement factories and other industries establishing their units near ports.

2. The banks are offering only 10-12% of their total credit in salinity affected villages. The people are also demanding loans for non-farm business purposes likes purchase of JCB machines, tractors and transport vehicles.

Graph: 6 Present status of migration and land selling in the study villages



	JAFRABAD	RAJULA
Seasonal migration - > 5 Km	831	4545
Seasonal migration - 5 to 10 Km	250	185
Seasonal migration - < 10 Km	0	2
Land sold - > 5 Km	139	380
Land sold - 5 to 10 Km	265	374
Land sold - < 10 Km	0	191

Findings

1. It is difficult to find young persons in the villages. Most of them have migrated to large cities like Surat, Bhavnagar and Ahmedabad where they work as diamond cutting and polishing workers.
2. The farmers having small rain-fed agriculture land move to adjoining districts of Junagadh, Jamnagar and south Gujarat where they get engaged in horticulture plantation on lease.

18. Initiatives

- Initiatives taken up

By Government department

  - By irrigation department (SIPC)-preventive structures
  - By WASMO-drinking water pipeline & local resource enhancement

- Major Initiatives taken up

By Non-Government department

  - Awareness about water conservation and mining activity
  - Drinking water source enhancement
  - Innovative practices for livelihood
  - Demonstrations of people oriented technologies
  - Promotion of organic farming & drip systems.
  - Soil and water testing.

- Major Initiatives taken up

By Agriculture university

  - Studies on impact of salinity on various crops
  - Development of salt tolerant crop seeds.

- Major Initiatives taken up

By individual (farmers)

  - Adoption of less water intensive cropping
  - Rain water harvesting-well recharge, RRWH
  - Farm Bunds
  - Use of gypsum

Table-13 Details of crops cultivated and affected by salinity in coastal Talukas of Amreli district.

Main crops	**Bajara, Wheat, Jowar, Maize and Cotton**
Production rate (Kg/ha)	1. Bajara- 800 to 3000 2. Wheat -4000 to 5000 3. Maize- 700-1200 4. Groundnut-1200-2000
Crops showing impact of salinity	Pulses, Ground nut, Til

Table-14 Suggestions made by communities for reducing salinity problem in coastal villages of Amreli district.

Sr.No	**Taluka**	**Villages**	**Suggestion/requirement**
1	Jafrabad	Babarkot	Bandhara constriction on ghane river
		Vandh	Construction of check dams on streams in the village.
2	Jafrabad	Lotpur	Construction of dam on Dhatarvadi river.
3	Rajula	Samadhiyala	Construction of Bandhara between Visalia and Kathivadar. Construction of bandhara between Khera and Samadhiyala village. Bandhara on Hadolyo and ramtilak river. Deepening of existing village pond can help recharging well which can irrigate 150-200 vigha land.
4	Rajula	Khera	Construction of dam on river Dhatardi can help reduce salinity in village Samadhiyala, Datardi and Khera village.
5	Rajula	Patva	Sealing of foundation excavation done for construction of dam on river

19. Scope for interventions

With increasing land prices and reduction in agriculture production, the farming in this area is going to be reduced. In village Babarkot 75% land is already purchased by the companies for mining. The same situation exists all along Amreli coast where the industries are purchasing land for port facilities and mining. In such situation, the small and marginal farmers would be most affected. Therefore it is required to focus on activities like livestock rearing and fisheries which can provide large amount of self employment. Keeping this in focus there are several possible interventions which can address the issue of salinity ingress and deteriorating living condition.

These interventions are:

- Mines recharge in association with cement companies.
- Mangroves plantation in coastal areas which can also help in strengthening animal husbandry and fisheries.
- Plantation of Gorad (Baval) in sandy area of sea coast is advisable because in this area it is suitable for environment.
- The major area is under rain-fed agriculture suitable for production of grains and pulses. Efforts should be made for production and marketing of Mung, Bajro, Math,

guwar etc. This can also strengthen animal husbandry as it provides more fodder for animals.

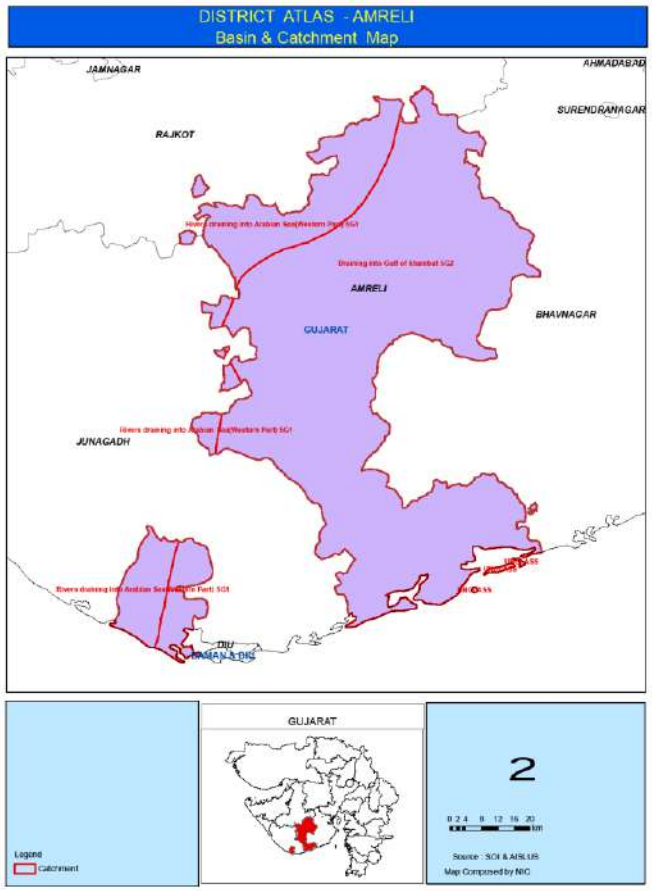
- Farmers, particularly small and marginal would adopt drip irrigation, if it is made available within affordable prices. IDE model should be promoted in Rajula.
- The existing plantation in the coastal areas is dominated by Neem trees. In village Rampar and Bheria have about 1,000 neem trees which show its suitability. Promotion of neem trees can be useful for agriculture as well as for small animals. It will also help in protecting the farms from industrial pollution. Additionally, it can also help in employment generation through production of Neem oil and cake, useful for treatment of saline soil.
- The reduction in animal husbandry activity has contributed to reduction in soil fertility and consequently its productivity. Efforts for strengthening animal husbandry will also create possibility of rejuvenation of farming.
- The coastal area in Amreli has large population of animals but no milk co-operatives are operational. There is a good scope for promotion of animal husbandry with the help of SKDP.
- The RRWH model and design should take in to consideration the needs of cattle. The drinking water facility will boost livestock rearing activity.
- The fishery is the future for the local people who are loosing interest in agriculture. Fishery can provide employment to a large numbers of agriculture labourers who are becoming jobless.

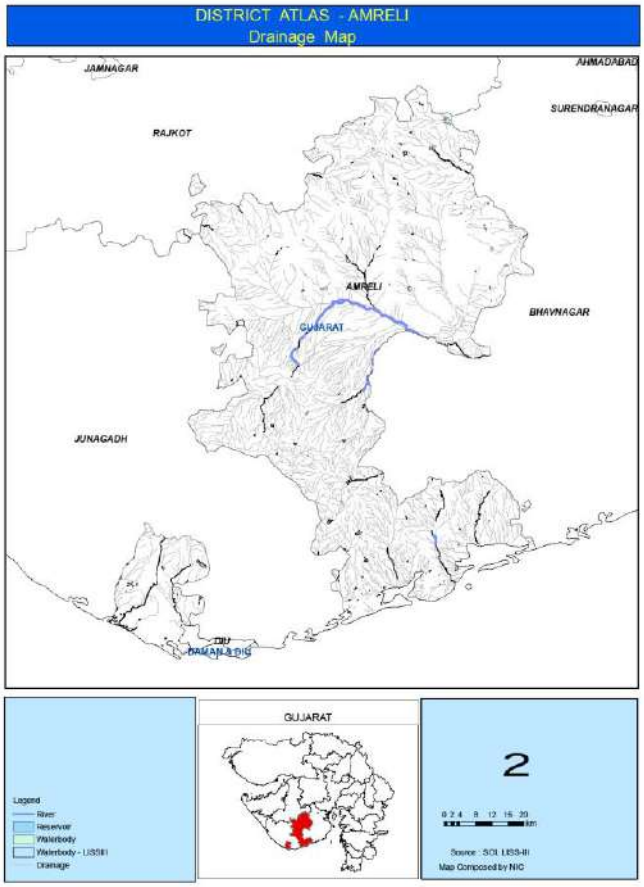
ANNEXURES

Maps, Tables & Graphs

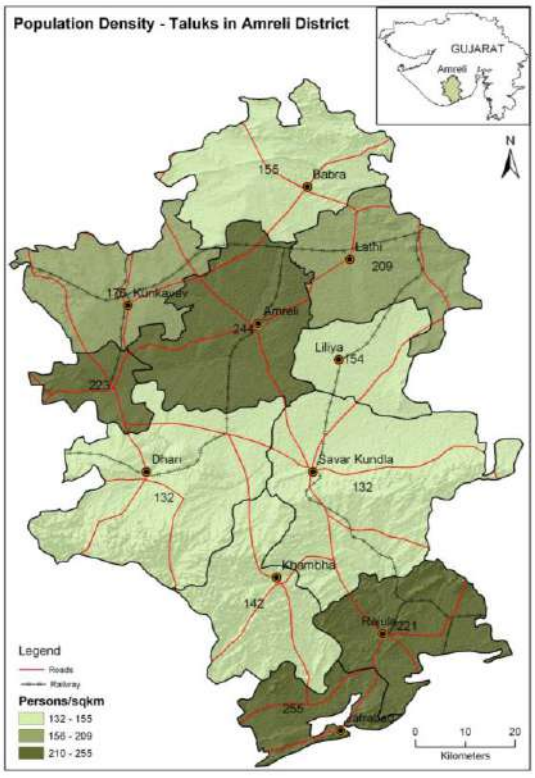
Maps

Map – 1 & 2 Maps showing basin & catchment and drainage of Amreli District

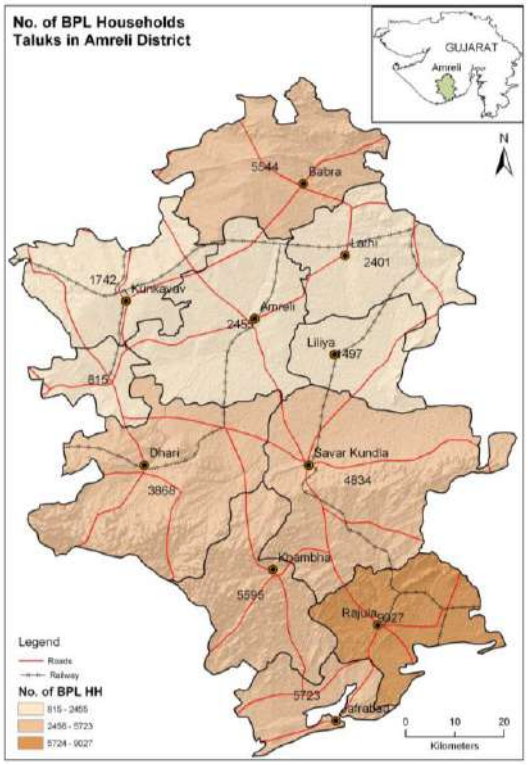


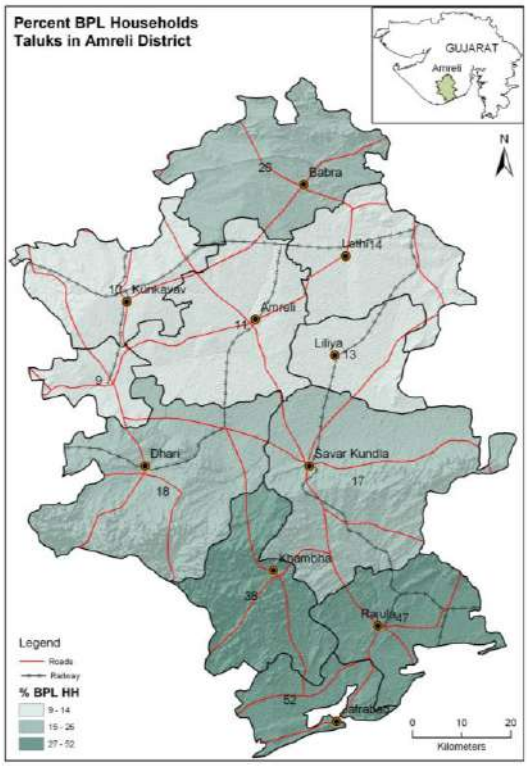


Map – 3 Talukawise population density in Amreli District

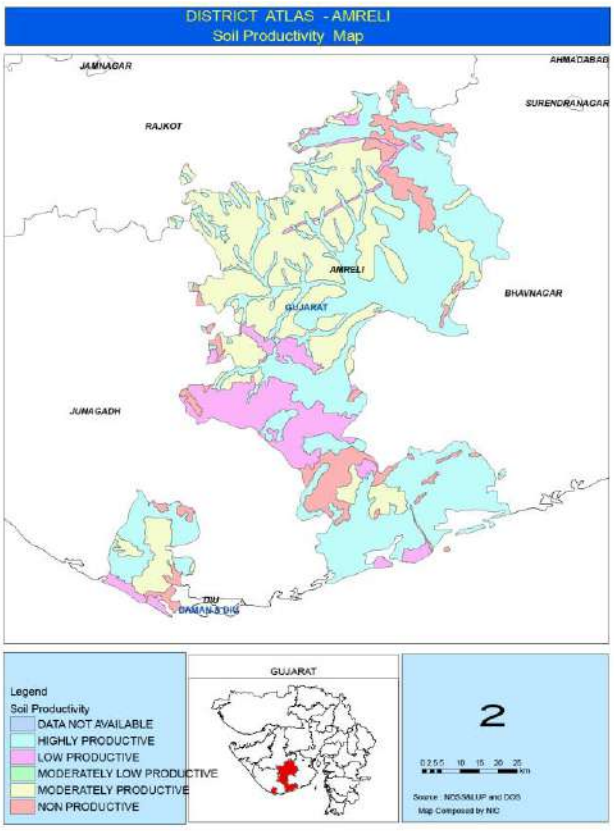


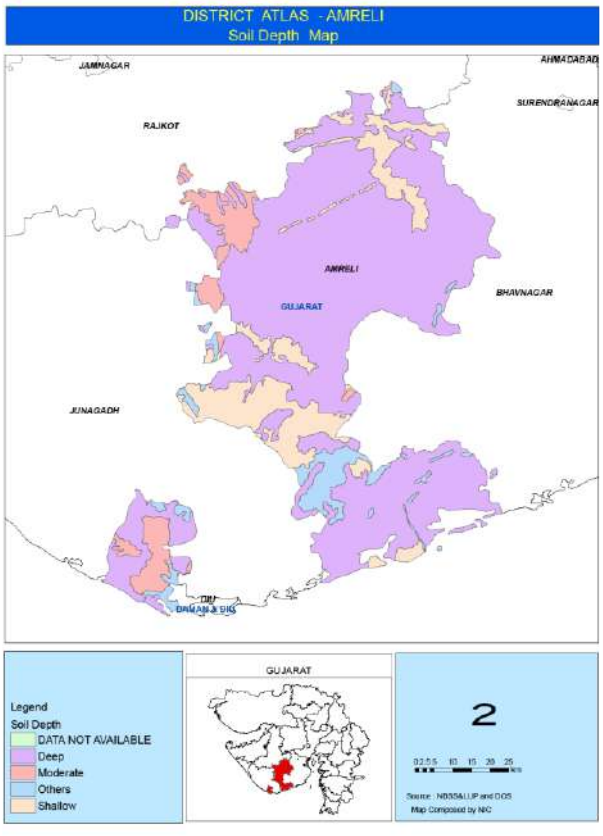
Map – 4 & 5 Maps showing talukawise BPL, Household and its percentage in Amreli District



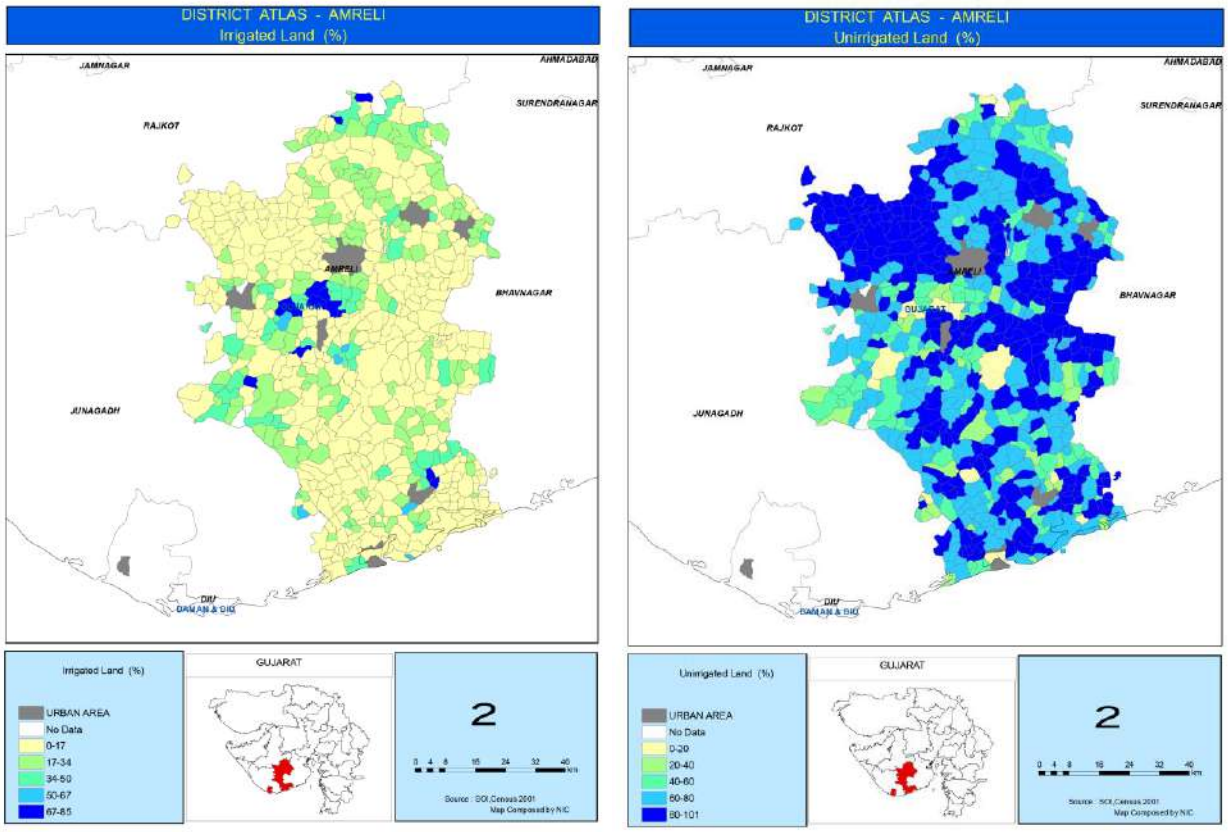


Map – 6 & 7 Maps showing soil productivity & soil depth in Amreli District

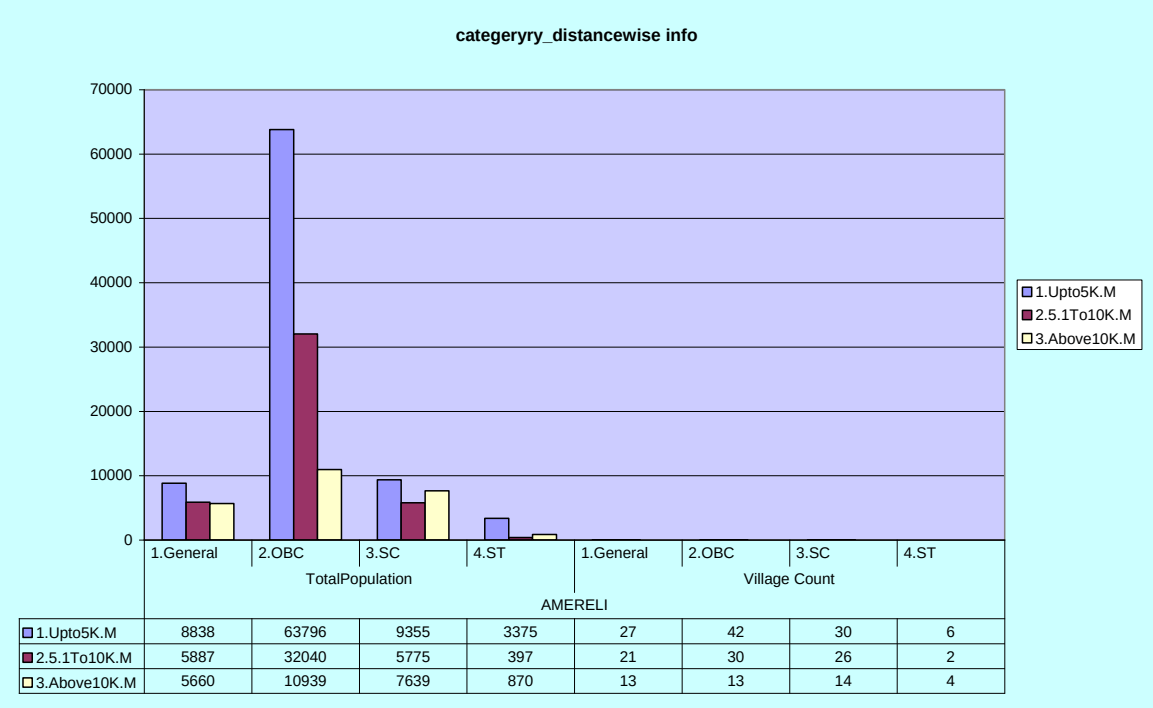




Map – 8 Maps showing villagewise percentage of irrigated and unirrigated land in Amreli District



Graph –1 Category wise population according to the distance from coastline



	1.General	2.OBC	3.SC	4.ST	1.General	2.OBC	3.SC	4.ST
	TotalPopulation				Village Count			
1.Upto5K.M	8838	63796	9355	3375	27	42	30	6
2.5.1To10K.M	5887	32040	5775	397	21	30	26	2
3.Above10K.M	5660	10939	7639	870	13	13	14	4

Table-1 Land use pattern (area in hectare)

Land type	Jafrabad	Rajula	Total
Geographical Land	32,479	31,278	63,757
Land- Saltpans	41		41
Land- Kharpat	681		681
Agri. Land	8,792	20,245	29,037
Un-irrigated Land	8,704	7,706	16,410
Forest Land	1,733	78	1,811
Fodder Land	3,480	2,747	6,227
Wasteland	1,417	1,806	3,223
Gamtal Land	180	738	918
Village Pond Area	15	397	412
Land Under Industries	600		600

Table: 2 Distance wise land use

Block	Land use type	1. Upto 5K.M	2. 5.1 to 10K.M	3. Above 10K.M
Jafrabad	1. Geographical Land	19,487	8,145	3,487
	2. Agri. Land	6,215	1,871	418
	3. Unirrigated Land	3,999	1,224	3,289
	4. Forest Land	977	209	58
	5. Fodder Land	855	2,217	82
	6. Waste Land	3	4	3
	7. Gamtal Land	51	60	68
	8. Village Pond Area	10	4	0
	9. Land Under Industries	600	0	0
	10. Land- Saltpans	41	0	0
	11. Muddy Land	0	0	0
	12. Land- Mining	0	0	0
Rajula	1. Geographical Land	12,838	9,107	9,333
	2. Agri. Land	7,977	6,079	6,189
	3. Unirrigated Land	1,161	4,165	2,380
	4. Forest Land	72	4	2
	5. Fodder Land	591	509	1,647
	6. Waste Land	4	4	3
	7. Gamtal Land	317	111	310
	8. Village Pond Area	280	68	49
	9. Land Under Industries	0	0	0
	10. Land- Saltpans	0	0	0
	11. Muddy Land	0	0	0
	12. Land- Mining	0	0	0

Table - 3 Crops production (Kg)

Crop	Unit	Jafrabad	Rajula	Total
Bajari	Kg	60,500	95,927	156,427
Chana	Kg	20,300		20,300
Coconut –Nos.	Nos.	2,000		2,000
Cotton	Kg	153,225	206,670	359,895
Groundnut	Kg		111,737	111,737
Jowar	Kg	13,067	31322	44,389
Kalthi	Kg		156	156

Crop	Unit	Jafrabad	Rajula	Total
Maize	Kg		27,460	27,460
Moong	Kg	1,600	6810	8,410
Onion	Kg		115,500	115,500
Paddy	Kg	5,000		5,000
Pulses	Kg		1,125	1,125
Til	Kg	33,250	40,607	73,857
TUVER	Kg		1,125	1,125
Udad	Kg		2,150	2,150
Wheat	Kg	78,675	51,479	130,154

Graph – 2 Irrigation-Source and benefits

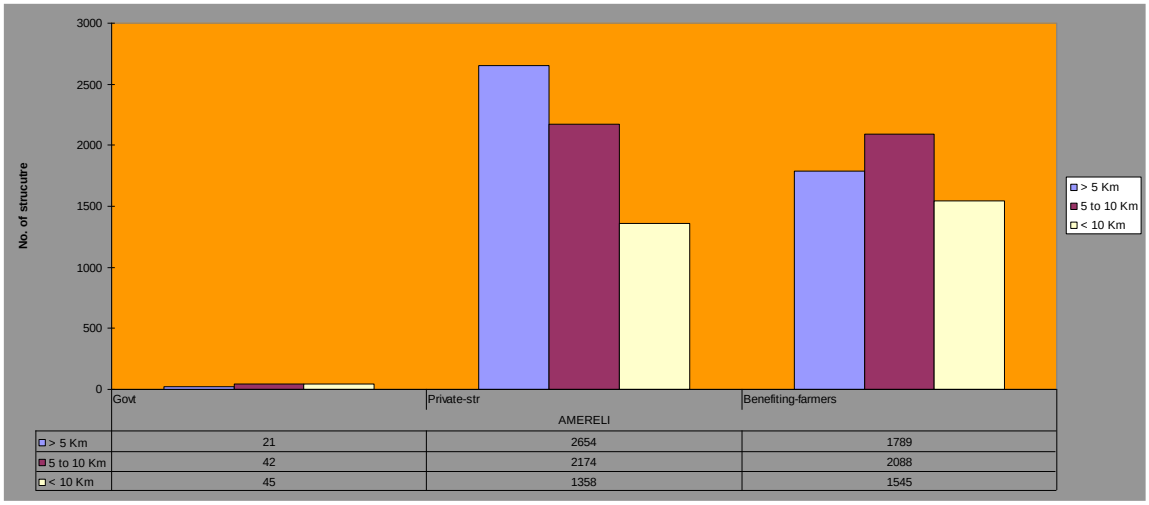
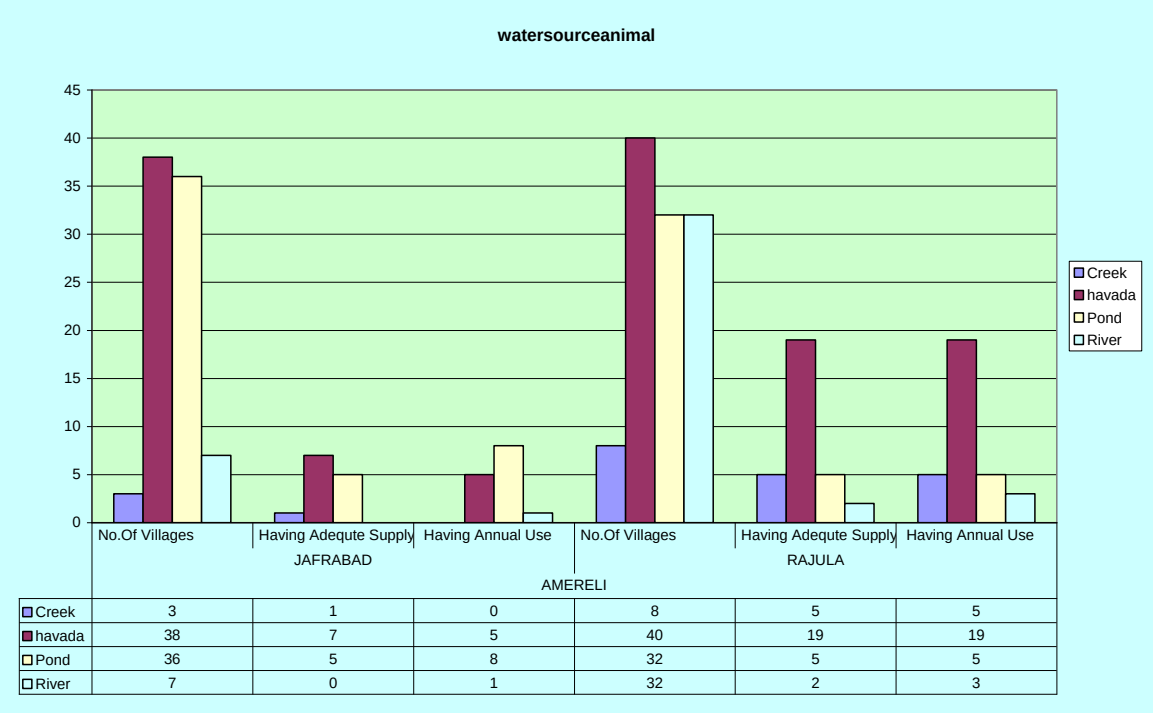


Table -4 Crop change

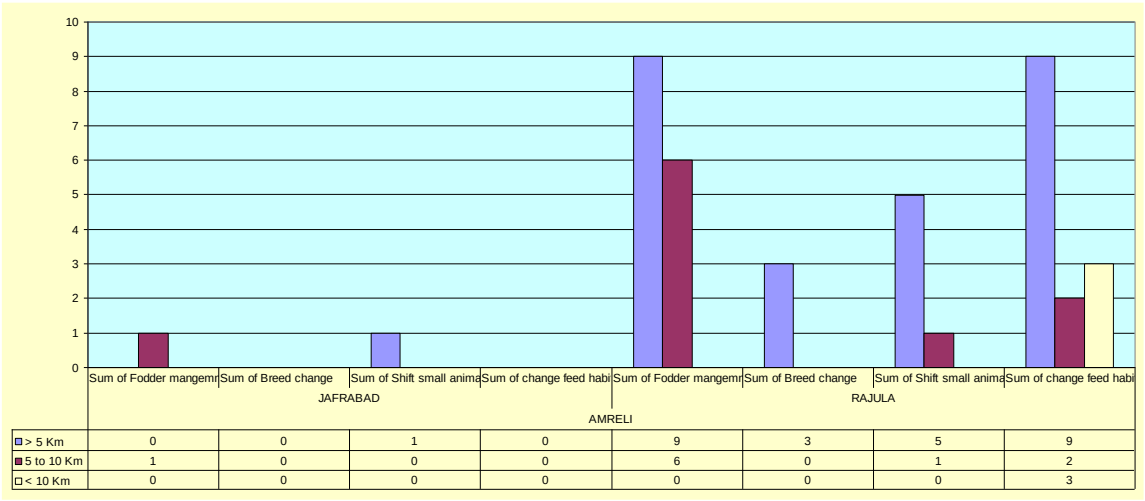
Block	Data	> 5 Km	5 to10K.M	< 10 Km	Grand Total
Jafrabad	No. of villages	16	7		23
	Area of village	26,541	14,178		40,719
	village Nos.-change food crop	18	9		27
	Village Nos.-change cash crop	16	6		22
	Village No.-change horticulture	0	1		1
	Village No.-change forestry	0	0		0
Rajula	No. of villages	17	14	4	35
	Area of village	21,859	11,544	7,580	40,983
	village Nos.-change food crop	23	14	4	41
	Village Nos.-change cash crop	8	6	3	17
	Village No.-change horticulture	0	3	0	3
	Village No.-change forestry	0	0	0	0
Total	No. of villages	33	21	4	58
	Area of village	48400	25722	7580	81702
	village Nos.-change food crop	41	23	4	68
	Village Nos.-change cash crop	24	12	3	39
	Village No.-change horticulture	0	4	0	4
	Village No.-change forestry	0	0	0	0

Graph- 3 Animal water need



	No.Of Villages	Having Adequte Supply	Having Annual Use	No.Of Villages	Having Adequte Supply	Having Annual Use
Creek	3	1	0	8	5	5
havada	38	7	5	40	19	19
Pond	36	5	8	32	5	5
River	7	0	1	32	2	3

Graph-4 Solution tried for –Livestock rearing



	Sum of Fodder mangemr	Sum of Breed change	Sum of Shift small anima	Sum of change feed habi	Sum of Fodder mangemr	Sum of Breed change	Sum of Shift small anima	Sum of change feed habi
> 5 Km	0	0	1	0	9	3	5	9
5 to 10 Km	1	0	0	0	6	0	1	2
< 10 Km	0	0	0	0	0	0	0	3

Table -5 Type of drinking water adequacy

	No. of villages having			
Block	**Adequate**	**Inadequate**	**Can't say**	**Total**
Jafrabad	13	22	4	40
Rajula	22	25	2	50
Total	**35**	**47**	**6**	**90**

Table –6 Drinking water problem

	No. of villages			
Block	**Yes**	**No**	**Can't say**	**Total**
Jafrabad	20	13	7	40
Rajula	29	19	2	50
Total	**48**	**32**	**9**	**90**

Table -7 Local source adequacy

	No. of villages			
Block	**Yes**	**No**	**Can't say**	**Total**
Jafrabad	10	27	2	40
Rajula	20	27	2	50
Total	**30**	**54**	**4**	**90**

Table - 8 Water sources availability round the year

		No. of villages			
District	**Block**	**Yes**	**No**	**Can't say**	**Total**
Amreli	Jafrabad	8	29	1	40
	Rajula	19	26	3	50
Total		**27**	**55**	**4**	**90**

Graph-5 Drinking water status

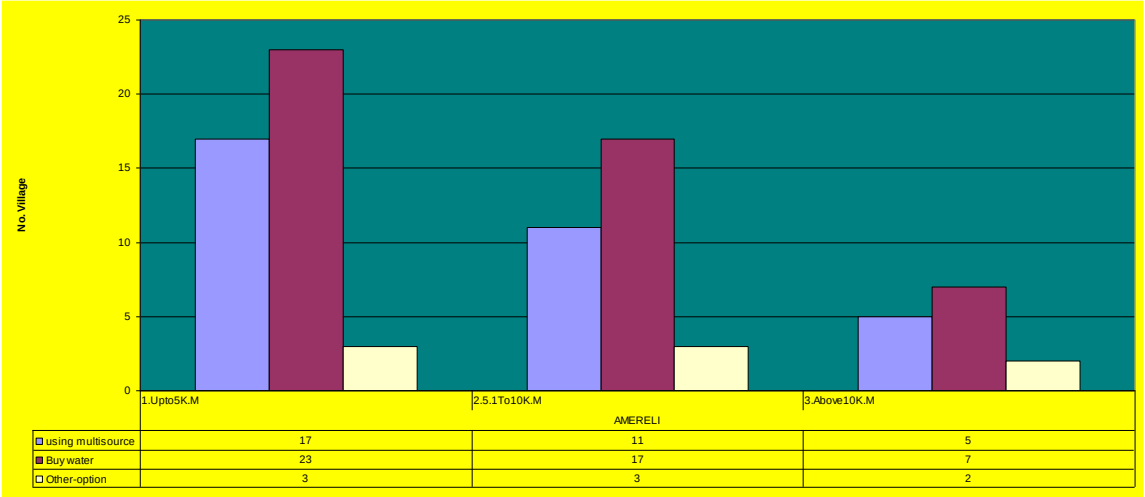


Table - 9 Villages facing drinking water situation

	Rajula	Jafrabad	Total
Adequate			
Yes	23	14	37
No	26	22	48
Can't say	2	4	6
Water problem			
Yes	29	20	49
No	19	14	33
Can't say		6	6
Problem type			
Quality	15	3	18
inadequate supply	20	11	31
seasonal shortage	6	5	11
No supply	1	2	3
No source	4	19	23
More than one	4	0	4
Pipe line supply			
Covered	24	4	28
Not covered	26	27	53

Table-10 Proposed plan for drinking water security in study taluka

Taluka	Total villages	Villages without population	No. of villages covered under			
			Group scheme	Individual scheme	Other (Hand pump + well+ RO)	Total
Jafrabad	42	0	12	16	2	42
Rajula	72	0	16	41	10	72
Total	**114**	**0**	**28**	**57**	**12**	**114**

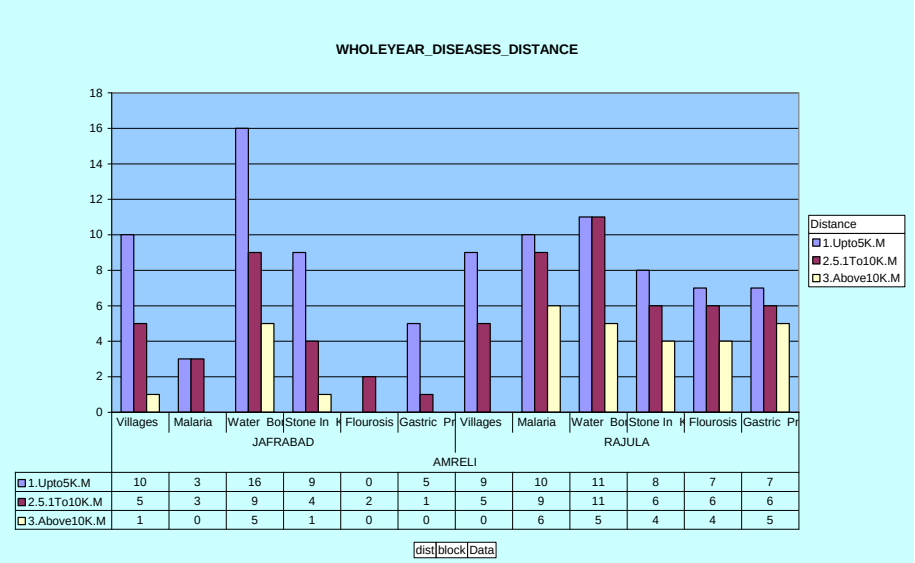
(Source: WASMO publication, 2007)

Table- 11 Villages proposed to be covered under "Sagarkhedu scheme"

Taluka	No. of villages	Sanctioned schemes		Completed		In process	
		Nos.	Cost	Nos.	Cost	Nos.	Cost
Jafrabad	46	15	150.78	0	-	15	135.78
Rajula	72	22	141.98	3	31.04	19	19.00

(Source: WASMO publication 2007)

Graph-6 Distance wise variation in whole year and seasonal diseases



	Villages	Malaria	Water Bo	Stone In K	Flourosis	Gastric Pr	Villages	Malaria	Water Bo	Stone In K	Flourosis	Gastric Pr
1.Upto5K.M	10	3	16	9	0	5	9	10	11	8	7	7
2.5.1To10K.M	5	3	9	4	2	1	5	9	11	6	6	6
3.Above10K.M	1	0	5	1	0	0	0	6	5	4	4	5

Graph –7 Relationship between distance from coast and disease pattern throughout the year

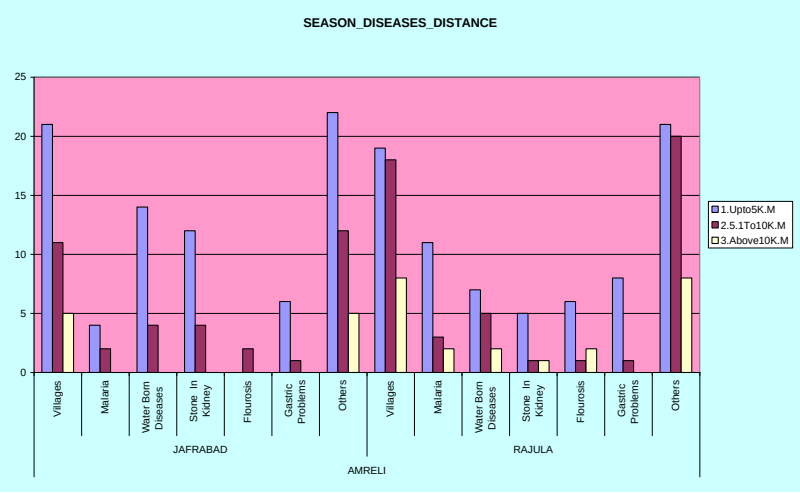
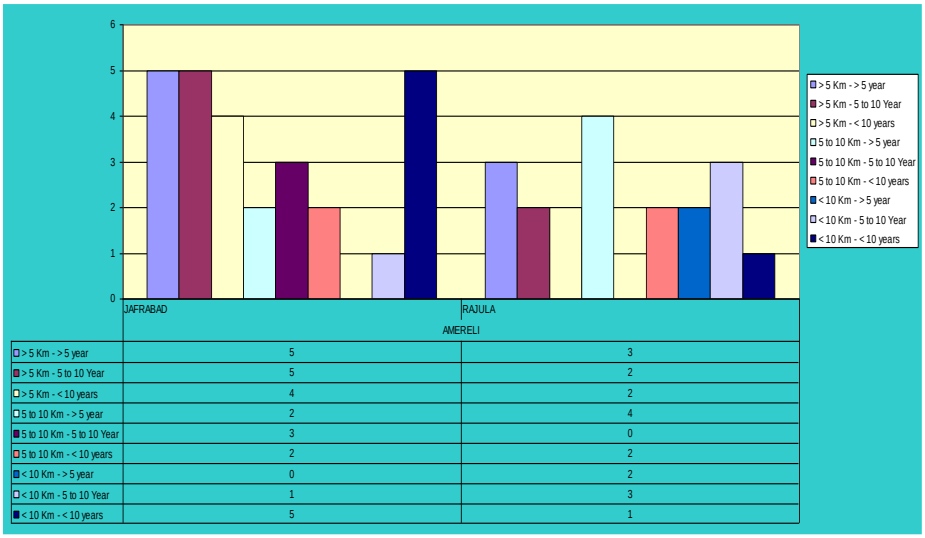


Table –12 Village level institution

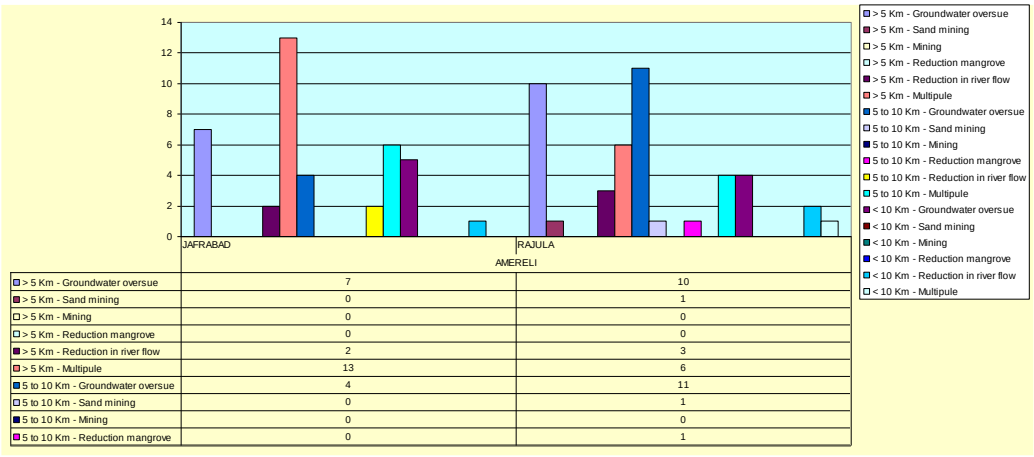
Organization type	Rajula		Jafrabad		Total	Total
	Nos.	Villages	Nos.	Villages	Nos.	Villages
SHG	27	4	6	5	33	9
Federation			2	2	2	2
Irri.co-operatives	1	1	3	3	4	4
water committee	15	9	7	7	22	16
watershed committee	1	1	0	0	1	1
NGO	3	23	3	40	6	63
Other	207	13	7	4	214	17

Graph –8 History of salinity ingress



	JAFRABAD	RAJULA
> 5 Km - > 5 year	5	3
> 5 Km - 5 to 10 Year	5	2
> 5 Km - < 10 years	4	2
5 to 10 Km - > 5 year	2	4
5 to 10 Km - 5 to 10 Year	3	0
5 to 10 Km - < 10 years	2	2
< 10 Km - > 5 year	0	2
< 10 Km - 5 to 10 Year	1	3
< 10 Km - < 10 years	5	1

Graph –9 Causes of salinity ingress



	JAFRABAD	RAJULA
> 5 Km - Groundwater oversue	7	10
> 5 Km - Sand mining	0	1
> 5 Km - Mining	0	0
> 5 Km - Reduction mangrove	0	0
> 5 Km - Reduction in river flow	2	3
> 5 Km - Multipule	13	6
5 to 10 Km - Groundwater oversue	4	11
5 to 10 Km - Sand mining	0	1
5 to 10 Km - Mining	0	0
5 to 10 Km - Reduction mangrove	0	1

Baseline Study of Coastal Villages affected by Salinity ingress in Junagadh District

May-07 to March-08

Prepared by:

Saline Area Vitalization Enterprise Ltd. (SAVE)

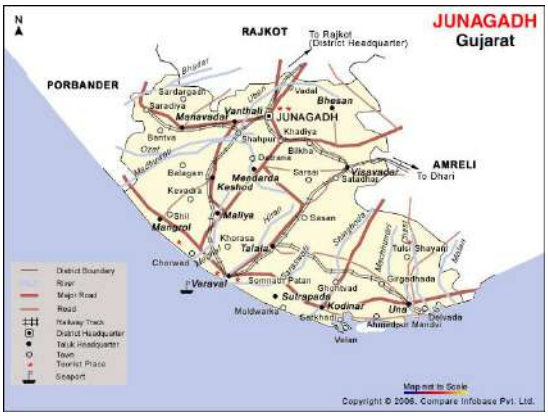
Prepared for:

Coastal Salinity Prevention Cell (CSPC)

Junagadh District

1. Introduction

Junagadh district lies between 21º 10' and 21º 40' north latitude and 70º 18' and 71º 15' west longitude region, in the state of Gujarat India, known as Kathiawar or Saurashtra. This district is bounded on the North by the Rajkot district, on the East by Amreli district, on the South by Arabian Sea and on the West by the Arabian Sea and Porbandar district. Total geographical area of Junagadh district is 6,996,011.21 hectors.



2. The coastal area in Junagadh district

The Junagadh district has fourteen talukas of which six talukas namely, Mangrol, Malia, Veraval, Sutrapada, Kodinar and Una are the coastal talukas. The six coastal talukas cover geographical area of 313,061 ha which, is forming 35% of the whole district. The survey has covered 293 villages out of total of 551 villages of six coastal talukas. The Geographical area of 297 villages is 207,788 ha which constitute 23.39% of the total area of the district and 66.37% of the area of talukas covered under the study.

Table-1 Geographical coverage of villages covered under the study

	District	Coastal Taluka	Study villages
Geographical area (ha)	888,100	313,061	207,788
% of district	100	35.25	23.39
% of taluka		100	66.37

The villages covered under the survey are divided in to fully saline, partially saline and prone to saline by irrigation department, GoG. The distribution of villages based on this classification and their percentage to total village covered under the classification is given in map below.

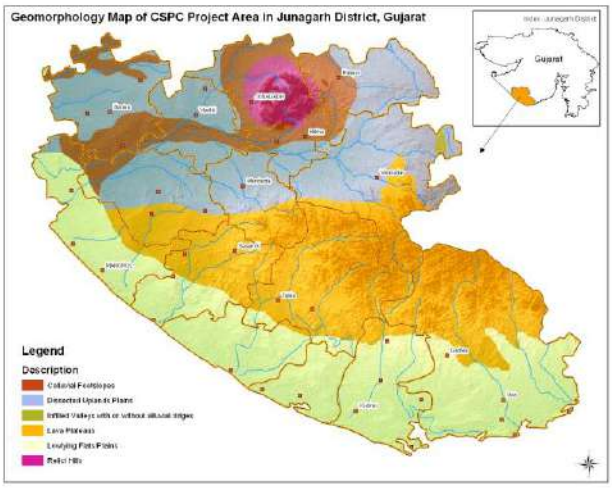


Table-2 Taluka wise number of villages according to salinity classification done by SPIC in Junagadh District

Details	Taluka	Salinity category			
		Fully saline	Partial saline	Probable	Total
No. of villages	Una	19	21	46	86
% of total villages		22.09	24.42	53.49	100
No. of villages	Kodinar	14	10	22	46
% of total villages		30.43	21.74	47.83	100
No. of villages	Veraval/ Sutrapada	27	11	47	85
% of total villages		31.76	12.94	55.29	100
No. of villages	Mangrol	22	9	29	60
% of total villages		36.67	15.00	48.33	100
No. of villages	Maliya	10	2	14	26
% of total villages		38.46	7.69	53.85	100
	Total	**92**	**53**	**158**	**303**
		30.36	**17.49**	**52.15**	**100**

More than 50% villages are falling in prone to salinity category, the 30% villages falling under fully saline category has highest number of villages in Mangrol taluka. The highest numbers of villages prone to saline are located in Veraval and Sutrapada taluka. Out of 303 villages, the study has covered 297 villages, which is also highest number of villages surveyed in a single district.

A comparison of surveyed villages with study talukas in Junagadh and entire coastal area covered under the present survey is shown in table-1 at annexure-1.

3. Climate & Rainfall

The climate in coastal Junagadh is moist and warm with annual rainfall between 700-800 mm occurring during 20-40 rain-days. The Junagadh district is having highest amount of average rainfall among the entire coastal district covered under the present study. There are fourteen rain gauge stations in the study area.

Table-3 Rainfall details in study talukas

Taluka	Rainfall in mm	Number of rainy days
Mangrol	732	19
Malia	786	32
Veraval	800	41
Sutrapada	487	29
Kodinar	767	38
Una	740	36

4. Physical features

4.1 Geo-morphology

The coastline in Junagadh district is trending northwestward which is remarkably straight. The famous miliolitic formations are found along this part of the Saurashtra coastline. The coastal plains are 5.50 km. wide, sloping very gently towards the sea and seen traversed by quite a few longitudinal - parallel stabilized miliolite dunal ridges.

The coastline is indented by a number of inflowing rivers their mouths typically forming tidal creeks with lagoons. All these creeks are characterized by sandy spits and are giving rise to linear backshore lagoonal mudflats behind the coastal ridge.

4.2 Hydrological

The Junagadh district is broadly divided in to two basins. The Northern basin covers more than 80% of the geographical area and drain in to Arabian Sea. The southern basin covering 20% of the area drains in to gulf of Khambhat area.

This coastal block directly faces an open 'Arabian Sea' characteristically marked with less tidal variations, strong long shore drift current and wave actions. This block comprises of highly fertile land and so the inhabitants have over utilized the terrain resources, water in particular. This has witnessed an unprecedented problem of salinity ingress and the entire coastal tract between Una-Harshad has become the main front of sea water intrusion.

The diversity in hydrogeological environments along this segment is attributed to its geomorphic characteristics, offering numerous landform characters viz. cliffy shoreline, tidal creeks, coastal dunal ridges, point bars, large surficial depressions etc. Here also the miliolitic limestone forms the potential aquifer for groundwater supply. On account of overexploitation, the watertable has witnessed a sharp decline in its level. In the span of seven years it has reduced by 4 to 15 m. causing saline water ingress up to more than 20 km. inland areas.

4.3 Geo-environment

This coastal segment is almost straight and trending NW-SE and characterized by uneven substrate of submerged miliolitics. This coast experiences the maximum impact of powerful breakers and resulting surf action due to strong southwesterly and westerly winds. This high energy coastal segment is also seen to experience considerable erosion and formation of submerged miliolites. The various rivers do not carry much sediment load and hence have minimum turbidity. But, the river water contains $CaCO_3$ thus augmenting to the $CaCO_3$ content of the sea waters.

5. Demographic Overview

The coastal villages covered under the study have recorded population of 8.09 lakh people with population density of 389 persons per sq Km. which is the most densely populated costal area under present study. The population density in costal Junagadh is more than double the average population density recorded in the coastal villages in Saurashtra and Kutch.

The population in coastal villages in Junagadh district has increased from 696,516 to 809,592 persons during last six years, i.e. an increase of 16%.

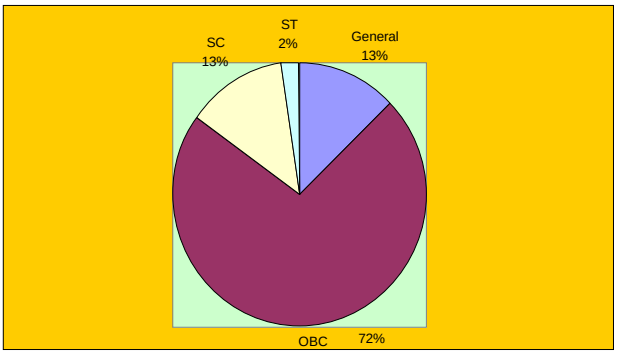
5.1 Coastal Junagadh comparison with costal are covered

The study has covered 297 villages in six coastal talukas in Junagadh district. The total area of 207,788 ha forms 16% of the total geographical area and 29% of villages, 34% of families and 38% of population of the 997 coastal villages covered in survey.

6. Population characteristic

The 72% of total population belongs to other backward community, which includes mainly Karaldias, Rajputs, Kolis, Ahirs, Bharvadas and Rabaris. The general population having Rajputs, Patels and Brahmins form 13% of the total population. The remaining population consists of schedule caste and schedule tribes. The schedule caste populations have Harijans and Hadiayas community. Villages with Muslim population are common in many villages.

Graph – 1 showing percentage of population under different categories



26% of the total families live below poverty line in coastal Junagadh area. 72% of them are OBC category. The BPL families are spread across the surveyed villages.

6.1 Village characteristic

The 297 villages are located at a distance from coastline to maximum up to 35 Km. Out of this, 125 villages are located at a distance more than 10 Km from the coast line, while 85 villages are located at a distance less than 5 Km from the coastline. The highest numbers of villages closest to sea are in Una taluka.

7. Occupation

The agriculture is a main occupation in the region with around 75,000 farming families in 297 villages. The farmers are supported by around 80,000 agriculture labourers who are also dependent on agriculture in the coastal area. Apart from these two major occupations, the coastal Junagadh has families involved in animal husbandry and fisheries which are being carried out as supportive economic activities. The industrial development around Kodinar, Sutrapada and Veraval provides opportunity for services sector activities like transport and skilled and semi skilled wage employment in industries.

The agriculture land holding information for Junagadh district indicate that highest amount of land is held by farmers having land holding between 1 to 3 hectares. As compare to State figures, Junagadh district has lower percentage of land holders in higher land holding category. The land holding among small and marginal farmers (holding land less than 1 ha) is small as compare to the state.

Table- 4 Land holding characteristics of Junagadh district

Land holding in ha.	District	Junagadh district		Gujarat (%)
		Amount	%	
Below 0.5	No.	11,669	4.46	12.18
	Area	3,625	0.56	1.29
0.5- 1.0	No.	43,381	16.58	15.16
	Area	34,440	5.32	4.38
1.0-2.0	No.	96,203	36.77	27.97
	Area	140,656	21.73	15.67
2.0-3.0	No.	42,825	16.37	16.28
	Area	103,633	16.01	15.15
3.0-4.0	No.	24,183	9.24	9.27
	Area	82,968	12.82	12.20
4.0-5	No.	15,303	5.85	6.22
	Area	68,051	10.52	10.58
5.0-7.5	NO.	17,954	6.86	7.50
	Area	108,350	16.74	17.32
7.50-10	No.	6,480	2.48	3.01
	Area	55,073	8.51	9.81
10-20	No.	3,396	1.30	2.23
	Area	41,778	6.46	10.92
20.00 & above	No.	215	0.08	0.18
	Area	8,599	1.33	2.67
Total	**No.**	**261,609**	**100.00**	**100.00**
	Area	**647,173**	**100.00**	**100.00**

8. Land use

According to census 2001, the coastal area in Junagadh district covers an area of 207,788 ha. This includes 3.27% forest, 69% agriculture land, 14% cultivable waste and 11% land not available for cultivation. The coastal Junagadh has highest amount of irrigated land in coastal districts covered under the survey. The Kodinar and Una talukas have more than 35% of its geographical area under irrigation. The lowest irrigation is found in Mangrol taluka. Among the talukas, Una taluka has highest percentage of geographical area (25%), forest (44%) and Irrigated area (31%). While lowest percentages of same are found in Maliya taluka.

The taluka level analysis shows that Una and Kodinar taluka have fairly good irrigated area than the other talukas. Mangrol taluka has highest Un-irrigated area which is 58% of total geographical area.

Table-5 Land use classification of Junagadh district & its percentage

Districts	Junagadh	
	Land use Pattern ('00 ha)	% of different categories of land use
Total geographical area	10,607	
Reported area	10,560	
Forest	1,993	18.90
Barren and un Cultutable waste land	310	2.90
Land put to non-agricultural uses	524	5.00
Permanent pasture and Grazing lands	1,114	10.50
Culturable waste	122	1.20
Current fallow	821	7.80
Other fallow	1	0.00
Net sown area	5,675	53.70
Area sown more than once	967	9.20
Gross sown area	6,642	62.90
Crop intensity percent		117.00

9. The natural resources

9.1 Soils

Almost entire coastal tract of Junagadh district is having sandy soils with deep to moderate depth. The deep soils have high productivity whereas sporadic patches running parallel to the coastline have moderate depth and productivity. The land close to coast and parallel to the coastline has low productivity. The soils in coastal Junagadh is highly permeable and hence useful for recharging the over exploited ground water resources.

The saline soils are characterized by medium soil texture, acidic in nature with deep water levels. The soils in Una and Kodinar are acidic in nature. These soils become sticky when wet and becomes hard when it becomes dry. The reclamation of these soils demands use of gypsum and soil conditioners. The saline soils found in Veraval and Mangrol taluka are saline in nature with low sodium absorption which can be reclaimed using low investment.

Table-6 Soil characteristic in coastal taluka in Junagadh district

Taluka	Conductivity (DC/m)	Alkalinity No.	Sodium absorption %
Una	3.6-10.00	8.2-9.9	5.3-46.5
Kodinar	0.1-16.5	7.9-8.0	11.7-63.4
Veraval	5.6-14.00	8.1-8.9	3.3-14.6
Mangrol	7.9-21.00	8.0-8.3	3.3-19.0

The soils in GAU, Arnej center in Kodinar shows that soil profile from 0-90 cm have water content of 17.5 % indicating suitable soil moisture condition for the growth of all variety of plants.

Table: 7 Depth wise available water content (%) in the soils of different stations (clay content < 30%)

Locations	kPa used as FC	Depth (cm)				Clay (%)	Textural class
		0-15	15-30	30-60	60-90		
Arnej	30	17.4	17.5	17.6	17.5	23.70	Loam

(Source - Zalawadia et al. 1999)

9.2 Ground water

The ground water is available freely in the coastal area, however, the over use of ground water has converted ground water resource saline. The easy availability of groundwater has promoted large number of shallow wells all along the coastal tract in Junagadh. Coastal area in Junagadh has recorded highest number of wells among the coastal district covered under the present survey. The coastal area has aquifers of miliolitics limestone which are highly porous formation and hence pumping ground water has given way to sea water ingress all along the coastline. The aquifers below 40 feet yield saline water due which the ground water recharge using rainwater becomes saline.

As shown in table-8 below, the ground water is the major source of water in the coastal talukas. The ground water is available with ease due to lower ground water levels in phreatic aquifers found in miliolitics limestone, however the ground water in aquifer below 30 m are saline in nature and are of no use. The upper aquifers yielding fresh water are exploited to its maximum potential in coastal areas converting the entire ground water resource saline due to encounter of saline water in deeper aquifers.

Table – 8 Taluka wise ground water balance in coastal Junagadh

Ground water in MCM						
Taluka	Gross recharge	Utilizable	Total draft	Balance	Level of ground water development (%)	Category
Mangrol	68.93	55.14	49.67	5.47	90.07	Dark
Maliya	74.05	59.24	51.23	8.01	86.48	Gray
Veraval/ Sutrapada	84.23	67.38	52.88	14.5	78.48	Gray
Kodinar	103.26	82.61	131.51	-48.9	159.2	Over exploited
Una	154.9	123.88	80.46	43.42	64.95	White

(Source – GWRDC, taluka ground water assessment 1997)

The taluka level ground water balance data in 1997 shows that ground water is in critical situation in Kodinar and Mangrol taluka where the ground water development reached 159% and 90% respectively. The situation has reached to this critical level mainly due to heavy water use in agriculture due to water intensive cropping pattern. In Kodinar, sugarcane and horticulture crops are main reasons for high water demand in agriculture.

Table- 9 Number of tube wells and dug wells in operation in Junagadh district (2003)

Number of Tube wells		No. of dug wells for irrigation purpose			No. dug well used for domestic purposes only	No. of wells not in use	Total No. of wells including Tube well	No. of Oil engines for irrigation	No. of electric motors used for irrigation purpose	Total No. of oil engines and electric motors for irrigation purposes
Public	Private	Masonry	Non-masonry	Total						
-	-	92,240	11,367	103,607	3,040	3,947	110,594	63,515	45,111	108,626

(Source: Statistical abstract of Gujarat State-2006)

The easy availability of ground water source during 80's and 90's led to development of large number of open wells followed by bore wells in coastal Junagadh. According to the farmers "earlier there were one well per 10 vighas, whereas today we have a well per every three vighas of agriculture land." The study area covering 23% of the geographical area of the district has 39,207 wells (more than 1/3rd of the total number of wells).

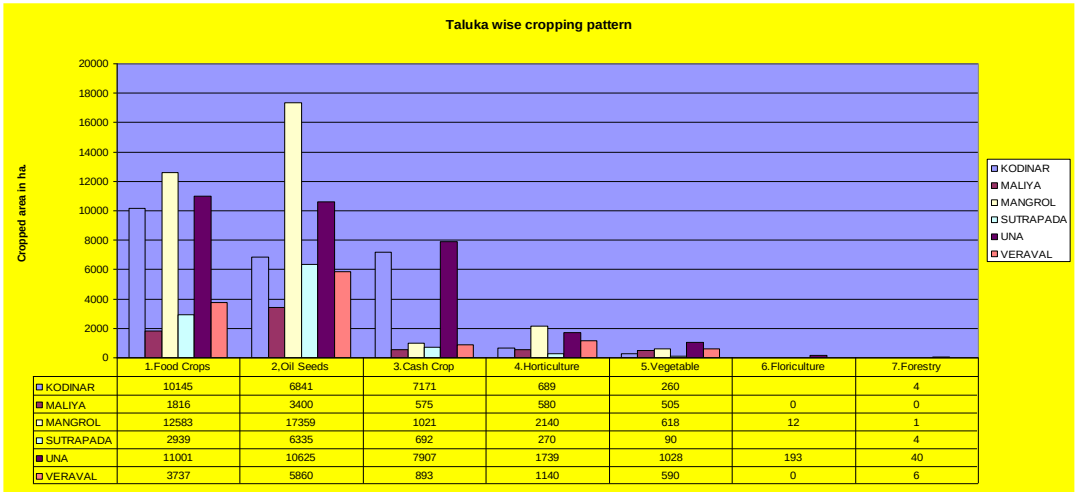
Table: 10 Irrigation source type in study villages in coastal talukas of Junagadh

Source of irrigation	Kodinar	Maliya	Mangrol	Sutrapada	Una	Veraval	Total
Bore wells	1,897	45	2,065	380	4121	175	8,683
Canals	11	2	84	1	1	4	103
Check dams	2		45	3	15		65
Open wells	4,465	6,982	5,352	4,621	4,236	4,868	30,524
Pond	8	8	17	2	12	9	56
River	18	4	24	242	142	734	1,164

10. Agriculture

The agriculture in coastal villages of Junagadh district is characterized by diversity. The majority of agriculture is rain-fed in nature supporting cultivation of food grains like Bajara and Jowar; oil seeds crops like ground nut, cotton and castor. The major irrigated crops include wheat, sugarcane, vegetables and horticulture. The agriculture is dominated by oil-seeds crops mainly ground nut and cotton. The study area has reported the highest amount of food grain cultivation in Una taluka. The Mangrol taluka dominates in oil seeds and horticulture among coastal talukas in Junagadh.

Graph-2 Cropping pattern in study area



	1.Food Crops	2,Oil Seeds	3.Cash Crop	4.Horticulture	5.Vegetable	6.Floriculture	7.Forestry
KODINAR	10145	6841	7171	689	260		4
MALIYA	1816	3400	575	580	505	0	0
MANGROL	12583	17359	1021	2140	618	12	1
SUTRAPADA	2939	6335	692	270	90		4
UNA	11001	10625	7907	1739	1028	193	40
VERAVAL	3737	5860	893	1140	590	0	6

11. Animal husbandry

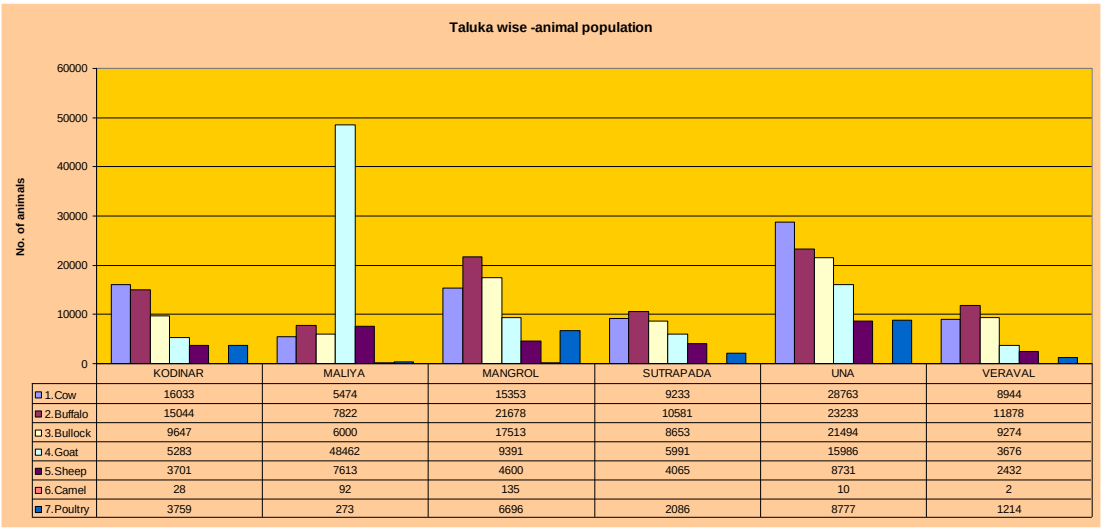
The animal husbandry is part of farming activity in Junagadh district. The information of animal population during 2000-2005 shows that at the district level cross breed cows are replacing indigenous cows and buffalo. The population of buffalos shows fluctuation with over all decreasing trend. This is mainly due to reduction in water and fodder availability. The population of small animals like goat and sheep has not changed over the past six-seven years. The poultry units have become more than double during 2004 to 2005.

Table- 11 Animal population in Junagadh district

Year	Cross Bred Cow (Nos.)		Indigenous Cow ('00 Nos.)		Buffalo ('00 Nos.)		Goat ('00 Nos.)		Total Sheep ('00 Nos.)	Poultry ('00 Nos.)		Total Layer ('00)
	Inmilk	Milch	Inmilk	Milch	Inmilk	Milch	Female	Total		Deshi	Improved	Nos.
2000-01	997	1,410	961	1,405	1,388	2,264	383	1,359	636	198	167	365
2001-02	1,254	1,729	838	1,295	1,351	2,008	605	1,343	592	202	64	266
2002-03	1,203	1,519	805	1,271	1,285	1,941	551	1,411	718	210	54	264
2003-04	1,153	1,473	822	1,214	1,235	1,802	545	1,236	557	161	0	161
2004-05	1,170	1,691	844	1,288	1,282	1,928	572	1,397	612	208	169	377

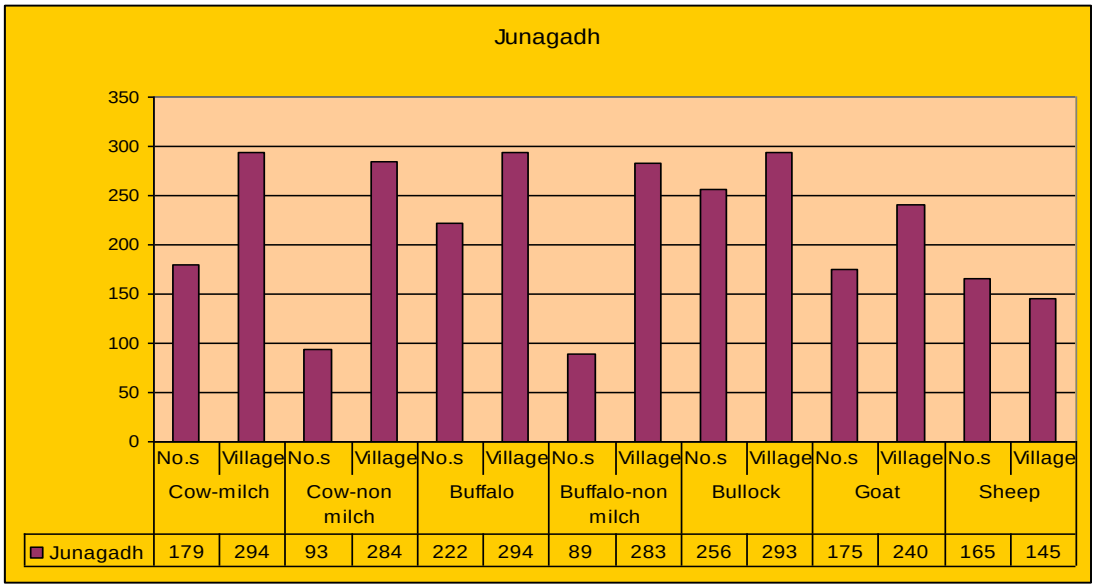
The study villages in coastal talukas show that population of buffalos is highest among the milch animals across all the talukas. The population of cows is decreasing gradually. The animal reaers prefer to rear local breeds like Kankarej cows and Jafrabadi buffalo.

Graph: 3 Taluka wise animal populations in study area



	KODINAR	MALIYA	MANGROL	SUTRAPADA	UNA	VERAVAL
1.Cow	16033	5474	15353	9233	28763	8944
2.Buffalo	15044	7822	21678	10581	23233	11878
3.Bullock	9647	6000	17513	8653	21494	9274
4.Goat	5283	48462	9391	5991	15986	3676
5.Sheep	3701	7613	4600	4065	8731	2432
6.Camel	28	92	135		10	2
7.Poultry	3759	273	6696	2086	8777	1214

Graph: 4 Average number of each type of major animals in study area



The average number of animals in the study villages is shown in graph above. The graph indicates that in coastal Junagadh, people prefer to keep only milch animals. The numbers of non-productive animals are less in the villages than the milch animals. Among the small animals, both goat and sheep are reared but gottary is found in more villages than the sheep.

The fodder requirement for the animals is met from the agriculture residues. It is found that the ground nut fodder is the most preferred green fodder in the coastal talukas and hence families having ground nut cultivation keeps more animals. The milk yield increases due to green fodder of ground nuts. In recent years the expansion of the SKDP network in the coastal villages of Junagadh has increased the scope of animal husbandry as an economic activity. The SKDP project has covered 644 villages out of the total 1,034 villages in Junagadh district. The dairy project is also helping in promotion of animal husbandry as an income generation activity among the families having small land holdings. The major constraint that people face in adopting animal husbandry is reduction in the availability of suitable fodder due to shift in cropping from the ground nut to cotton and castor crops and drinking water for the animals. However, field observation shows that the animal husbandry can be profitable venture by purchasing drinking water as well as fodder.

Table-12 Taluka wise seasonal variation in milk production

Block	Daily milk production in liter			% change in milk production		
	Winter	Summer	Monsoon	Winter	Summer	Monsoon
Kodinar	92,046	77,817	84,785	108.60	91.80	100
Maliya	7,750	5,948	6,641	116.70	89.60	100
Mangrol	408,527	273,122	271,735	150.30	100.50	100
Sutrapada	304,466	247,201	321,810	94.60	76.80	100
Una	48,835	31,128	44,524	109.70	69.90	100
Veraval	41,174	29,183	35,105	117.30	83.10	100
Grand Total	**902,798**	**664,399**	**764,600**	**118.10**	**86.90**	**100**

The milk production in the study villages shows variation across seasons, which is a major constraint for promotion of marketing of milk. The information collected from the villages indicates that the milk production goes down to 13% during summer and increase by 18% during winter season. This fluctuation is smaller as compare to other coastal areas covered in the study.

13. Fisheries

The Veraval is a main fish processing center in Junagadh district as well as in the state. Junagadh district is one of the important marine fish production center. Apart from Veraval, Kodinar, Una and Mangrol are having population of fishing community. There are about 13,964 persons engaged in fishing and fish processing activity. The fishermen from the district go for fishing activity in other centers like Porbandar, Okha and Salaya. Majority of fishermen get associated with the traders who own boats. The fishermen work with them on piece rate basis and hence bear risk to venture in deep sea in hard condition. The incidences of fishermen crossing international water boundaries are increasing. Dry fish production is a major income generation activities carried out in Mangrol, Mul-Dwarka, Saiyad-Rajapara and Nava Bandar villages of Junagadh district.

14. Irrigation

Junagadh district has total geographical area of 888,180 hectare out of which 66,731 hectare is cultivated area. The district has irrigation facility in 104,664 ha. The below graph shows that majority of the coastal villages have 18-37 % irrigation. The irrigated area in southern part of the coast covering villages of Una and Kodinar taluka have relatively better area under irrigation, but as one moves towards north, the irrigated area decreases. The ground water is a major source of irrigation with villages close to rivers using lift irrigation and canal irrigation.

About 30,147 ha land is irrigated by small structures developed by irrigation department of district panchayat. The department carries out small irrigation schemes through lift irrigation, percolation tanks, check dams and safe stage works. The department has two sub division in coastal area of which one covers Mangrol, Maliya and other covers Una, Veraval and Sutrapada Kodinar has separate sub-division.

Table-13 The department has developed following structures in the districts

Sr. no	Type of structures	No.	Area benefited	Expenditure
1	Small irrigation schemes	13	5,987.00	136.54
2	Percolation tanks	68	1,360.00	175.00
3	Safe stage work	261	5,220.00	681.50
4	Checkdam (under sardar jal snachay Yojana)	1,250	12,500.00	1,296.17
5	Check dam	508	5,080.00	
	Total	**2,100**	**3,884.45**	

(Source: Web site -District panchayat, Junagadh district)

In coastal villages, major irrigation infrastructure belongs to private sector i.e. farmers. The main source of irrigation is ground water wells which are owned mostly by the individual farmers. A scenario of one farmer having more than one source is common in Sutrapada, Kodinar, Mangrol and Veraval density of private structures along with water intensive cropping pattern nullifies the recharge efforts focused by the state government through various departmental schemes such as SIPC, Sardar Jal Sanchay Yojana and NGO.

Table- 14 Irrigation structures - Types and Numbers in study villages covered under Junagadh

Type	Unit	Kodinar	Maliya	Mangrol	Sutrapada	Una	Veraval	Total
Rivers	No. of village	20	12	20	16	35	66	169
Irrigation Ponds	Nos.	9	2	14	3	47	4	79
Village Ponds	Nos.	11	8	22	23	30	8	102
Farm Ponds	Nos.	9	17	86	131	30	78	351
Canals	Nos. of Village	9	5	154	1	7	32	208
Check Dams	Nos.	31	27	60	82	71	79	350
Bandharas	Nos.	6		48	0	0	8	66
Bore Wells	Nos.	19	323	38	463	210	281	1,334
Wells	Nos.	5,465	3,020	7,139	4,567	8,878	3,858	32,927

Apart from the private wells and bore wells, irrigation ponds, canals and farm ponds are also used as a source for irrigation. The check dam and Bandhara constructed by SIPC and other government programmes are also important source of irrigation. However, the surface water resources turn saline in period of six to eight months after storage and hence water can be utilized only for protective irrigation purposes.

14.1 Use of water saving devices

The Junagadh district has one of the highest numbers of water saving devices among coastal districts covered under the study. As per state government report, 2003, there were 7,020 sprinklers and 1,193 drip irrigation sets in the Junagadh district which are 31.76% and 18.57% of the total sprinklers and drip sets being used in coastal district covered under the present study. The number of farmers adopting water saving devices has increased after formation of GGRC in the state.

Table-15 District wise availability of water saving devices

District	Sprinkler set	Drip Set	Sprinkler set	Drip Set
	Nos.	Nos.	% of total in coastal dist.	% of total in coastal dist.
Kutch	405	385	1.83	5.99
Rajkot	5,092	2,600	23.04	40.47
Jamnagar	2,073	1,273	9.38	19.82
Porbandar	2,894	284	13.10	4.42
Junagadh	7,020	1,193	31.76	18.57
Amreli	4,616	689	20.89	10.73
Coastal dist	22,100	6,424	100	100

(Source: Statistical abstract Gujarat state 2006)

Table – 16 Progress of water saving device schemes by GGRC during 2007

District	Application received		Work order issued		Work completed	
	No.	Hectare	No.	Hectare	No.	Hectare
Junagadh	3,524	4,603	3,255	4,056	3,100	3,752
Total-Study Coastal district	6,357	9,148	5,461	7,413	5,341	7,242

(Source- Progress report-GGRC, web site)

The GGRC progress report for 2007 is indicative of the farmers' interest in water saving devices. The report shows that out of 6,357 applications received from the districts covered under the study, 3,524 were from Junagadh district. This shows that among the coastal district, the farmers from Junagadh are more inclined towards using water saving devices. Almost 90% of applicants have adopted water saving devices covering 3,752 hectare land in the district. The reason for popularity of water saving devices in Junagadh district is mainly due to lagers coverage of horticulture plantation in which farmers prefer to adopt drip irrigation system.

15. Drinking water

The ground water is a major source for drinking in entire taluka till arrival of water from Narmada based water supply scheme reached the district. At present the drinking water supply in the coastal talukas is fulfilled through group, individual and other (RO, Hand pump etc.) schemes. The new technological solution of RO is established in villages Bamanwada, in Mangrol taluka having no other suitable source. Almost 50% villages are covered under group water supply schemes based on the ground and surface water sources. 149 villages have individual source of water and remaining villages are going to be covered by RO systems and hand pumps. Since majority of water supply schemes are based on ground water source, the drinking water supply is facing problem of quality and quantity of water.

Table-17 Present situation of drinking water coverage in coastal Junagadh

Taluka	No. of villages	Covered under type of scheme			Total
		Group	Individual	Other	
Una	220	81	45	33	159
Sutrapada	47	26	17	4	47
Mangrol	63	41	21	1	63
Maliya	63	29	29	5	63
Kodinar	63	46	13	4	63
Veraval	55	27	24	1	52
	511*	250	149	48	447

* Inclues 61 un-in habitat villages in Una taluka.

Looking at the source, quality and quantity constraints, 129 problematic villages were covered under various reservoirs based water supply scheme under "Sagar Khedu" scheme for coastal area. These villages are receiving water from Machundri, Somat, Ojhat, Hiran and Narmada reservoirs. The state government has proposed 65 schemes at a cost of Rs.844 lakh of which 25 schemes are completed and remaining 40 are in process.

Table- 18 Taluka wise status of drinking water projects in coastal Junagadh area

Taluka	No. of villages	Sanctioned schemes		Completed		In process	
		Nos.	Cost	Nos.	Cost	Nos.	Cost
Mangrol	63	8	122.48	3	39.87	5	82.61
Maliya	63	22	160.95	9	38.07	13	122.88
Veraval	55	12	226.28	1	21.50	11	204.78
Sutrapada	47	10	213.36	4	89.97	6	123.39
Kodinar	63	11	98.75	8	41.70	3	57.05
Una	159	2	22.84	0	-	2	22.84
District Total	450	65	844.66	25	231.11	40	613.55

(Source: Drinking water security in coastal areas in Gujarat, Department of drinking water, Gujarat state)

Even with such voluminous efforts, the problem of drinking water in coastal villages is still not fully addressed. The study information reveals that part of the population is still facing acute shortage of quality drinking water. This population fetches drinking water from rivers, ponds and wells meant for irrigation. Many families in these villages have adopted roof rain water harvesting (RRWH) structures for drinking water security. Majority of them are located in Kodinar, Mangrol and Maliya taluka where NGOs including AKRSP and ACF are involved.

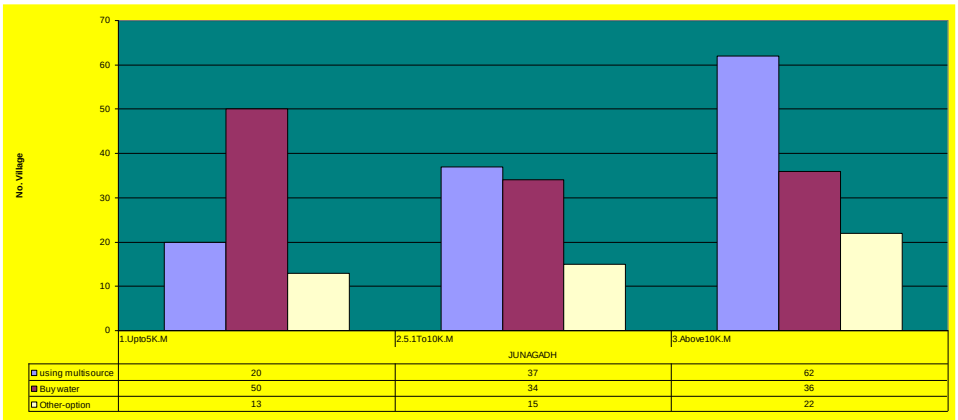
Table-19 Taluka wise number of Sources used for drinking water in coastal Junagadh

Source	Kodinar	Maliya	Mangrol	Sutrapada	Una	Veraval	Grand Total
Rivers	21	7	21	21	30	13	113
Ponds	24	22	51	23	46	11	177
Open Wells	5,030	38	4,305	1,829	4,006	1,100	16,308
Tube Wells	12		12	17	146	157	344
Hand pumps	277	486	508	148	132	202	1,753
Pipeline	54	17	19	46	96	25	257
Rainy Water Tanks	1,176	639	1,254	90	78	161	2,298
Tanker	17	5	18	5	32	15	92

(Source: Village Baseline survey, 2007)

Out of 297 village records, 108 villages still have to collect drinking water from 1 to 10 Km. distance during part of a year. In Una taluka, 41 villages out of 84 surveyed villages have to fetch water from a distance ranging from 1 to 15 Km. Similar situation is faced by villagers in Sutrapada taluka having 36 villages having no local source. Nearly 1/3rd (92 villages) are using tanker water supply during a year.

Graph-5 Mitigation measures adopted for drinking water



The drinking water situation is equally bad across all the study villages irrespective of the location of the village from the coastline. Out of 297 villages covered under the study 119 villages are using more than one source for drinking water. The drinking water markets are operative in 120 villages where people purchase drinking water. The percentage of villages purchasing drinking water is more in radius of 5 Km from the coastline.

16. Sanitation

The villages covered under the study have poor sanitation infrastructure situation contributing towards personal and public hygiene conditions. The survey analysis shows that the public amenities such as stand-posts, toilets and drainage systems are not available in majority of villages. The proper drainage system is available only in 18 villages most of which are in large villages belonging to Kodinar, Una and Veraval talukas.

Table- 20 Number of villages having primary amenities required for sanitation and good living condition

Facility	Kodinar	Maliya	Mangrol	Sutrapada	Una	Veraval	Grand Total
Stand Post	20	13	28	25	44	21	151
Public Toilets	7	5	24	14	18	9	77
Bath Room	9	5	17	15	18	10	74
Drainage System	6	1	1		6	4	18
Soak Pits	23	6	16	11	27	6	89
Internal Road	34	24	47	32	67	34	238
Crematoriums	18	20	58	19	60	27	202
Burial Grounds	13	9	25	10	19	13	89

17. Villages Institutions

The coastal villages have institutions meant for social cohesiveness, economic activities, providing services and environmental groups. These institutions are promoted by NGOs, DRDA, communities and religious groups. The presence of AKRSP, ACF has promoted village institutes which are conducting activities for environmental and economic activities. The baseline survey analysis shows that Youth groups and watershed committees are available in majority of villages. 51 villages have irrigation co-operatives. The highest number of community groups is found in Una taluka followed by Veraval and Kodinar talukas.

Table-21 Numbers and types of Village level institutions in coastal taluka

Organization type	Kodinar	Maliya	Mangrol	Sutrapada	Una	Veraval	Grand Total
SHG	5	6	20	19	28	43	121
Irrigation Cooperative	21	4	2	2	17	5	51
Water Committee	12	13	19	17	80	12	153
Satsang Mandal	32	7	20	8	19	41	127
Yuvak Mandal	45	25	40	29	46	58	243
Caste Mandal	30	12	25	23	31	12	133
Total	**145**	**67**	**126**	**98**	**221**	**171**	**828**

The recent initiatives of drinking water and dairy have added *Pani Samitis* and milk producers groups in village level institutions. Both of these village institutions are important to address the salinity in the coastal area. The milk producers groups promoted by Saurashtra Kutch Dairy Project (SKDP) are very popular in the coastal villages. The dairy network has covered 142 villages (47% of the villages) covered under the present study. The milk producers groups in Kodinar, Sutrapada and Maliya have covered more than 70% of the villages which have been covered in study.

Table – 22 Numbers of villages having milk co-operatives

Taluka	Village covered in study	No. of villages having Milk co-operatives	% of covered villages
Una	82	27	32.93
Kodinar	44	35	79.55
Sutrapada	44	34	77.27
Veraval	42	7	16.67
Mangrol	59	21	35.59
Maliya	26	18	69.23
Total	**297**	**142**	**47.81**

The other major initiative for drinking water promoted by WASMO includes establishment of water committees (*Pani Samitis)* at village level. These *Samitis* are designed to address the drinking water needs of people at village level. 151 villages have Pani Samitis. Una and Veraval talukas have more than 60% villages with *Pani Samitis*. These *Pani Samitis* are important institutional resource for addressing drinking water management at village level.

Table – 23 Number of villages having milk co-operative societies

Taluka	Villages covered in study	No. of villages having Milk co-operatives	% of covered villages
Una	82	56	68.29
Kodinar	44	13	29.55
Sutrapada	44	21	47.73
Veraval	42	26	61.90
Mangrol	59	21	35.59
Maliya	26	14	53.85
Total	**297**	**151**	**50.84**

Apart from the community based organizations (CBOs), the coastal areas have presence of Non-Governmental organization (NGOs). The note worthy are AKRSP and ACF, both the NGOs have their focus on salinity in coastal areas. They are major players in addressing salinity in coastal Junagadh. In addition to these organizations, NGO "*Protsahan*" and JANPATH have networks working with fishing communities. The cement and other industries have their own CSR project activities. This includes Siddhi Cement in Sutrapada and Indian Rayon in Veraval taluka.

18. Salinity problem

The Junagadh district is considered as the first district that had reported salinity ingress on the Gujarat coast. The coastal area of Junagadh has history of salinity ingress history of more than 40 years. A farmer in village *Panadara* in Kodinar taluka recalled that salinity

impact was first recorded in his village in year 1967. According to families living in the villages in coastal area, even though the salinity was exisisting since last 40 years, the impact of salinity ingress has increased during last two decade. The salinity is reported in both water and soil. At present the salinity problem is extended in 226 villages spread at an average distance of 15-20 Km from the coastline. According to the coastal communities, 69 villages feel that though their villages are considered having salinity problem villages, the villagers are not feeling its impact on their livelihood or health at large. The numbers of villages reporting no impact of salinity are from Veraval, Kodinar, Maliya and Una taluka. The least number of villages reporting no impact of salinity are found in Mangrol and Sutrapada talukas.

Table-24 Perceptions of local people about salinity problem in study villages

Taluka	Salinity existence				Total study villages
	Yes		No		
	No. of village	% of total	No. of village	% of total	
Una	66	78.6	18	21.4	84
Kodinar	30	65.2	16	34.8	46
Sutrapada	37	84.1	7	15.9	44
Veraval	24	57.1	18	42.9	42
Maliya	20	76.9	6	23.1	26
Mangrol	55	93.2	4	6.8	59
Total	**226**	**77.1**	**69**	**22.9**	**297**

Almost all villages along the coastline are affected by severe salinity in soil and water. Majority of villages located between 10 and 20 Km from the coastline have also started facing salinity problem since last 5 years.

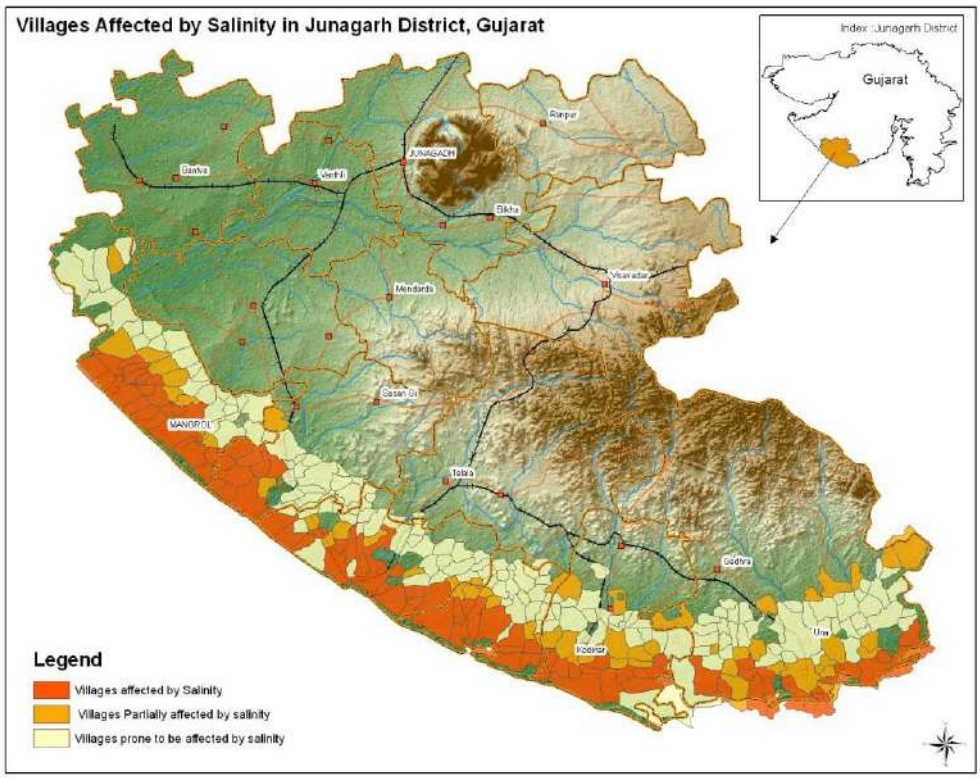


Table-25 Number and percentage of villages affected by salinity levels in study area

Details	Taluka	Salinity category			
		Fully saline	Partial saline	Probable	Total
No. of villages	Una	19	21	46	86
% of total villages		22.09	24.42	53.49	100
No. of villages	Kodinar	14	10	22	46
% of total villages		30.43	21.74	47.83	100
No. of villages	Veraval/Sutrapada	27	11	47	85
% of total villages		31.76	12.94	55.29	100
No. of villages	Mangrol	22	9	29	60
% of total villages		36.67	15.00	48.33	100
No. of villages	Maliya	10	2	14	26
% of total villages		38.46	7.69	53.85	100
	Total-Junagadh	92	53	158	303
		30.36	17.49	52.15	100

The above table-25 shows that overall, 30% of the total villages in the study area are facing severe salinity problem. Most of these villages are located in Veraval and Mangrol talukas. The highest numbers of villages which are on verge of facing salinity problem are found in Una and Veraval talukas.

19. Reasons for salinity

The causes of salinity ingress are multiple, with increase in ground draft is being the major contributing factor in all the coastal talukas in Junagadh district. Apart from over use of ground water resources, sand mining from the river bed and coastal region is another contributing factor. In coastal region from Kodinar to Veraval, the soil salinity is increasing mainly due to saline winds, which directly hit the land. Though mining is considered as one of the major reasons for invasion of sea water in the wells, people do not see it as a major contributor towards increasing salinity.

20. Impact of salinity

The salinity in coastal Junagadh district is affecting nearly 6 lakh people of 128,000 households. Majority of affected families belong to Kolis, Ahirs, Muslims, Karaldias, Rajputs belong to OBC categories.

The major social impacts felt in terms of

- The wage employment from agriculture sector has reduced forcing large number of families to opt for non-agriculture livelihood.
- Reduction in interest in agriculture and animal husbandry.
- Migration has become a regular feature particularly from coastal talukas of Una, Kodinar.
- Health problems - Kidney stones and Florosis in some villages of Una and Kodinar.

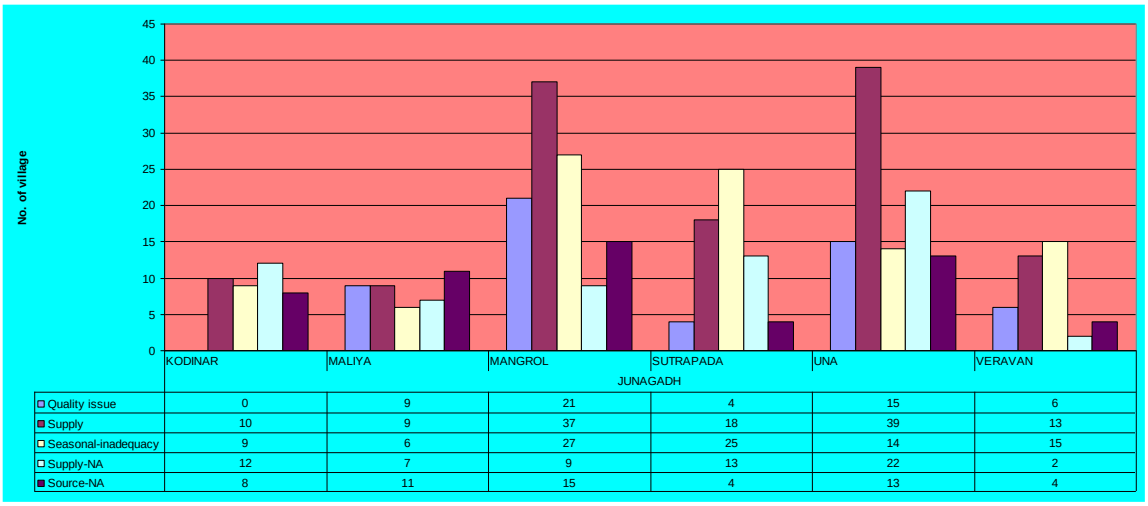
- The growth of industries and reduced income from agriculture is resulting in sales of agriculture land among small and marginal land holders.
- There is a reduction in family level income among marginal families, which is posing pressure on youth for earning. The education is seen as an investment, but the families living in coastal villages do not have capacity to bear the expenditure to educate their children beyond education facility available in the village or in close vicinity.

The salinity ingress has major impact on drinking water resources, agriculture and animal husbandry. Among the 297 villages covered under the study 172 villages have reported impact on agriculture, followed by 148 villages reporting impact on drinking water source and 121 villages on animal husbandry.

20.1 Impacts on Drinking water

One of the major impacts of salinity is felt on availability and quality of drinking water. The salinity ingress has affected the quality of local sources of drinking water used for drinking purpose by the costal communities. The villages in Mangrol taluka have highest impact on the drinking water resources. The survey has come across 65 villages reporting no supply from the existing arrangement and 55 villages having no local dependable source for drinking water. The drinking water quality shows seasonal variation. As summer approach drinking water source become saline and hence people satisfy their drinking water demand using more than one source. It is found that RRWH is one of the best models of decentralized drinking water management system in the coastal area.

Graph-6 Taluka wise number of villages facing various drinking water problem



	KODINAR	MALIYA	MANGROL	SUTRAPADA	UNA	VERAVAN
Quality issue	0	9	21	4	15	6
Supply	10	9	37	18	39	13
Seasonal-inadequacy	9	6	27	25	14	15
Supply-NA	12	7	9	13	22	2
Source-NA	8	11	15	4	13	4

20.2 Impacts on Agriculture

The salinity ingress has major impact on agriculture sector. The increase in level of salinity in water and soil has resulted in change the cropping pattern drastically. The area under horticulture is reducing gradually, no new plantation of mangoes and coconut is carried out by the farmers. The farmers having mango orchids are facing major challenge to their plantation since irrigating mango orchid. Use of saline water affects the production in terms of quality as well as quantity.

The cultivated area of pulses has reduced in coastal areas. The ground nut, one of the major crops is being replaced by cotton which is known for its salt tolerance capacity.

The increase in salinity has impacted agriculture by

1. Reduction in crop productivity.
2. Increase in input cost and agriculture operation cost.
3. Affect quality of the agriculture produce.
4. Reduce area under horticulture, pulses and ground nut crop.
5. Use of saline water has turned soil saline.

In absence of fresh water, farmers growing cotton, castor and wheat use saline water for irrigation which increases salinity in soil. As a result the farmers require higher inputs for growing crops in next agriculture season.

The salinity is one of the major reasons for change in cropping pattern in the coastal villages. The change in crops observed through survey findings is given in table 26. The finding indicates that changes in crop have occurred in 154 villages out of 297 villages covered in Junagadh district. These villages are equally spread across all distance categories from the coastline. The food and cash crop change is occurring in 112 villages. The maximum number of villages where crop change is observed is located within 5 Km from the coast line. In case of horticulture, crop change is found in villages located within 10 Km distance.

In case of food crops, the farmers have reported shift from pulses, wheat, Bajara and Tal to Jowar, cotton and castor crops. On other hand, the cash crop of ground nut is reducing and replaced by cotton and castor crops. Sugar cane which is a major cash crop in Kodinar, Una and Veraval is now restricted to the pockets having assured irrigation water facilities. The horticulture crop of mango and coconut is replaced by chickoo, Sitafal and Pomegranate plantation.

Table -26 Numbers of Villages observing crop change due to salinity in study area

Description	Village distance from the coast line			
	> 5 Km	5 to10K.M	< 10 Km	Total
No. of villages	49	48	57	154
Area of village	122,575	111,919	136,562	371,056
village Nos.- change food crops	33	39	39	111
Village Nos.- change cash Crops	42	20	50	112
Village Nos.- change horticulture	16	12	6	34

Table: 27 Comparison of productivity of crops

Crop	Unit	Standard rate of production	Junagadh
Groundnut	Kg/ha	1800-2200	1500-2500
Wheat	Kg/ha	4000-5000	2600
Cotton	Kg/ha	2500-4000	2500-3000
Castor	Kg/ha	2500-4000	3000
Bajari	Kg/ha	2000-2500	800-2500
Jowar	Kg/ha	1500-2000	1000-1200
Sugarcane	Ton/ha	100-120	35-220
Til	Kg/ha	400-800	1600
Jiru	Kg/ha	700-800	200-250
Guwar	Kg/ha	1500-2000	NA
Moong	Kg/ha	850-1400	1800-2000
Kharek	Kg/ha		NA
Coconut	No./ha	10000-12000	3000-7000
Mango	No./ha	8000-10000	4000-10000
Chickoo	Kg/ha	12000-15000	8000-10000

(Source: Standard rates – Based on Khedut Margadarshika, Junagadh Krishi University, Junagadh & village base line survey, 2007)

The above table shows that the crop production rates in coastal villages of Junagadh district with that of standard production rates. The table shows that the production of wheat, coconut, chickoo, Jiru, Jowar is lower than the standards in these villages. The production rate of the ground nut and cotton which cover major cropped area shows wide variation within villages. It also shows that cultivating food grain crops is non-viable in the salinity affected villages. In these villages, farmers are cultivating Jowar as a fodder crops, however the production rates are lower than the standard rates. This can be taken up as a research issue for promotion of animal husbandry.

Escalation of Input cost

The farming on saline land or using saline water requires higher inputs as compare to the normal land. For cultivating any crop, the farmers in coastal villages have to use more seeds, irrigation and manure/fertilizer. The farmers require 25-50% more seeds and have to provide five – six extra irrigations.

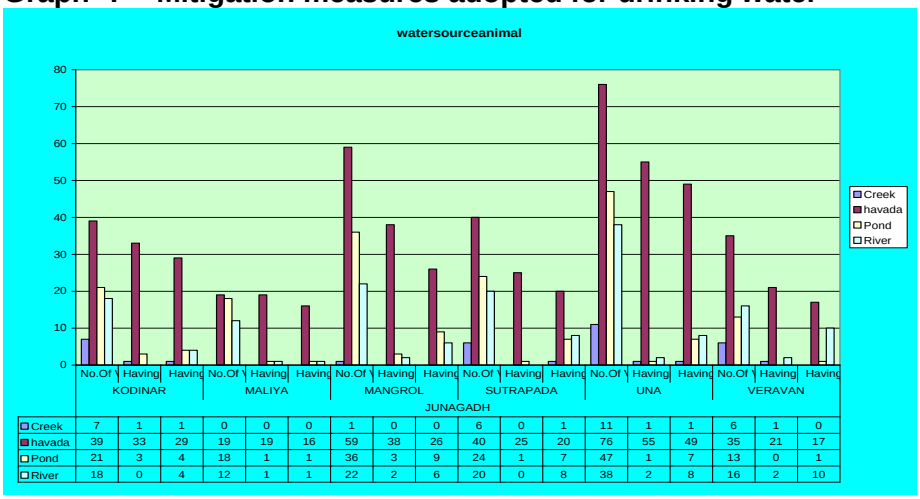
20.3 Impact on animal Husbandry

Over a period of last two decades, the activity of animal husbandry has reduced in the coastal villages. The number of milch animals per family has reduced from 10-12 animals 20 years back to two-three animals at present. The milk production capacity of the animals has reduces due to reduction in availability of green fodder from the agriculture. The animal health is a major concern that animal rearer face due to saline climate. The saline fodder and water weaken the digestive system of milch animals. The farmers shared that animal yielding 15-20 liter milk in north Gujarat, produce less than 10 liter milk per day in coastal villages. In many cases animals brought from outside the area die within three to five years in coastal area.

Non-availability of water for cattle

The quality of drinking water is one of the main impacts of salinity on the livestock rearing. Though all villages have infrastructure like cattle troughs for providing water to the animals, the availability of water is a major constraint faced by the livestock rearers. In such situation the animals are fed using various sources like ponds, creeks and rivers. Since water in these sources is available during limited period, the water for animal remains a major problem in coastal villages. The graph below shows taluka wise number of villages using different sources for cattle water needs and its seasonality.

Graph- 7 Mitigation measures adopted for drinking water



	KODINAR			MALIYA			MANGROL			SUTRAPADA			UNA			VERAVAN		
Creek	7	1	1	0	0	0	1	0	0	6	0	1	11	1	1	6	1	0
havada	39	33	29	19	19	16	59	38	26	40	25	20	76	55	49	35	21	17
Pond	21	3	4	18	1	1	36	3	9	24	1	7	47	1	7	13	0	1
River	18	0	4	12	1	1	22	2	6	20	0	8	38	2	8	16	2	10

Increase in Input cost

While on one hand, the health and production capacity of the animals is decreasing, the input cost for the livestock rearing is increasing due to reduction in availability of fodder from the agriculture and purchase of water for cattle. According to village survey an average expenditure of Rs. 500 to Rs.1700 is incurred towards green fodder and feed per animal/per month. The expenditure is highest in Una taluka and lowest in Sutrapada taluka.

20.4 Impact on Health

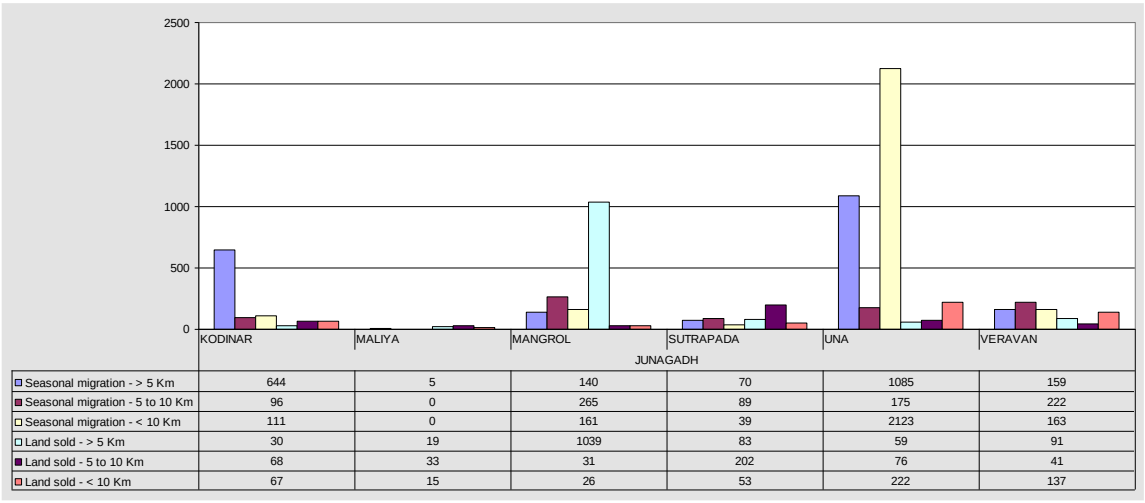
The coastal communities suffer from various health problems as a result of poor quality of drinking water and use of saline water. The diseases like stone in kidney, florosis, skin and gastric diseases are common in coastal villages. These diseases are found across all the villages covered under the study. Among them water born diseases, florosis and gastric problems dominates across all villages. The village survey analysis shows that Una and Mangrol taluka are the most affected talukas from the point of view health problems.

20.5 Impact on Economy

The salinity impact on economic situation of the coastal area is visible in terms of number of bank defaulter, migration and farmers selling their land. The increasing salinity has reduced the productivity of land, forcing farmers in to debt trap as well as selling their land. According to survey analysis, the study villages have more than 20,000 bank defaulters. Nearly 50% of them are from villages in Mangrol and Una talukas. Nearly 2,300 farmers have sold their land in these villages.

The lack of work opportunity is increasing migration from the coastal areas in Junagadh district. The migration is common among the small and marginal farmers and fishing community, who are affected by the salinity ingress. The survey estimated 5,500 persons choosing seasonal migration to other areas. The fishermen from Una, Kodinar migrates to Porbandar and Jamnagar in search of work with the fishermen doing deep sea fishing. The farmers from the same taluka having skills of horticulture migrate to other parts of Junagadh district having mangoes and chickoo plantation as a share cropper.

Graph- 8 Migration and land selling phenomenon in study villages according to distance from coastline



	KODINAR	MALIYA	MANGROL	SUTRAPADA	UNA	VERAVAN
Seasonal migration - > 5 Km	644	5	140	70	1085	159
Seasonal migration - 5 to 10 Km	96	0	265	89	175	222
Seasonal migration - < 10 Km	111	0	161	39	2123	163
Land sold - > 5 Km	30	19	1039	83	59	91
Land sold - 5 to 10 Km	68	33	31	202	76	41
Land sold - < 10 Km	67	15	26	53	222	137

Table-28 Details of banking and economic activities in coastal Junagadh taluka.

Description	Kodinar	MALIYA	MANGROL	SUTRAPADA	UNA	Veraval	Total
Bank creditor	6438	1098	5791	3634	5949	2412	25322
Motor Boat-Fisherman	150	0		257	20		427
Conventional Boat-Fisherman	250	0		329			579
Cottage Industry		6	7			7	20
Bank defaulters	2059	1755	5887	2293	5584	2522	20100
Bank-Depositor	18306	843	6084	1238	3420	1562	31453
Agri. Loan	2650	2789	4748	2729	4121	2034	19071
Animal Loan	310	247	443	239	295	236	1770
Fisheries Loan	10	0	350	55			415
Seasonal Migration	851	5	566	198	3383	544	5547
Land Selling Farmers	165	67	1096	338	357	269	2292
Land Purchaser Farmer	166	71	88	196	308	233	1062

21. Major initiatives

As mentioned earlier, the salinity problem in coastal area in Junagadh is existing since last 40 years and hence the communities, NGOs, state department and corporate are trying to solve the problem. Some of the important initiatives taken up to address salinity are described below.

By Government department

The state government recognized the salinity problem and initiated the Salinity Ingress Prevention Cell within irrigation department to prevent salinity in the region based on recommendations given by the high level committee (HLC-I).

The cell activity focus on

1. Management which includes addressing change in cropping and agriculture practices.
2. Change in ground water use practices
3. Recharge techniques
4. Salinity control techniques
5. Coastal land reclamation techniques.

Out of five identified activities, the cell is mainly promoting recharge and salinity control techniques in Junagadh district. The cell has constructed tidal regulators.

- By irrigation department (SIPC)-preventive structures
- By WASMO-drinking water pipeline & local resource enhancement
- Watershed projects in Veraval & Sutrapada
- Promotion of water saving device by GGRC
- Subsidies schemes for fishermen.
- NDDB is promoting milk marketing services.

By Non-Government Organisations

- Awareness about water conservation and mining activity
- Drinking water source enhancement
- Innovative practices for livelihood
- Demonstrations of people oriented technologies
- Promotion of organic farming & drip systems.
- Water harvesting, promotion of alternative cropping
- Sealing of saline well
- Private companies for seeds, pesticides provide input as well as crop advices. (e.g. Rallis)
- River/canal linking project carried out by ACF in Kodinar and Sutrapada.
- Revival of river Meghal through watershed approach by AKRSP

Notable work has been done by AKRSP and ACF the NGOs are addressing salinity issue through Kharash Vistarotthan Yojana in Junagadh district. AKRSP is addressing the salinity issue through cluster development approach-wherein, the people in clusters of villages facing salinity issues are organized under SHG, user groups, Pani Samitis and income generation activities. The important activities adopted for addressing salinity, include promotion of drip irrigation, water management, crop change in agriculture. The activity of sealing of wells has become popular among the farmers facing salinity problem in Mangrol, Maliya and Veraval talukas.

The women participation in the programme is ensured through addressing common issue of drinking water across entire coastal region. It is carried out on the basis of decentralized drinking water planning and management. The organization has constructed and promoted roof rain water harvesting (RRWH) structures among the families facing acute drinking water problem.

ACF has played pivotal role in promotion of river linking concept in the coastal Junagadh area along with the state irrigation department. The results of pilot project have encouraged, the NGO to adopt the river linking project as one of the major program in the coastal Junagadh.

By individual (farmers)

- Adoption of less water intensive cropping
- Rain water harvesting-well recharge, RRWH
- Farm Bunds
- Use of gypsum
- Sealing of saline well

22. Opportunities and scope of work

Water management

- Generally, the land in coastal Junagadh is sloping towards sea. This provides opportunity for constructing check dams to harvest rain water.
- The numerous streams flowing between Una and Sutrapada provide potential for construction of canals inter-linking rivers at proper distance. The experience of Ambuja Cement Foundation (ACF) indicate that the technique is effective in curbing further movement of salinity as well as water harvesting to recharge the coastal aquifers.

- The inter linkage of rivers between Jamwala to Bhebhagam salinity control structures will enable prevention of salinity in coastal villages of Una taluka.
- The propagation of drip irrigation system requires awareness building and efforts to bring down the cost affordable by small and marginal land holders. Since the land in Junagadh district is highly fragmented, it will need mass awareness programme for promotion of drip irrigation among more than 75,000 farmers. Since the crops grown here also include horticulture and field crops like ground nut, the drip irrigation can be more effective in reducing water use in agriculture.
- The experience of farmers using drip irrigation shows that the use of drip irrigation not only reduces input cost and saving of water but also helps in improving the quality of horticulture produce.
- The watershed development work has been carried out in many coastal villages. These villages should be adopted on the basis on cluster development approach for addressing water management, cropping pattern and value addition and processing activity infrastructure.
- The sub surface stratum in Mangrol, Maliya and Veraval talukas is limestone having recharge potential. However, the ground water is saline with variation in depth. In this area, wells encountering saline water strata needs to be sealed to avoid deterioration of quality of well water. The well sealing activity carried out by ACF in Kodinar and AKRSP in Mangrol has received good response from the farmers. This demands scientific mapping of layers of saline water.
- The salinity prevention cell, is constructing garland canal linking rivers from Porbandar to Una to prevent salinity. The objective of creating canal is to restrict sea water by creating water pressure wall.
- It is found that majority of villages have ground water as a main drinking water source. Since ground water is facing severe quality constraint, roof rain harvesting structures can be a feasible option for drinking water security.
- The saline winds are one of the contributing factors in the coastal villages of Mangrol, Veraval, Sutrapada and Kodinar talukas. The observations indicate that saline winds burn the standing crops of groundnut. The problem can be solved by creating live hedge of vegetation by forest department in Mangrol and Maliya talukas like the one created in Kodinar and Sutrapada talukas.
- The present approach of water management in coastal area is restricted to generating additional water resources using various water harvesting methods. This has resulted in increase in water resources in the coastal area. This can only help in preventing salinity if community adopts efficient system of water use and its management. It is evident that this is possible by policy change. It is observed that the farmers who were irrigating field when ever power supply is available are getting same production after restricting power supply to eight hours. A systematic study should be conducted to know the impact of policy change on agriculture production and water conservation. This can provide future direction for promotion of cropping pattern in saline villages.
- The land management and well/bore sealing programme carried out by AKRSP and ACF is found to be effective in preventing further salinity in soil. These activities need to be scaled up in larger area address the salinity issue in Junagadh district.
- The drip irrigation system promoted by AKRSP and VRTI in Junagadh and Kutch region proved effective to sustain economics of agriculture in saline area. The farmers in salinity affected Dari village of Veraval taluka are cultivating banana using drip irrigation system. In the village, farmers whose water sources are affected by salinity, purchase water tanker and use it for irrigating banana with the help of drip systems. The Gujarat Green Revolution Company (GGRC) promoting drip irrigation systems in the state provides a major opportunity for saline area. However, the feedback of drip irrigation system users

indicate that the drip is economically viable for large land holders where as the small land holders are still not able to adopt it due to high initial investment.

- The experiments of combination of drip irrigation and mulching (organic material carried out by one of the farmer Mr. Nazibhai in village Kukasvada, taluka Maliya shown good result for preventing impact of salinity on horticulture plantation. Such activities need to be promoted in villages having horticulture plantation across coastal Junagadh.
- The use of vermin-compost should be promoted to reduce salinity in soil.
- The marginal lands in coastal region have potential of cultivating bio-fuel plantation. The local branch of Dena Bank in Mangrol is willing to finance such projects.
- The clogging of micro tubes is a major constrain for adopting drip irrigation in saline areas. This can be avoided by promotion of acid treatment.
- The study team has come across a magnate based technology for farming using saline water. The product named 'Sada-hara' is widely used by farmers in village Jarapara and Kandhagra in Mundra taluka. This technology along with drip irrigation can be helpful in the villages having saline ground water.

Animal Husbandry

- Animal Husbandry is a traditional skill of the coastal communities living in Junagadh. The establishment of dairy network of MPI under Junagadh dairy has once again brought rays of hopes for coastal communities involved in livestock rearing. Two basic requirements for promotion of animal husbandry in this area is 1) provision of water needs of animals and 2) infrastructure for veterinary services. This can boost the livestock rearing in entire Junagadh coast.
- The availability of large amount of grazing land in Una, Veraval and Kodinar can help in promotion of sheep and goat rearing which can survive under drought condition also.
- The "*Kesar*" mangoes from coastal Junagadh are known horticulture crop. There is a huge potential for promotion of value addition and processing infrastructure in Una, Kodinar and other talukas. The similar initiatives carried out in Kutch districts have yielded good results.

Fisheries

- Brackish water prawns cultivation can be developed in the region. At present it is cultivated in Ghoghala and Vanankbara. The muddy land on the sea coast in the villages like Manekpar, Vasod, Olvan, Paladi, Tad, Bhigarana, Kob and Chikhali provide sites feasible for prawns cultivation.
- The fishermen from Una migrates to fishing centers like Okha and Jakhau Bandar as there are not enough fish merchants in Una. An effort for financial linkages of the fishermen for purchasing boats can improve their condition and fishing business in the coastal village in Una taluka.
- The *Pagadia* fishermen need organized market and processing centers for sales of their produce. The villages Saiyad, Rajpara and Nava Bandar have potential for development of fishing activity.
- Fish nets are brought from Bombay and their price ranges from Rs. 30,000/- to Rs. 60,000/-. The fishermen, particularly women can be trained for making fishnets using raw materials providing income generation activities to fishing community.

Opprotunities in Kodinar, Sutrapada, Veraval villages

- The saline winds blowing from Arabian Sea hit the Kodinar and Sutrapada coast directly causing increase in soil salinity. This can be prevented by creating green fence of *Prospis Juliflora* and S*haru* in coastal land in region from Kodinar to Veraval. The major problem people face due to *Prospis Juliflora* is increase in population of *Nilgai* and wild pigs which destroy the agriculture. This is a major and cross cutting issue in coast area. However, linking *Prospis* plantation with income generation activities like production of laquer, cattle feed etc. This would also help in generating local employment.
- The cropping in coastal area is changing very fast. In salinity affected areas, groundnut - traditional crop is being replaced by cotton. The interaction with majority of farmers indicates that cotton is the most suitable crop for the region and its coverage is expected expand in future. In this context, local availability of cotton ginning factory in the region will promote cotton as well as it will encourage farmers to take proper measures like soil and water management.
- The area under horticulture crops like coconuts and mangoes is reducing in coastal area due to salinity problems resulting in reduction of income for the farmers. Many farmers have replaced coconut and mangoes plantation with Chikoo plants, however lack of market is restricting promotion of Chikoo plantation. The agriculture experts feel that dates being cultivated in Mundra and Mandvi talukas of Kutch are the most salinity resistant horticulture crop. The soil and water quality in coastal Junagadh is suitable for date farming.
- In many villages located on the coastline, availability of safe drinking water is a major problem leading to health and livelihood problems. The ground water in these villages is highly saline and hence can not be used for drinking purposes. In such areas roof rainwater harvesting (RRWH) and RO plants are the only solutions possible to address drinking water problem. Presently WASMO has started special RRWH and RO scheme for coastal villages.
- The research wing of Junagadh Agriculture University is trying to address salinity problem, using local resources. The University has recommended use of molasis (an acidic waste remaining after sugar production) for reclamation of saline land. In the project area sugar factory located at Kodinar has planned to do an experiment in village Panpadra. If the experiment is successful than more land reclamation can be possible.
- At present, the green fodder required for animals is available in areas having irrigation facility, while in remaining area cattle do not have green fodder. This results in reduction of milk production which is a major hurdle for establishing dairy in these areas. This demands awareness about fodder management practices through promotion of chaff cutter and silage practices.
- On one hand the fishery sector is growing fast and expected to grow further due to establishment of ports and other infrastructure in near future. On the other hand, reduction in fresh water availability is affecting the fish processing industries established in Jafrabad, Veraval, Porbandar and Okha. The use of saline water in fish processing unit reduces the shelf life of the products and also affects the shinning of the raw fish. As a result, the fish processing units from Veraval having competition from Tuticorin and other fisheries center in south receive lower returns. To overcome this problem the fisheries processing units association in Veraval have planned to establish RO Plant which will convert waste water in to reusable water. The water will be sold to the fish processing units at a cost. The president of fish processing association Mr. Chopadkar

expressed that the industry can recover the running cost and maintenance through proposed model.

- The horticulture in Junagadh has potential of establishing processing units for coconut and Sapota. At present, the green coconuts are transported from Mangrol, Veraval and Maliya talukas to other parts of the state and country. Establishment of processing unit can help in developing products which can be marketed easily. A processing unit established to develop coconut water as a health drink, is running successfully in Chorwad. The packaged coconut water is exported to Brazil and other countries.
- The Sapota (Chikoo) crop has proved successful under saline water and land conditions. In coastal Junagadh, many farmers having coconut and mango plantation have switched over to Sapota plantation. However, due to perishable nature and lack of markets the farmers are losing interest in the chickoo plantation. Many farmers who have failed to recover the production cost have removed Sapota plantation. Efforts should be made to convert fruits in to dry powder which can be marketed. Looking at the potential of Sapota plantation in saline area, such value addition processes can help farmer sustain their livelihoods.

ANNEXURES

Maps, Tables & Graphs

Annexure-1
Demographic details

Table-1: Study villages in district compare to study talukas and entire coastal area

		Junagadh	Total
Total Taluka	Area	313.062	2494.168
	No. Villages	511	1.873
	No. Household	207,943	827,328
	Population	1,265,909	4,511,161
	Population density	404	181
Total-study villages	Area	207,788	1267,241
	No. of Villages	297	998
	No. of households/families	112,403	330,227
	Total population	696,516	1829,241
	Population density	335	144
Study villages As % of study talukas	Area	66.37	50.81
	No. of Village	58.12	53.28
	Nos. of Household	54.05	39.91
	Population	55.02	40.55
Study villages As % of total study area	Area	16.33	50.81
	No. of Village	15.86	53.28
	Nos. of Household	34.59	39.91
	Population	34.44	40.55

Table-2: Gender wise demographic details

Block	Children	Female	Male	Grand Total
Kodinar	11,203	77,156	80,015	168,374
Maliya	12,920	34,464	36,532	83,916
Mangrol	16,421	56,683	61,793	134,897
Sutrapada	18,945	45,217	46,724	110,886
Una	30,044	77,176	84,349	191,569
Veraval	16,566	50,998	52,386	119,950
Grand Total	**106,099**	**341,694**	**361,799**	**809,592**

Table-3: Category wise population

Block	General	OBC	SC	ST	Grand Total
Kodinar	8,695	138,820	6,500	1,230	155,245
Maliya	7,029	67,609	5,425	2,714	82,777
Mangrol	11,420	85,402	28,179	3,260	128,261
Sutrapada	18,069	73,274	11,971	1,683	104,997
Una	32,436	138,374	31,997	598	203,405
Veraval	20,060	49,581	14,479	7,517	91,637
Grand Total	**97,709**	**553,060**	**98,551**	**17,002**	**766,322**

Table-4: Population living below poverty line

Distance from sea	General	Other	OBC	SC	ST	Total
5 to 10 Km	288	812	7,025	1,026	70	9,221
> 10 Km	642	1,457	7,433	861	6	10,399
<5 Km	1,353	1,794	5,756	1,101	298	10,302
Total	**2,283**	**4,063**	**20,214**	**2,988**	**374**	**29,922**
% of total	**7.63**	**13.58**	**67.56**	**9.99**	**1.25**	**26.62**

Table – 5 Locations of Villages

District	Block	Up to 5K.M	5.1 to10K.M	Above 10K.M	Total
Junagadh	Kodinar	11	13	20	44
	Maliya	6	9	11	26
	Mangrol	17	16	25	58
	Sutrapada	13	16	15	44
	Una	26	23	35	84
	Veraval	12	10	19	41
Junagadh Total		**85**	**87**	**125**	**297**

Table- 6 Major Occupation in coastal Junagadh details (No. of person)

Occupation	Kodinar	Maliya	Mangrol	Sutrapada	Una	Veraval	Total
Big Farmer	3,506	1,586	3,858	2,770	5,189	2,861	19,770
Workers	1,,862	804	2,051	1,392	2,220	2,697	11,026
Small Business	827	757	1,433	582	930	770	5,299
Service	4,641	682	2,380	754	691	1,032	10,180
Misc. Labour	3,211	1,829	8,099	3,795	3,780	8,602	29,316
Small Farmer	6,428	2,495	5,963	4,185	8,518	4,433	32,022
Marginal Farmer	3,888	1,780	4,604	3,217	6,847	2,689	23,025
Agri. Labour	8,817	5,439	19,237	9,419	20,034	17,873	80,819
Fishermen	1,861	0	2,345	3,563	4,390	1,265	13,424
Fish Processing			100	80		360	540
Animal Husbandry	3,699	357	1,725	2,391	3,058	2,056	13,286

Table- 7 Taluka wise Land use pattern with % of each land use to total for study area covered in Junagadh district (area in hectare)

Taluka	Area	Forest	Irrigated	Un-irrigated	Cultivable waste	Not available for cultivation
Mangrol	47,070.56	1,374.53	9,378.22	27,713.22	5,884.67	2,719.92
%	22.65	20.24	15.82	31.76	19.64	11.11
Maliya {ha}	18,905.63	230.91	4,205.14	9,311.68	3,013.89	2,144.01
%	9.10	3.40	7.09	10.67	10.06	8.76
Una	52,050.68	3,056.14	18,414.60	17,126.3	7,999.66	5,453.98
%	25.05	44.99	31.06	19.63	26.69	22.28
Veraval	24,749.31	510.23	6,102.84	8,872.47	3,364.14	5,899.63
%	11.91	7.51	10.29	10.17	11.23	24.10
Sutrapada	30,297.40	1,140.01	8018	11,660.88	5,503.81	3,974.70
%	14.58	16.78	13.52	13.36	18.36	16.24
Kodinar	34,714.90	480.39	13,170.36	12,572.06	4,203.31	4,288.78
%	16.71	7.07	22.21	14.41	14.03	17.52
Dist-Junagadh	207,788.50	6,792.21	59,289.16	87,256.61	29,969.48	24,481.02
%	100	100	100	100	100	100

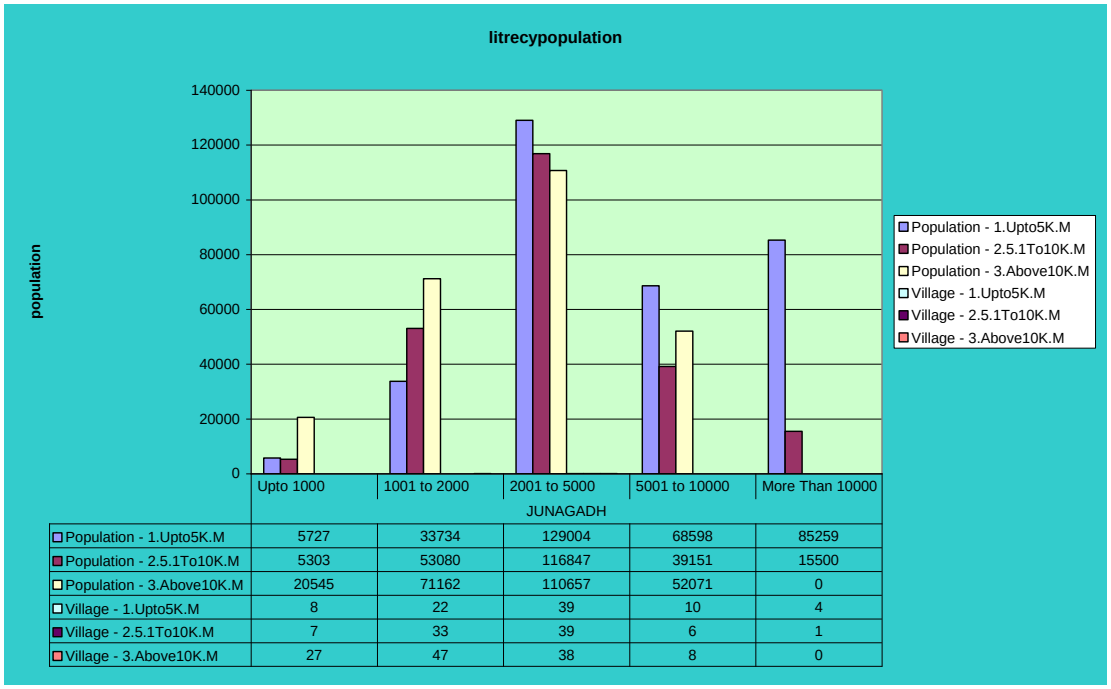
Table-9 Cropping pattern (area in hectare)

Crop-type	Kodinar	Maliya	Mangrol	Sutrapada	Una	Veraval	Grand Total
1.Food Crops	10,145	1,816	12,583	2,939	11,001	3,737	42,221
2,Oil Seeds	6,841	3,400	17,359	6,335	10,625	5,860	50,420
3.Cash Crop	7,171	575	1,021	692	7,907	893	18,259
4.Horticulture	689	580	2,140	270	1,739	1,140	6,558
5.Vegetable	260	505	618	90	1,028	590	3,091
6.Floriculture		0	12		193	0	205
7.Forestry	4	0	1	4	40	6	55

Table- 10 Crops grown and its production (1000 Kg)

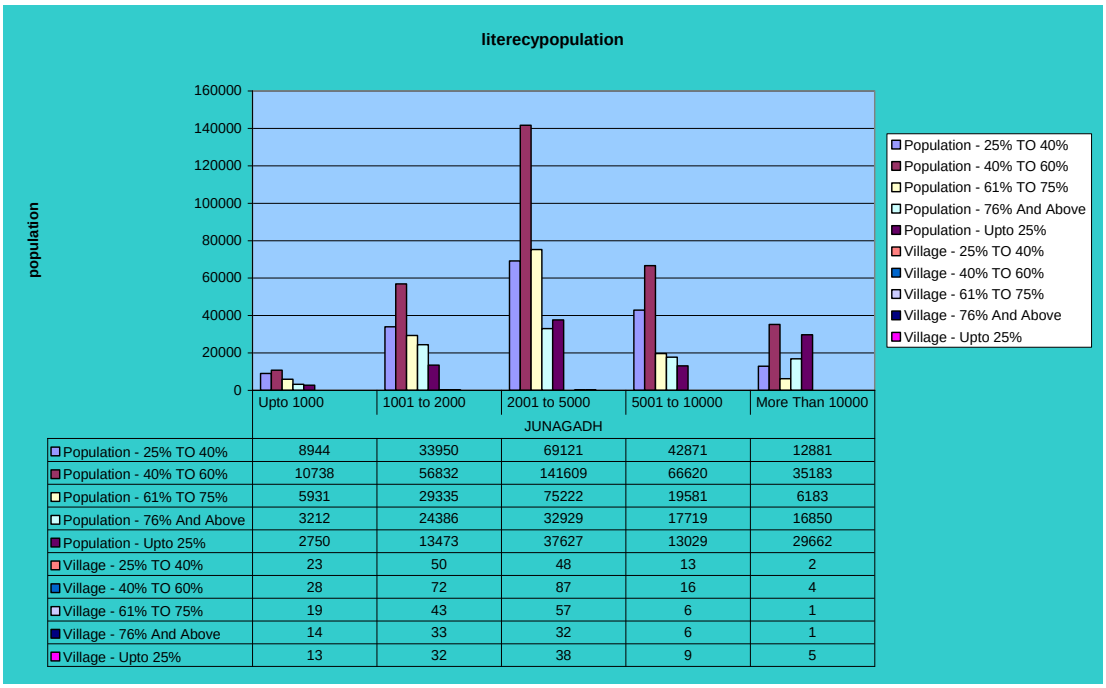
Crop	Kodinar	Maliya	Mangrol	Sutrapada	Una	Veraval
Bajari	99,190	55,800	83,507	87,515	168,754	159,000
Bajari deshi					1,500	
Banana		2,300				10,000
Bt Cotton			8,035			
Castor	41,640	14,200	9,525	11,050	66,554	71500
Chana		5,900	17,700	800	5,500	
Choli		2,000				
Coconut			400			
Cotton	79,725	15,565	25,385	68,850	241,992	17,000
Dhana		1,900				
Groundnut	118,075	71,100	101,205	86,700	193,337	205,170
Jiru			242	5,842	400	
Jowar	47,525	12,100	51,196	38,301	66,250	15,700
Kantoli		1,000				
Lasan			7,200			
Maize	8,485	937	4,800	0	12,150	7,800
Moong		23,150	8,500	1,371	13,450	2,000
Onion			16,800			
Paddy	8,400					3,600
Pulses		4,350	15,900			
Sugarcane	4,045,050			91,540	436,028	635,700
Til	13,740	8,500	8825	4,500	29,830	3,350
Tuver		950				
Udad		21,350	900	1400	3,975	900
Wheat	93,925	52,250	120,780	109,015	164,175	145,550
Grand Total	**4,555,755**	**293,352**	**472,865**	**506,884**	**1,403,895**	**1,277,270**

Graph – 1 Literacy among people and distance of the village from the coast



	Upto 1000	1001 to 2000	2001 to 5000	5001 to 10000	More Than 10000
Population - 1.Upto5K.M	5727	33734	129004	68598	85259
Population - 2.5.1To10K.M	5303	53080	116847	39151	15500
Population - 3.Above10K.M	20545	71162	110657	52071	0
Village - 1.Upto5K.M	8	22	39	10	4
Village - 2.5.1To10K.M	7	33	39	6	1
Village - 3.Above10K.M	27	47	38	8	0

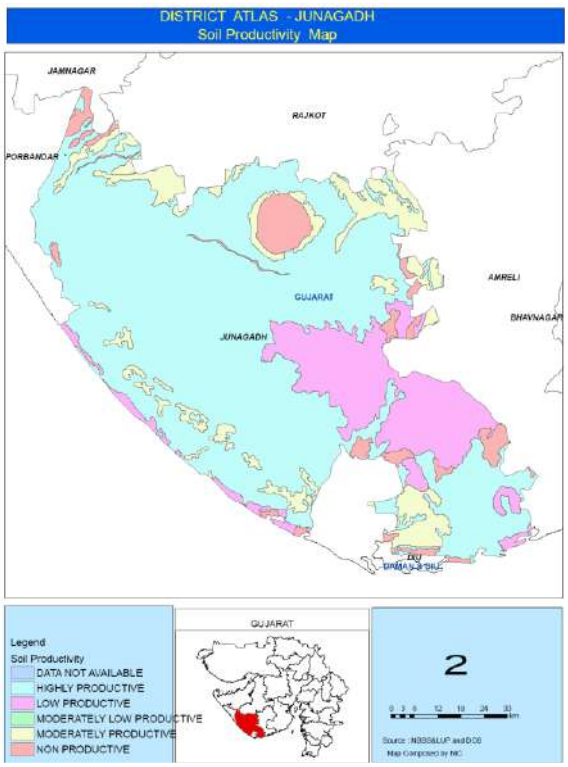
Graph-2 Percentage of people with literacy and distance of the village from the coast

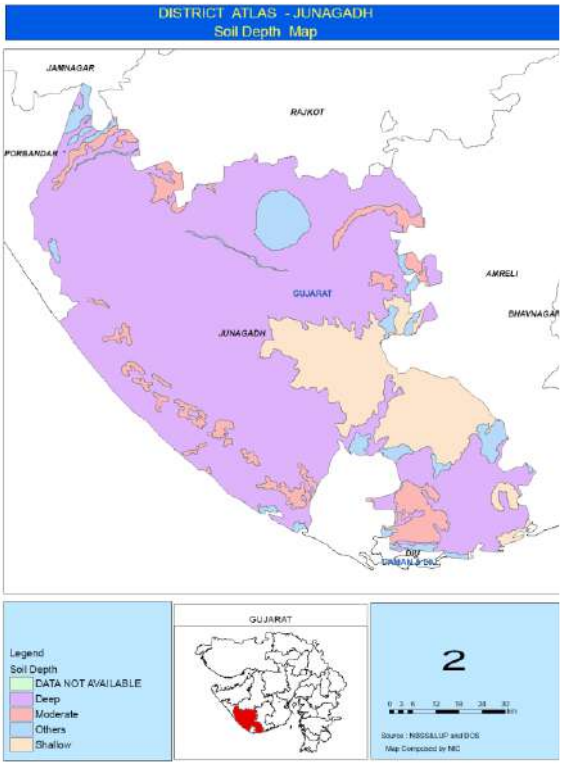


	Upto 1000	1001 to 2000	2001 to 5000	5001 to 10000	More Than 10000
Population - 25% TO 40%	8944	33950	69121	42871	12881
Population - 40% TO 60%	10738	56832	141609	66620	35183
Population - 61% TO 75%	5931	29335	75222	19581	6183
Population - 76% And Above	3212	24386	32929	17719	16850
Population - Upto 25%	2750	13473	37627	13029	29662
Village - 25% TO 40%	23	50	48	13	2
Village - 40% TO 60%	28	72	87	16	4
Village - 61% TO 75%	19	43	57	6	1
Village - 76% And Above	14	33	32	6	1
Village - Upto 25%	13	32	38	9	5

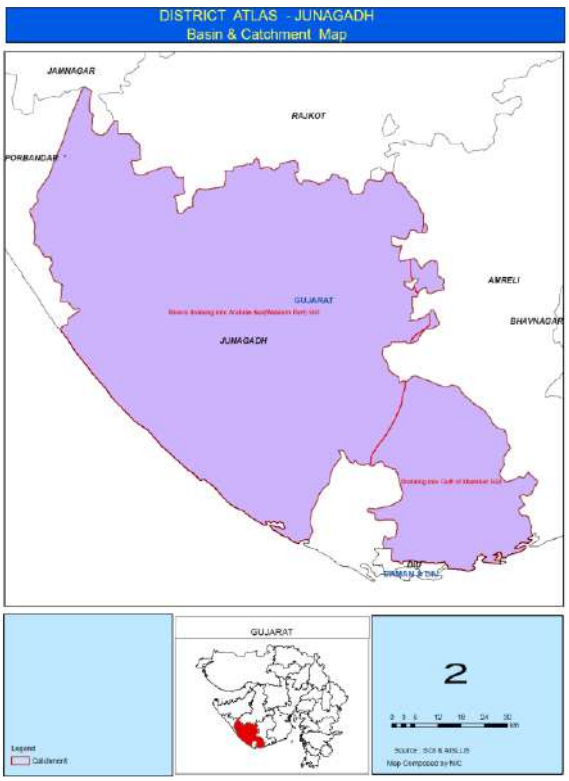
Maps

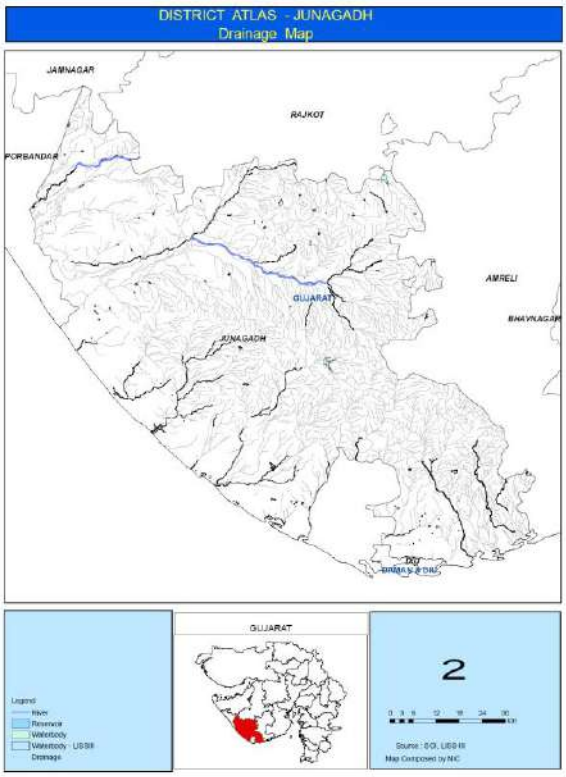
Map – 1 & 2 Maps showing basin & catchment and drainage of Junagadh District



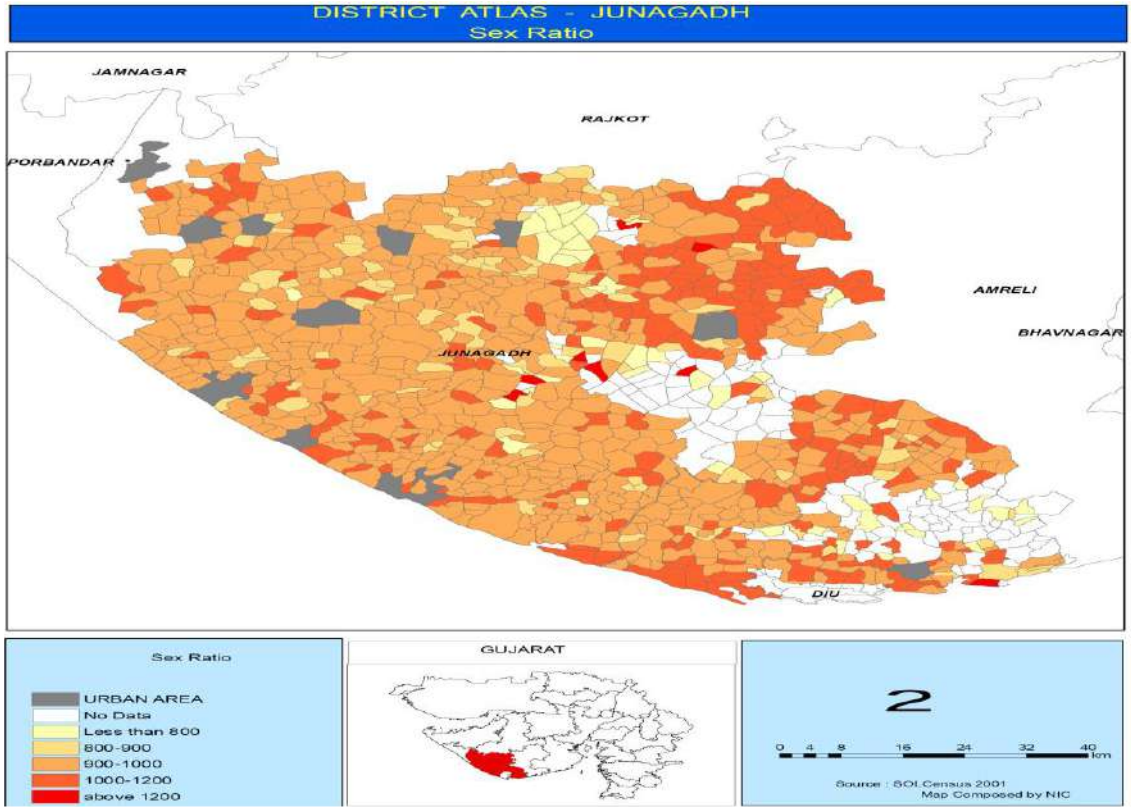


Maps – 3 & 4 Maps showing soil productivity and soil depth in Junagadh

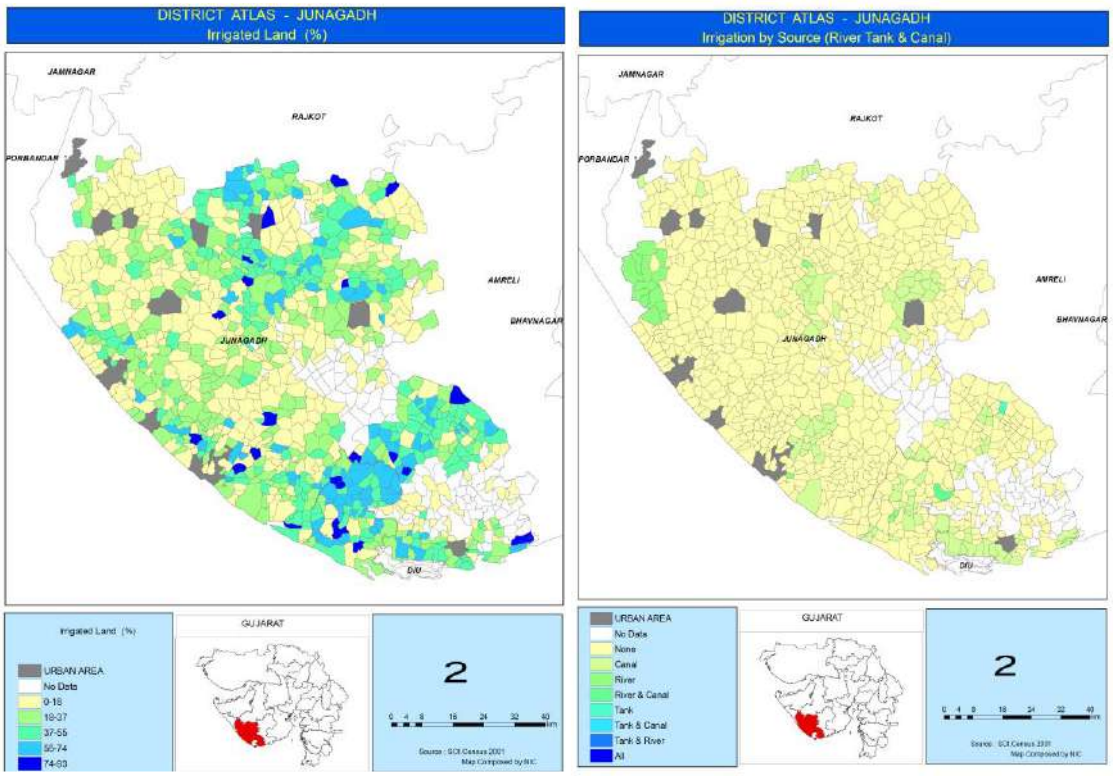




Map-5 & 6 Maps showing village wise status of irrigation and source in Junagadh District



Map-7 Map showing villagewise sex ratio in Junagadh District



Baseline Study of Coastal Villages affected by Salinity ingress in Porbandar District

May-07 to March-08

Prepared by:

Saline Area Vitalization Enterprise Ltd. (SAVE)

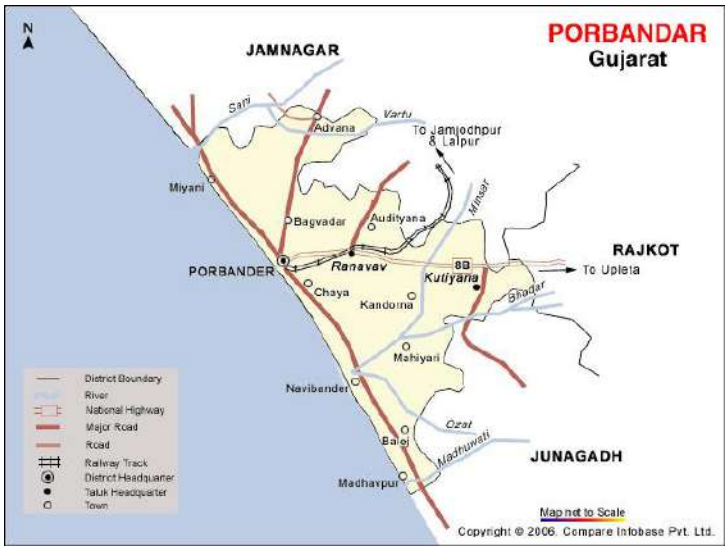
Prepared for:

Coastal Salinity Prevention Cell (CSPC)

Porbandar District

1. Introduction

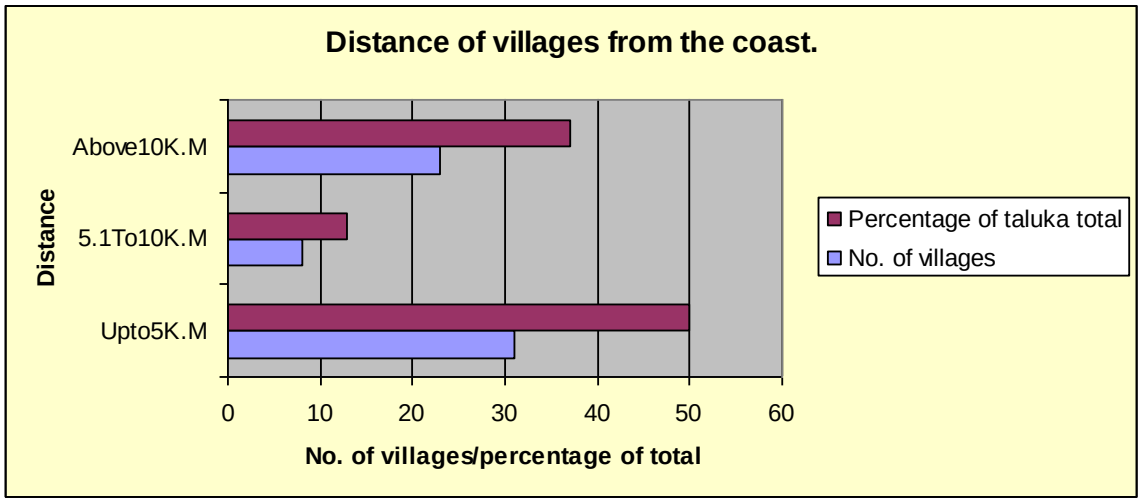
Porbandar district lies between 21° 15' and 21° 45' north latitude and 70° 10' and 70° 25' west longitude in North West, in the state of Gujarat India, District Porbandar has three talukas, 186 villages and 5 towns. Population of the district is 536,854 persons. Total area of the district is 2018 sq kms. The district can be divided into Hilly region - Barda Dungar area in Ranavav Taluka & Plain region - Ghed area and coastal area. Drainage pattern of the district is dendritic type. Major rivers of the district are Bhadar, Sorthi, Vartu, Kalindri and Minsar and they drain into the Arabian Sea.



2. Coastal area in Porbandar district

Out of three talukas in the district, Porbandar taluka covering 74 villages fall in the coastal area. The present survey was carried out in 62 coastal villages in Porbandar taluka having 74 villages in taluka. The 50% of the villages are located at a distance less than 5 Km. from the coast indicate that most of the villages are facing salinity problem.

Graph – 1 Number of villages according to distance from the coastline



3. Climate & Rainfall

The district is characterized by dry climate all round the year. The temperature range around 38 degree which reaches as low as 15 degree. The district receives 592 mm rainfall during south-west monsoon that occur in 30-35 rain-days. The coastal area records average rainfall 4500mm during June to September. The coastal area has six (6) rain gauge stations located in Porbandar taluka.

4.0 Physical features

4.1 Geomorphology

The coastline is remarkably straight having famous miliolitic formations along entire coastline. The coastal plains are 5.50 km. wide, sloping very gently towards the sea and seen traversed by quite a few longitudinal - parallel stabilized miliolite dunal ridges.

The present day shoreline comprises partly submerged dunes, cliffs, wave-cut platforms. Above the high water line all along the shoreline prominent coastal ridges are seen. At certain places where the river mouths cut the shoreline, the sandy ridges form well defined spits and bars with lagoon patches behind them. The beach or lower foreshore is narrow varying from 5 to 150 m. in width, with the backshore sandy ridge rising to almost 15 m. above the bermline. A salient feature of the foreshore and near off-shore is the presence of numerous submerged and dissected stabilized miliolite ridges either form rocky platforms or project out as steep cliffs of 8 to 10 m height from a veneer of loose beach sands.

The coastline is indented by a number of inflowing rivers their mouths typically forming tidal creeks with lagoons. All these creeks are characterized by sandy spits and are giving rise to linear backshore lagoon mudflats behind the coastal ridge. The coastline between Meda and Porbandar is characterised by absence of the rocks. At Porbandar, a small part of the coast is rocky, but further southeast up to Antroli, the coast is exclusively sandy. Beyond this point up to Kodinar, the coast is characterized by rocky foreshore cliffs. The area north of Porbandar constitutes a large tidal creek of river Bhadhar which is very peculiar. The sea beach is separated by a long dunal ridge and to its east whole region is depressed one, to the extent that its altitude is lower than the mean sea level. This area is locally known as Ghed which experiences annual flooding during monsoon and or rough weather condition.

4.2 Hydrological

This coastal block directly faces an open ‘Arabian Sea' characteristically marked with less tidal variations, strong long shore drift current and wave actions. This block comprises highly fertile land and so the inhabitants have over utilized the terrain resources, water in particular. This has witnessed an unprecedented problem of salinity ingress and the entire coastal tract between Shil -Harshad became the main front of sea water intrusion.

The district has diversity in hydrogeological environments which is attributed to its geomorphic characteristics, offering numerous landforms characters viz. cliffy shoreline, tidal creeks, coastal dunal ridges, point bars, large surficial depressions etc. Here also the miliolitic lime stone form the potential aquifer for groundwater supply. On account of over exploitation, the water table has witnessed a sharp decline in its level. In the span of seven years it has reduced by 4-15 m causing saline water ingress up to 10-20 km inland areas. The average depth the water table has reached at 8-20 m. The area adjacent to Madhavpur Navi Bandar (i.e. Bhada river creek), though agriculturally potential, constitutes a low lying regional depression, causing flooding and inundation problems. The depth to the water level in the northern parts i.e. area around Porbandar - Miyani shows variation which is attributed to closeness to the sea and the aquifers composition viz. limestone, basalt etc.

4.3 Geo-environment

This coast experiences the maximum impact of powerful breakers and resulting surf action due to strong southwesterly and westerly winds. This high energy coastal segment is also seen to experience considerable erosion and formation of submerged miliolites. The various rivers do not carry much sediment load and hence have minimum turbidity. But, the river water contains $CaCO_3$ thus augmenting to the $CaCO_3$ content of the sea waters.

5. Overview of Porbandar District:

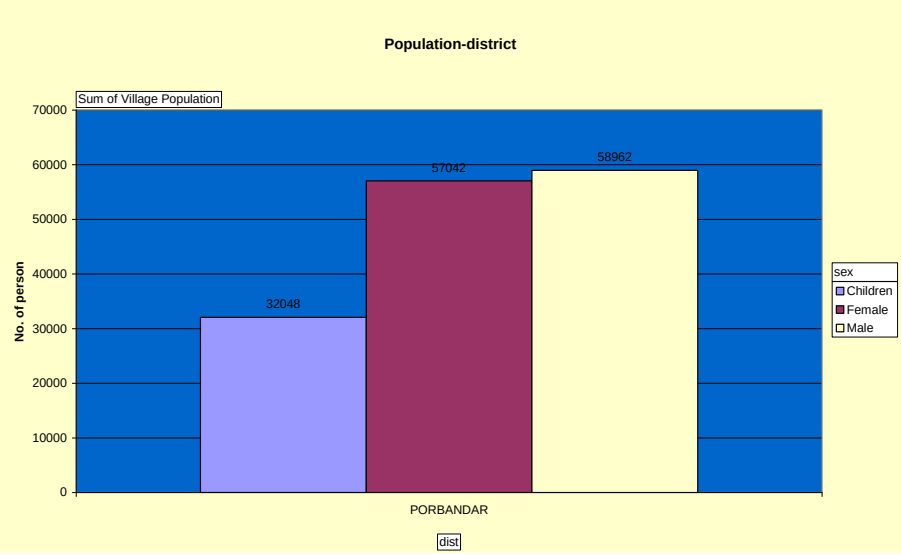
Table -1 Category wise population in study villages in Porbandar taluka.

Category	Population	% of total population
General	9,926	6.87
OBC	120,532	83.40
SC	12,407	8.58
ST	1,655	1.15
Total	**148,052**	**100.00**

5. 1 Demographic

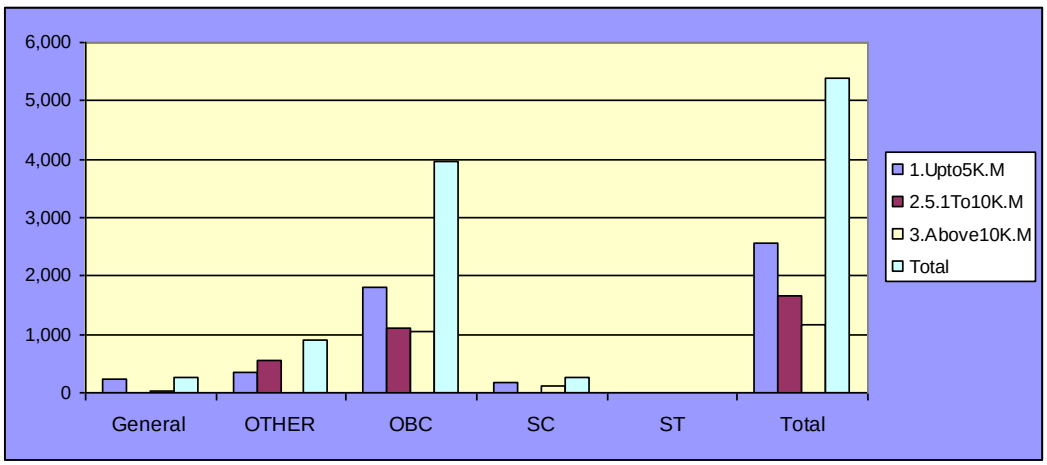
The Porbandar District has 186 villages and 5 towns. Population of the district is 536,854 persons living in 2018 sq. km of area. The 62 villages in Porbandar taluka have total population of 144,520 persons. Majority of population belongs to OBC category which includes caste like Ahirs, Mers, Kolis, Sathvaras and Muslims.

Graph-2 Demographic details of villages covered under survey in Porbandar district



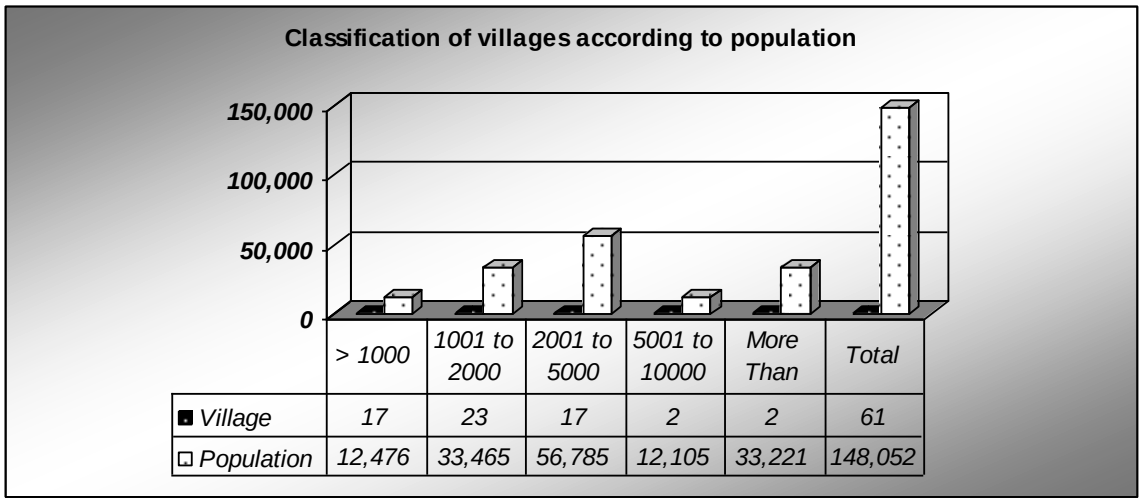
The population covers 5,036 families living below poverty line. Most of them belong to OBC category who is staying in villages close to the coastline. The salinity problem is further impacting their status.

Graph-3 Status of BPL families in relation to distance from sea coast



The surveyed villages have population ranging from 130 (sukhpur/Hathiyani) to 7,500 persons (Madhavpur). Among them maximum villages (23) have population between 1,000 and 2,000 persons, however, it covers only 22% of the total population in coastal Porbandar. This is indicating scattered population in the coastal area. The coastal villages in Porbandar taluka are broadly divided in to three areas called Barda area, Miyani area and Madhvpur to Chikasa area based on similarity in the natural condition.

Graph-4 Classification of villages according to population



	> 1000	1001 to 2000	2001 to 5000	5001 to 10000	More Than	Total
Village	17	23	17	2	2	61
Population	12,476	33,465	56,785	12,105	33,221	148,052

The analysis of surveyed information indicates that the overall literacy percentage shows that the majority of villages have literacy rates between 60 and 70% with some villages having more than 75% literate population. The Largest literate population is found in villages having population between 2,000-5,000 persons.

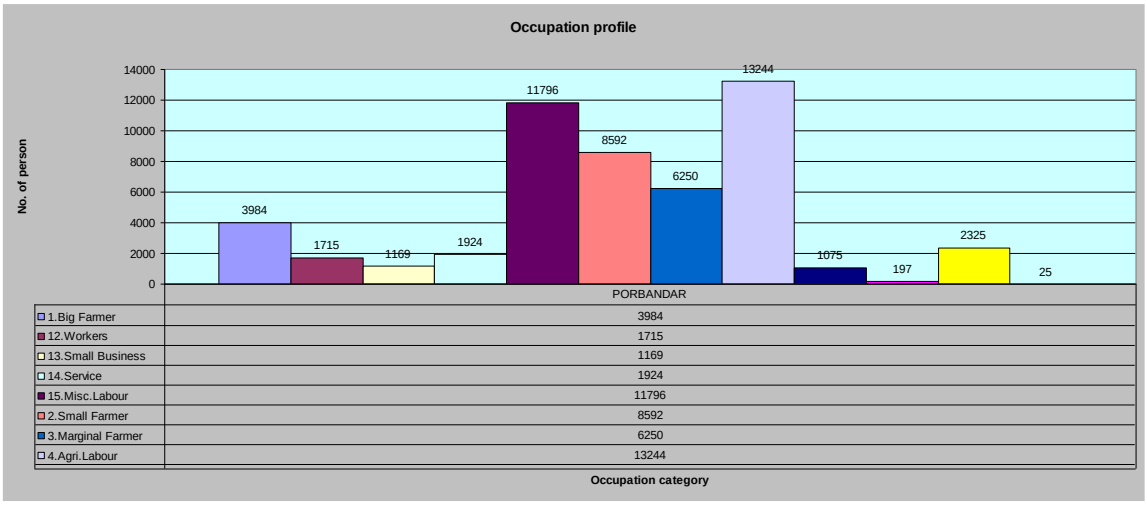
5. 2. Occupation

The study area recorded 52,000 persons engaged in different income generation activities. More than 18,000 persons of which are farmers holding land under large, small and marginal categories. As seen in other coastal talukas animal husbandry is performed along with the agriculture as an income generation activity by land holders and others. The taluka has 10% of total marginal farmers and 7% of agriculture labour force of entire study area. The percentage of agriculture labourers as compare to land holders is low in Porbandar district indicating poor status of agriculture in coastal Porbandar area.

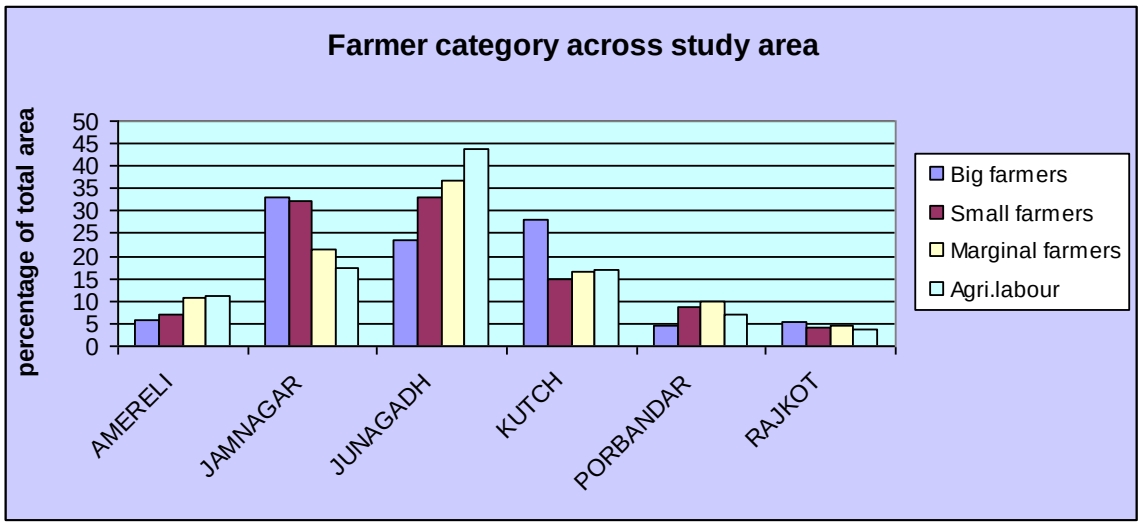
The other main occupations are fishing and animal husbandry being carried along with agriculture. Interestingly, though the coastal area has large tracts of *Prosopis Juliflora,* not many families have adopted charcoal production as income generation activity in coastal villages.

The Porbandar district largely lags behind in non-farm sector occupations as compare to two adjoining coastal districts indicates that large section of population is still dependent on the primary sector for their livelihood. This provides a good scope for the providing non-farm sector skills among youth.

Graph-5 Occupational profile of the study villages



Graph-6 Farmers categories across study villages



Among the farming community marginal farmers are in highest numbers among the all farmer categories. In contrast to other coastal areas, the agriculture laboures population is lower than the farmer in coastal Porbandar.

6. Resources

6.1 Soils

The coastal tract in Porbandar district is characterized by Loamy and sandy soils having goods percolation capacity characterized by coastal alluvium. The land is highly suitable for all varieties of crops particularly crops demanding high water percolation like groundnut.

6.2 Water

The coastal Porbandar is having both surface and ground water resources which are used for agriculture production and drinking water.

6.2.1 Surface water resource

The Major rivers of the district Bhadhar, Sorthi, Vartu, Kalindri and Minsar are all ephemeral streams carrying water during rainy season and one-two months after monsoon. The upper catchments of all these rivers have dams which store water for irrigation and drinking needs. Few villages in coastal areas receive benefits of irrigation through link channel created by SIPC along the coastline.

Ghed Region

The part of coastal region known as Ghed area is natural depression, which remains inundated during monsoon due to its ground level lower than the surrounding area. These region comprises of 10 surveyed villages is prone to flooding in normal rainfall conditions followed by release of water from the dams constructed on river Ozat, Bhadar and Minsar. The entire area remains cut of from other parts of the region making life miserable. The list of villages is given in table below.

Villages in Ghed area	Navagaon, Lusada, Mitrada,Ohaddar, Chikasa, Garege, Jarnara,Bhoaksar, Chatrava, Mayari

These villages remain flooded for period ranging from 20 days to as long as 2 months in post monsoon season which hampers all activities related to agriculture in the area. The flooding affects more than 1,000 hectare land. The agriculture activity becomes possible only after the water recedes allowing sowing of crops like cotton, Chana, Jowar etc. The possibility of constructing water harvesting structures for agriculture needs is difficult, as the stored water turns saline as summer approaches.

6.2.2 Groundwater resources

Geohydrologically Porbandar district comprises of sedimentary rocks – miliolite limestone known as Porbandar stone and alluvial deposits. Deccan trap basalt also occupies considerable area of the district. Few villages south of Kutiyana, Ranavav and Porbandar taluka fall under " Ghed Area " which comprises of alluvial deposits and has inherent salinity even at shallow depth.

Western flank of the district is bounded by the Arabian Sea. Due to proximity of the sea, the area is affected by seawater ingression resulting into deterioration of ground water quality. Potable ground water zone is restricted in the Northern and NE portion of Porbandar taluka. General depth of open wells ranges from 10 to 25 mts to 75 -100 mts. in case of DTH bores. Major part of Ranavav taluka falls under saline water zone. Potable ground water zone is restricted in the Northern and Western part of the taluka. Kutiyana taluka is comprised of Deccan trap basalt and alluvial formation, which is affected by salinity and excessive fluoride content in ground water.

6.3 Findings

1. **Land/Soil**

    a. The land becomes hard pan due to irrigation with saline water.
    b. The tilling in hard soil requires tractors. The use of bullocks in agriculture practices has reduced due to hard and compact soils.
    c. The soils require higher amount of water due to high percolation rate.

2. Water

a. The water stored in the dams turn saline before next monsoon.
b. The water stored in Bhadar dam is highly polluted due to mixing of chemical from Jetpur dyes industries which is creating health problems like cancers in the population using it for drinking purpose.
c. The ground water is found below 200 ft. which is saline.
d. The water in well recharged by rain water turns saline within 2-3 months.
e. The villages falling in Ghed area remain inundated after monsoon.
f. In Modhavada village farmers have recharged 20 wells through rainwater. The recharge benefits farmers in providing two protective irrigations for groundnut crop which secures the production.
g. The farmers have benefited by constructing check dams and farm ponds in Ghed area. (Madhavpur to Chikara and Barda village)

7. Land use

The study area has geographical coverage of 93,382 ha. of which 64% is agriculture land. Nearly 60% of the agriculture land is un-irrigated and used for rainfed agriculture. The Porbandar taluka is one of the coastal taluka having wasteland more than 20% of its geographical area. Majority of the wasteland is covered with Prosopis Juliflora. Large tracts of coastal belt are traditionally used for mining the milliliter limestone, many agriculture land plots which have become saline are also used for mining the rock.

Table- 2 Landuse in Porbandar taluka

Landuse	Area-Ha.	% of taluka total
Geographical Area	93,382	100.00
Agriculture Land	60,306	64.58
Unirrigated Land	35,870	59.48
Forest Land	1,896	2.03
Wasteland	20,078	21.50
Village Pond	290	0.31
Muddy Land	24	0.03
Industries	157	0.17
Mining	60	0.06
Salt Pan	386	0.41

8. Agriculture

Majority of the area is carrying out rain-fed agriculture. In Porbandar taluka, farmers earn their livelihood through rainfed agriculture and animal husbandry. Nearly 50% farmers carry out animal husbandry as supportive activity. Due to this attitude, the farmers prefer to grow crops which also provide fodder for animals. The popular crops grown in Porbandar District include groundnut, cotton (desi), gram, wheat, cumin, bajara, green gram, coriander, Sorghum etc.

The agriculture in Porbandar taluka is dominated by oilseeds crops mainly groundnut and cotton. Major food crops include Wheat, Bajara and Sorghum (Jowar). The other crops like pulses and horticulture crops like coconut, mango, sitafal (custard apple) is declining with increasing salinity in coastal area. In recent period cotton and castor crop area is increasing due to change towards groundnut crop which is highly sensitive to saline water.

Table- 3 Cropping pattern (area in hectare)

Crop type	Area (hectare)
Food Crops	16,439
Oil Seeds	39,331
Cash Crop	8,080
Horticulture	100
Vegetable	226

Cotton and groundnut are two main crops sown in coastal Porbandar as main Kharif crops. Recently castor is also grown along with these crops. The main food crops grown include Bajari, Moong, Moth, Udad and in Rabi season, Wheat and Chana.

Table – 4 Crop production (in Kg)

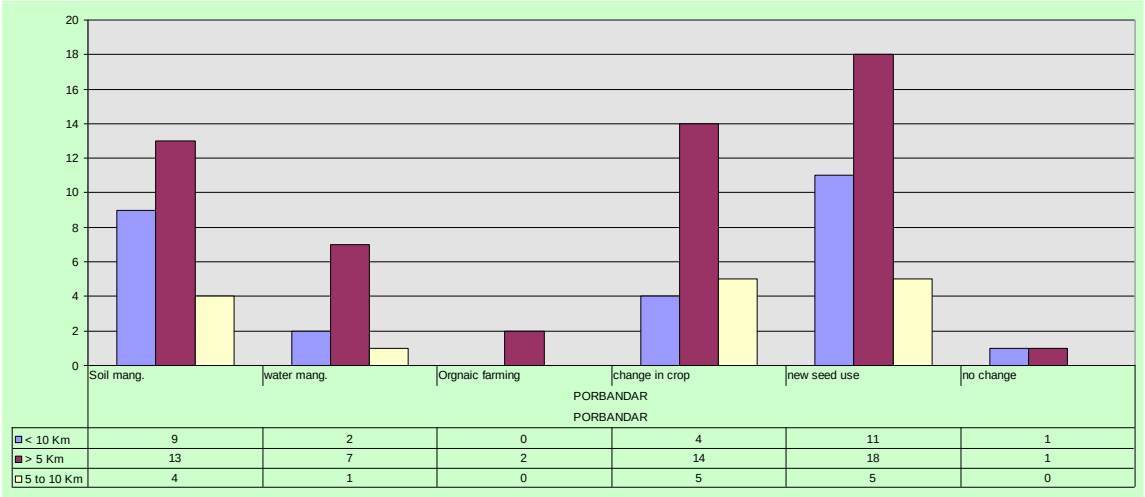
Crop	Porbandar
Bajari	53,650
Castor	22,160
Chana	29,660
Cotton	150,725
Groundnut	130,455
Jiru	7,345
Jowar	41,350
Moong	6,050
Raydo	1,000
Til	9,775
Udad	4,400
Wheat	149,475

Out of 62 villages, 25 villages have recorded change of crops in last five years. Most of these villages are located at a distance less than five Km from the sea. The changes have occurred in food crops as well as cash crops. Two villages have also adopted changes in horticulture crops as shown in table below.

Table-5 Variation in Cropping pattern in relation to distance from the coast line

Details	> 5 Km	5 to10K.M	< 10 Km	Total
No. of villages	17	3	5	25
Area of village	55,374	7,350	3,300	66,024
Village Nos. -change food crops	16	0	2	18
Village Nos. -change cash crops	11	2	2	15
Village Nos. -change horticulture	2	0	0	2

Graph-7 Solution tried by farmers for reducing salinity impact on agriculture



	Soil mang.	water mang.	Orgnaic farming	change in crop	new seed use	no change
< 10 Km	9	2	0	4	11	1
> 5 Km	13	7	2	14	18	1
5 to 10 Km	4	1	0	5	5	0

8.1 Findings

1. The farmers are loosing their interest in agriculture due to salinity ingress. The farming has become expensive because the hike in power terrifies, pesticides, farming equipment, availability of markets, fertilizer and irrigation water problems etc. On the other hand the agriculture production has been declining by 50% due to deteriorating quality of agricultural land forcing farmers to use higher amount of pesticides and seeds for maintaining production.
2. Change in cropping is recorded in twenty five (25) villages. The most of these villages are located at a distance less than five Km from the coast line. Majority of villages have changed food and cash crops. (refer table_5_)
3. The vegetable crops have reduced to such an extent that many farmers who were supplying vegetables in the market are now buying it from the markets.
4. The cotton crop is replacing groundnut in coastal villages. Similarly, castor is also becoming popular crop in the study villages.
5. The cultivation of Jowar is highest in Porbandar taluka among all coastal talukas covered under the study. The higher amounts of Jowar cultivation help in supporting animal husbandry.
6. To reduce the effect of salinity on agriculture, farmers are focusing on soil management, use of new seeds and change in crops. The study has recorded maximum efforts made in diversification of crops in the villages located at a distance less than five Km. which indicate that the farmers in these villages are searching the solution eagerly.
7. Adoption of organic farming and efficient water management is also recorded in few villages located at a distance less than 5 Km from the coastline.

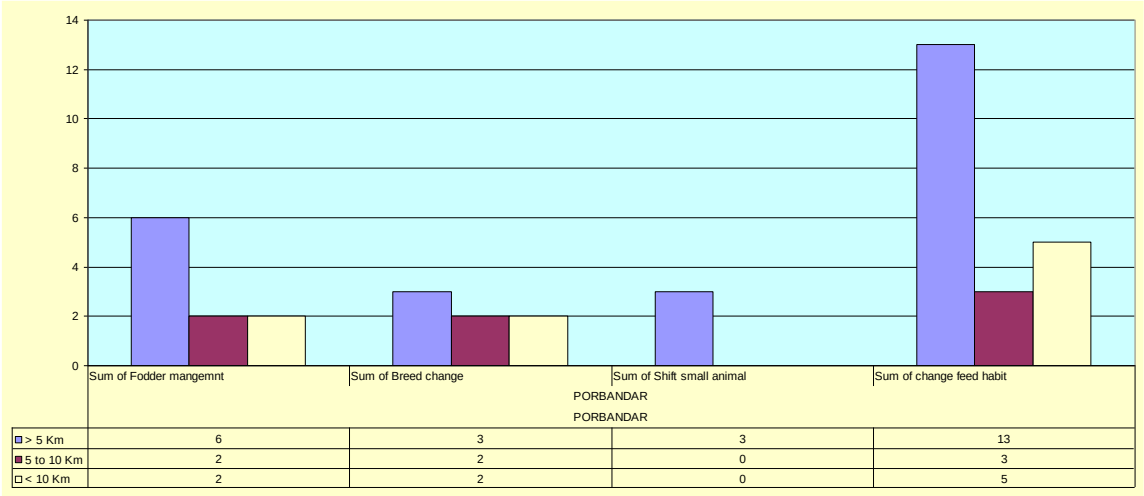
9. Livestock rearing

The availability of grass land and green fodder from agriculture has supported livestock rearing in the past. During last 20 years, the population of animals and animal rearer has declined due to reduction in grasses from the common property resource as well as from the agriculture. The reduction of groundnut crop has further reduced the livestock rearing in Porbandar. At present large numbers of farmers in coastal villages carry out milch animal rearing activity mainly to satisfy their own consumption needs.

Table-6 Livestock population in the study area

Block	Cow	Buffalo	Bullock	Goat	Sheep	Camel	Poultry
Porbandar	11,904	26,663	19,018	12,696	30,917	64	145

Graph-8 Solution tried for reducing impact on - Livestock rearing



The coastal belt has around 56,000 milch and draught animals apart from which around 42,000 sheep and goat population. On an average each village has 300-350 milch animals. In these villages buffalos are preferred for milk production. The ratio of buffalos to cows is almost more than double. The average milk production ranges from 3 to 4 liter/day in summer to 8-10 liter/day in winter season. The increasing salinity is creating health problems in the milch animals.

9.1 Observation on animal husbandry

1. The population of animals is showing declining trends. However, in villages where new water sources are established the number of animals has increased due to availability of green fodder. E.g. village Bhavpara.
2. Animal husbandry is carried out as a supplementary income generation activity along with agriculture.
3. The livestock reaers prefer to have local breeds.
4. Due to increasing salinity the health of the animals is deteriorating by consuming salt through fodder and water. The major animal diseases are related to kidney and digestive system.
5. Due to salinity problem, the animal rarer are taking step for changing feed habit and fodder management, change breeds, shifting to small animal rearing. The feed management practices are the most popular solution for the livestock rarer in Porbandar district.
6. The drinking water for animal is a major constraint in the coastal area. In the study villages, animals are fed on water from creek, river, cattle troughs and ponds. None of these sources last round the year.
7. Decade back villages around Miyana were having population of Maldharis and were known for milk production. Today, many of them have left the villages permanently. Those who are living in the villages have few animals and are working as a laboures.
8. The animals in the region are facing health problems due to salinity in water and fodder. The yielding capacity of animals brought from outside reduces immediately.

9. The population of bullocks is reducing due to reduction in their use in agriculture caused by hardening of soil due to saline water.
10. Twenty seven (27) villages have milk co-operative societies.

10. Fishing

Porbandar is one of the major fishing centers in Saurashtra. The fishermen from adjoining Junagadh and Jamnagar districts migrate for fishing to Porbandar. According to fisheries department records (2003) 4,707 families are engaged in fishing activities covering population of 26,176 persons. About 3,500 of them are involved in sea fishing while more than 2,300 are involved in preparing nets and repairing business. The villages having major population of fishing community is given in table below.

Table –7 Villages having presence of fishing community in Porbandar taluka

District	Taluka	Villages Name	No. of villages
Porbandar	Porbandar	Navi Bandar, Ratia, Gorasar, Chingaria, Pata, Miyani, Untada, Khambhodar, Balej, Kadach, Bukhara, Degam, Kachadi,	13

The fishing season lasts for 3 to 5 months in a year providing monthly income of Rs. 2,500 to Rs. 3,000 per month to the fishermen. The resource available for fisheries in the district are as below.

Table – 8 Resources available for fishing

	Nets		Boats	
1	Pole	11539	Trawlers	1936
2	Gilnet	90287	Gilnetor	108
3	Coste	503	FRPIBM	11
4	Hook and coir	27350	FRPOBM	1770
5			Simple boats	130

11. Irrigation

The information on sources of irrigation shows that both surface and ground water resources are used for irrigation. The increasing salinity in ground water has resulted in construction of farm ponds and check dams for providing protective irrigation to the crops. The wells are used as a main source of irrigation however these wells do not yield adequate water. The wells which were able to yield water for 8 to 10 hours are now yielding water only for 2-3 hours and hence the net irrigated area through wells have reduced as compare to a decade ago. The quality of ground water has become saline below 30-40 feet, however in absence of any other source the farmers use water from the wells for cultivation of salt resistant crops like Jowar and cotton.

Table-9 Irrigation structures - Type and Numbers

Type of source	No. of structure
River	12
Irrigation Pond	21
Village Pond	7
Farm Pond	264
Canal	26
Check Dam	86
Bhandhara	18
Bore Well	2,474
Well	10,550

12. Drinking water

The availability of fresh and potable drinking water is a major concern in coastal villages in Porbandar district, particularly in villages located in Ghed area. The drinking water demand is being met from both local sources as well as through piped water supply. The water has high content of fluoride and salt harmful for the body. At present people are dependent on more than one type of water sources. Many villages in Porbandar-Dwarka road have adopted roof rainwater harvesting tanks for drinking purpose. Due to shallow water level hand pumps are also used for drinking purpose but they yield saline water in post monsoon season and hence are not useful.

Table- 10 Number of villages and type of source of water

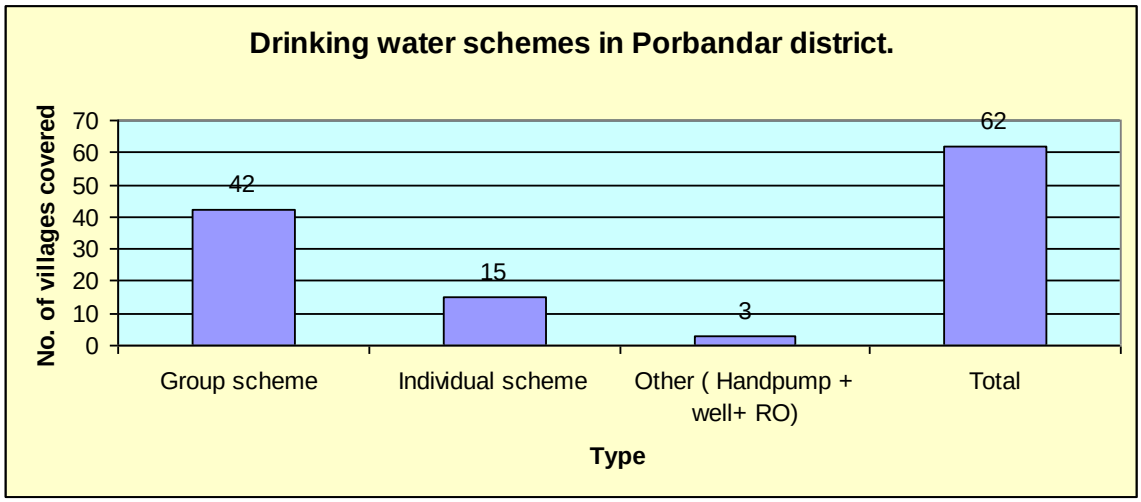
Rivers	3
Pond	35
Open Well	330
Tube Well	402
Hand pump	1,209
Pipe Line	42
Rainy Water Tank	965
Tanker	31

The non-availability of drinking water is one of the major concerns among the coastal talukas in Gujarat. The situation gets aggravated in “Ghed” area where people are forced to use flood water for drinking and other domestic use.

12.1 Present situation

According to a report of WASMO (2007), out of 62 villages in Porbandar taluka majority of villages are covered under group water supply schemes based on surface water storage. However, during survey work it was observed that the villages are facing drinking water in terms of availability as well as quality. In fourteen villages the local drinking water sources do not have potable drinking water. These villages are proposed to be covered through reverse osmosis plants at a cost of Rs.44.1 lakh. The number of the villages proposed for RO plants in Porbandar taluka are given in Graph- below.

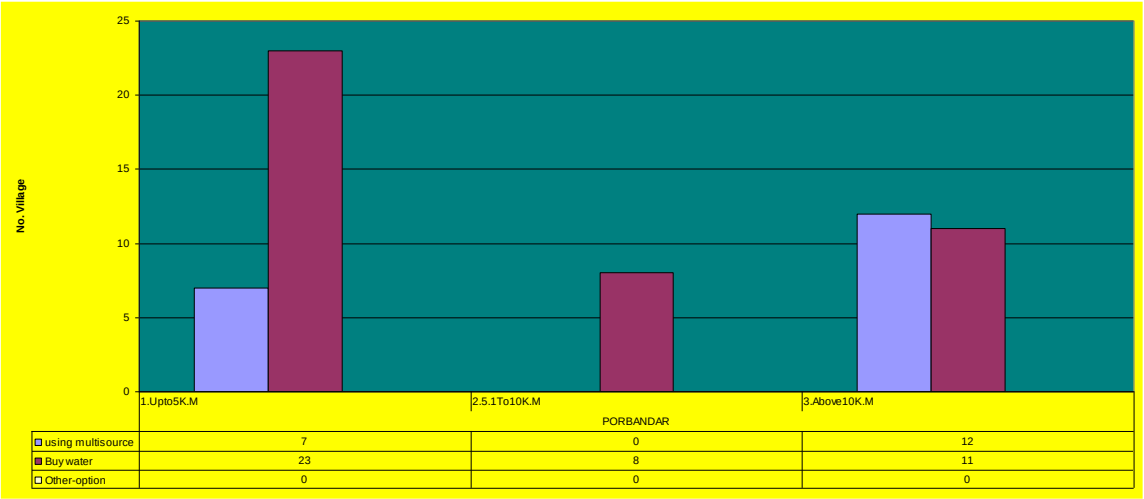
Graph – 10 Drinking water schemes in Porbandar district



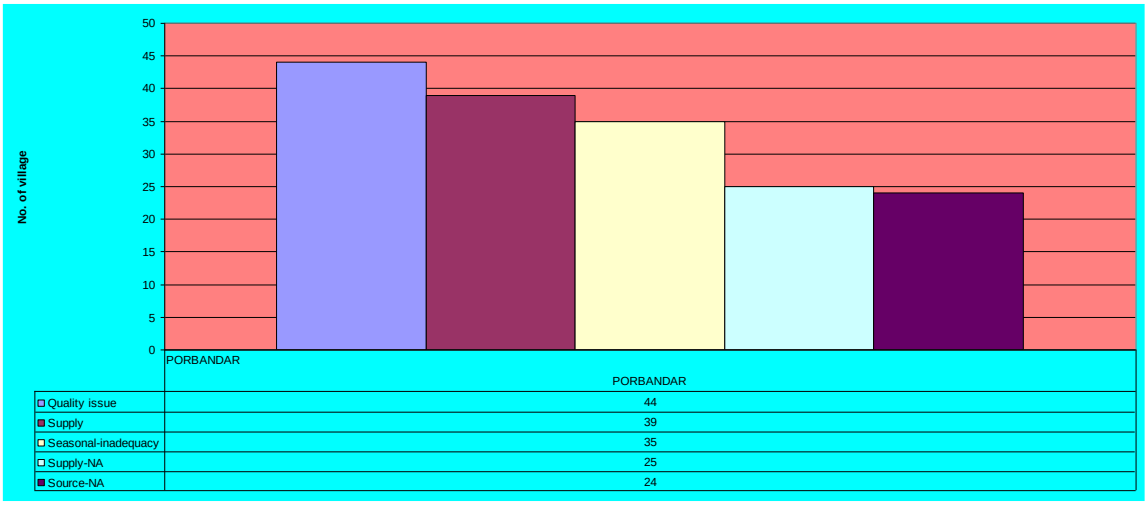
12.2 The findings of the survey shows

1. In 42 villages people purchase drinking water.
2. 44 villages face quality issues. The highest No. of villages facing quality issues are located on coast.
3. 25 villages have no source and dependable supply of water
4. Government has proposed 15 individual scheme, 42 group schemes and 14 RO plants in the Porbandar taluka.
5. The state government has proposed five schemes covering 76 villages for Porbandar taluka *Sagarkehdu Yojana*, two of them are completed.

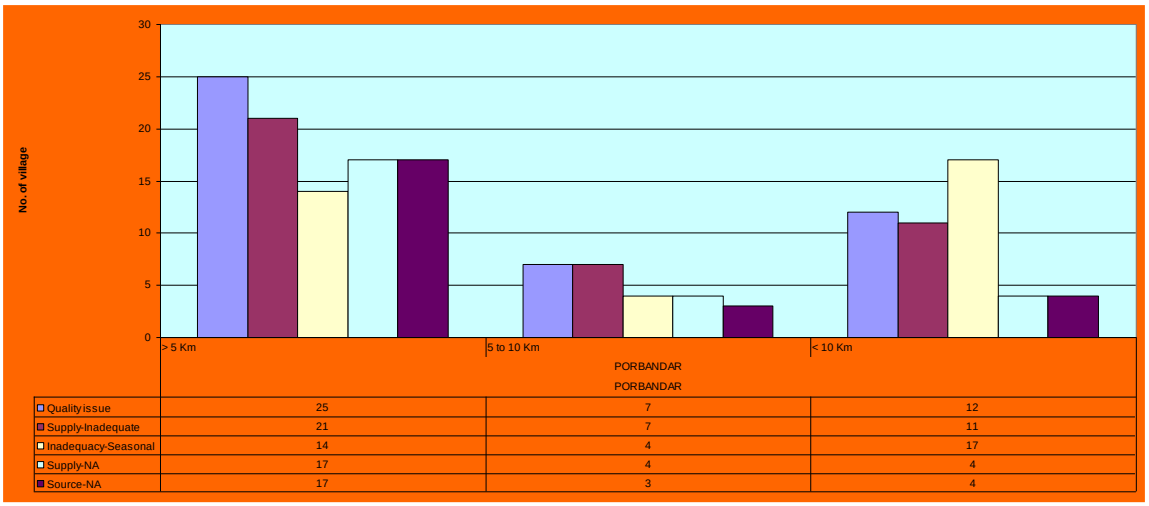
Graph-11 Solutions adopted by the coastal communities for drinking water



Graph-12 No. of villages facing drinking water problems and its types



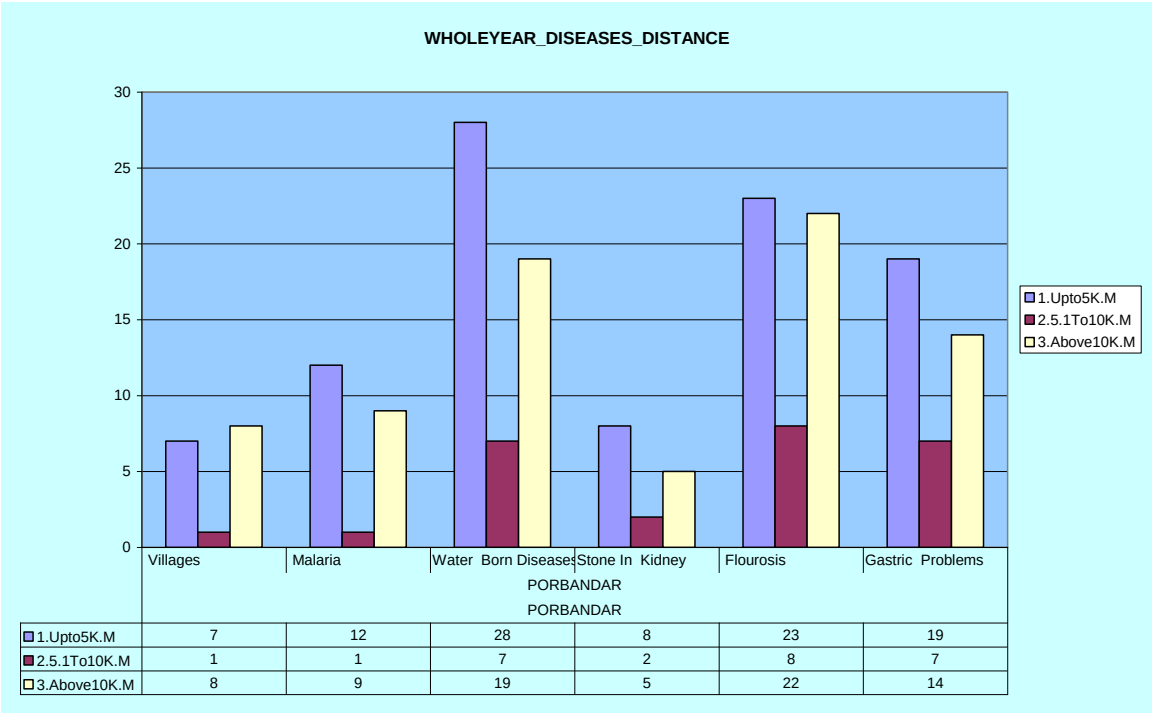
Graph-13 Variation in drinking water problems types according to distance from the coastline.



13. Health and sanitation

The unsafe drinking water sources impact the health of the community. The stone in Kidney, skin diseases and joint pains are common complains of majority of villagers in coastal area. The health conditions of the people in Porbandar are poor due to lack of potable drinking water source. The Florosis impact is more visible in villages across all distance from the coastline which, contain high fluorides. Totally 55 villages have reported people suffering from joint pain due to Florosis in water. Many villages in Porbandar have adopted water purifier at household level. The water born diseases are common in villages close to coast. The sanitation infrastructure is found only in few villages which accelerate the health problem caused by saline water. Apart from this, gastric problem is a prominent disease, found in the area.

Graph-14 Health: Relationship between distance from coast and disease pattern throughout the year

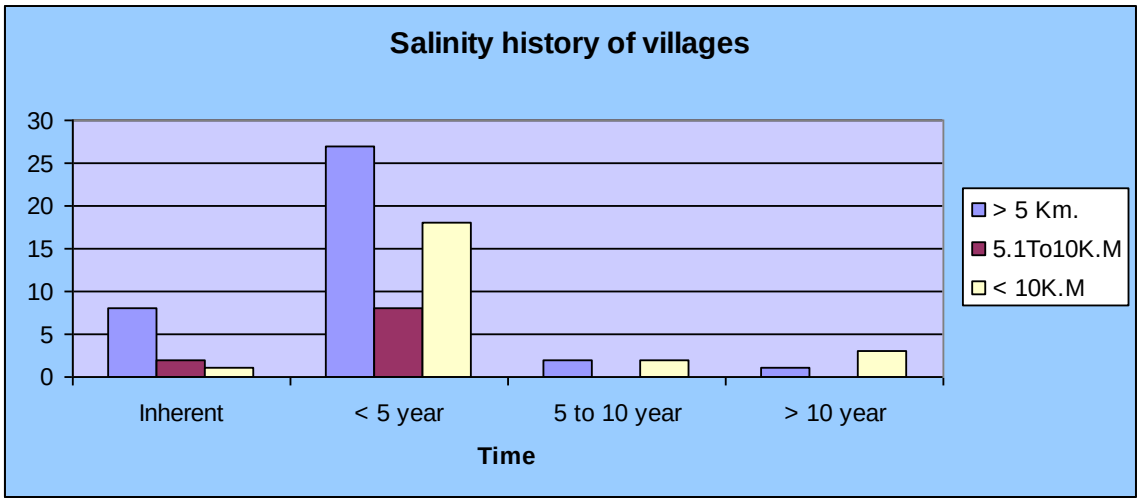


	Villages	Malaria	Water Born Disease	Stone In Kidney	Flourosis	Gastric Problems
1.Upto5K.M	7	12	28	8	23	19
2.5.1To10K.M	1	1	7	2	8	7
3.Above10K.M	8	9	19	5	22	14

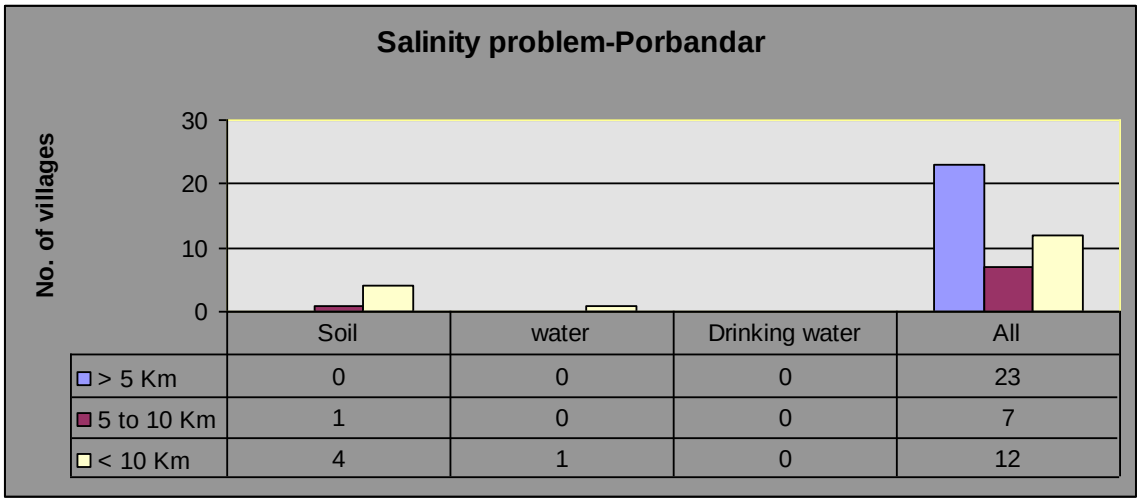
14. Salinity history in coastal Porbandar

The information collected on history of salinity shows that the impact of salinity problem is seen more in recent years. Majority of villages expressed that they are facing salinity problem since less than 5 years. Out of sixty villages covered under the survey, 42 have reported salinity in soil as well as water. The increasing salinity affects drinking water, agriculture and animal husbandry equally in 58 villages.

Graph-15 Period of salinity problem in study villages

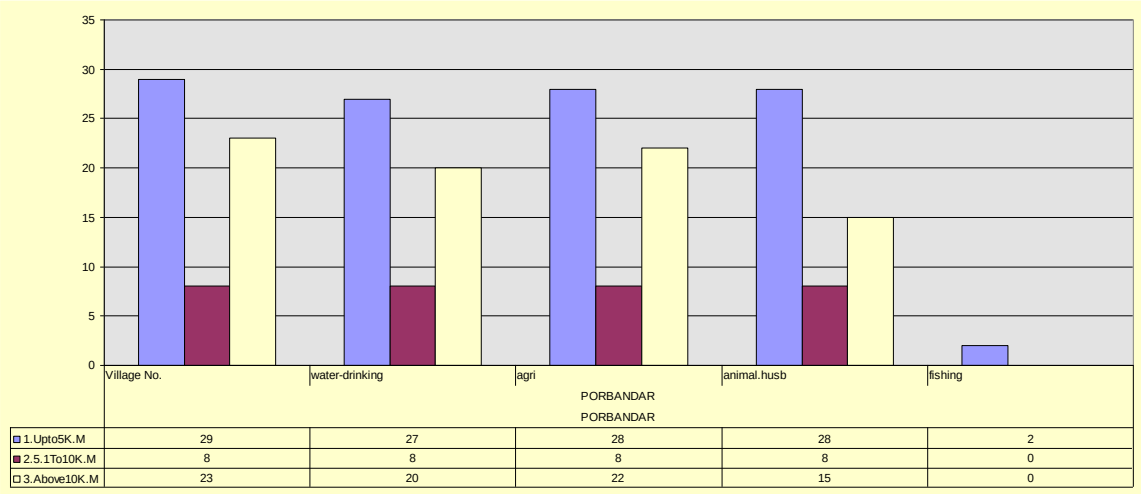


Graph-16- Variation in Impact of salinity on land and water resources in relation to distance from coast



	Soil	water	Drinking water	All
> 5 Km	0	0	0	23
5 to 10 Km	1	0	0	7
< 10 Km	4	1	0	12

Graph-17 Distance wise number of villages facing impact on drinking water and primary occupations

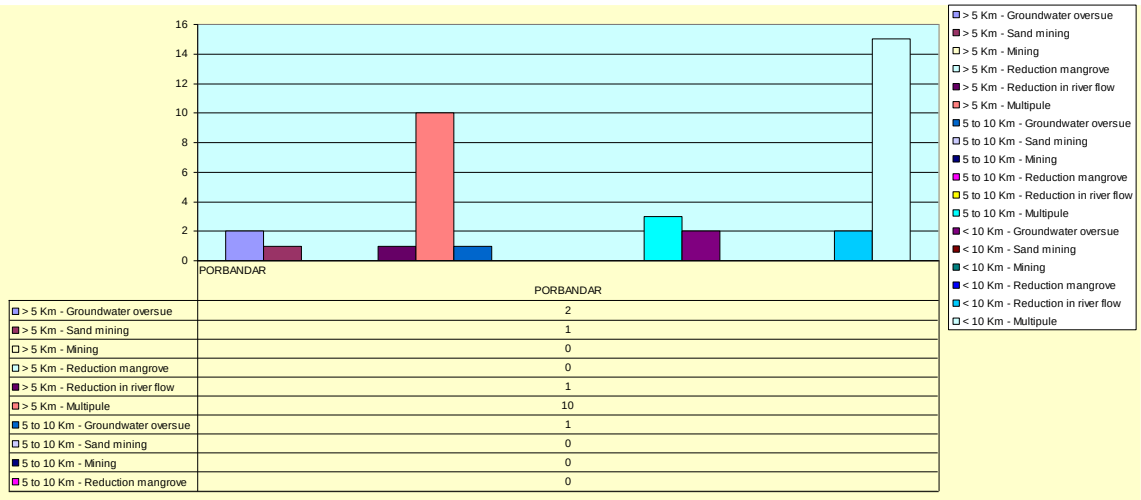


1.Upto5K.M	29	27	28	28	2
2.5.1To10K.M	8	8	8	8	0
3.Above10K.M	23	20	22	15	0

15. Reason for salinity

According to the communities living in the coastal villages, the reasons of salinity ingress in the coastal villages of Porbandar vary from one village to another depending on local situation. Many villages are facing salinity since more than 30-35 years but majority of people believe that the salinity has increased during last 5 years. The situation of natural salinity has been aggravated by human factors like damming of rivers, ground water over drafting for water intensive cropping, cutting of forest and change in rainfall pattern.

Graph-18 Reasons of salinity in relation to distance from the coastline (No. of villages)

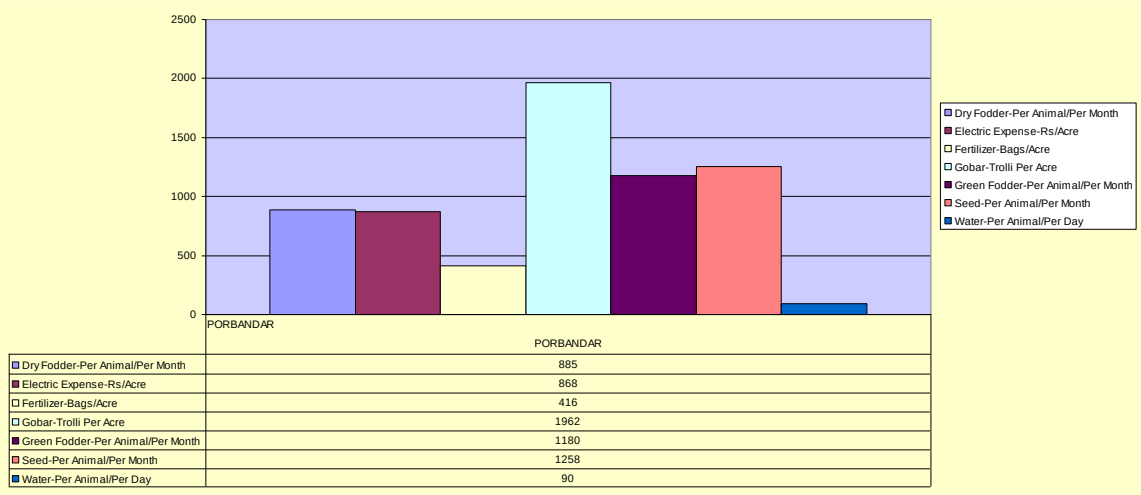


	PORBANDAR
> 5 Km - Groundwater oversue	2
> 5 Km - Sand mining	1
> 5 Km - Mining	0
> 5 Km - Reduction mangrove	0
> 5 Km - Reduction in river flow	1
> 5 Km - Multipule	10
5 to 10 Km - Groundwater oversue	1
5 to 10 Km - Sand mining	0
5 to 10 Km - Mining	0
5 to 10 Km - Reduction mangrove	0

16. Impact of salinity on livelihood

The salinity has impacted the livelihoods of the coastal communities by increasing expenditure for conducting the rural livelihood activities like agriculture and animal husbandry. The saline land demands higher amount of seeds and fertilizer and extra inputs like manure. Due to salinity problem fodder and water required for animal husbandry has become costly. For each animal a monthly expenditure of Rs.1300-1500 is required which does not guarantee returns.

Graph-19 Expenditure on various input cost in study area.



	PORBANDAR
Dry Fodder-Per Animal/Per Month	885
Electric Expense-Rs/Acre	868
Fertilizer-Bags/Acre	416
Gobar-Trolli Per Acre	1962
Green Fodder-Per Animal/Per Month	1180
Seed-Per Animal/Per Month	1258
Water-Per Animal/Per Day	90

17. Suggestion/scope of work

The coastal communities facing salinity problems have given following suggestion for reducing salinity in the Porbandar taluka.

1. There are many mines in Porbandar taluka between Madhavpur and Chikasa. The mines which are now abounded should be used for recharging the ground water. One such location is available in village Untada.
2. The Prosopis sucks sweet water in large quantity and hence activity of removal of Prosopis from the saline wasteland needs to be carried out on priority.

3. The water in Medh creek constructed on earlier salt pan site requires to be deepened by removing the gypsum that is formed at the bottom.
4. The salinity control structure at confluence of river Ozat and Bhadar should be completed on priority basis. This will solve salinity problems in 22 surrounding villages.
5. The coastal canal should be kept filled with water round the year. Two canal sections one between river Madhuvanti and Kadach and another between Chingaria and Mander would help in reducing salinity in the area.
6. Village Chingaria has two ponds which can be repaired along with diversion of canal to provide drinking and irrigation water.
7. There is a need to develop mechanism to remove rain water stored in Ghed around month of October.
8. Extend the coastal canal (require developing a offshoot) from Karli dam to Ugali rivers.
9. All water harvesting structures in Ghed have no gates. It is suggested that all structures should have proper gates for disposal of water.
10. The villages Ghed area receives drinking water from Thoyana head works. This does not provide enough water during summer. This can be solved by connecting Kohala dam with Thoyana head works by extending pipeline from Kedorana to Thoyana head works.

Baseline Study of Coastal Villages affected by Salinity ingress in Jamnagar District

May-07 to March-08

Prepared by:

Saline Area Vitalization Enterprise Ltd. (SAVE)

Prepared for:

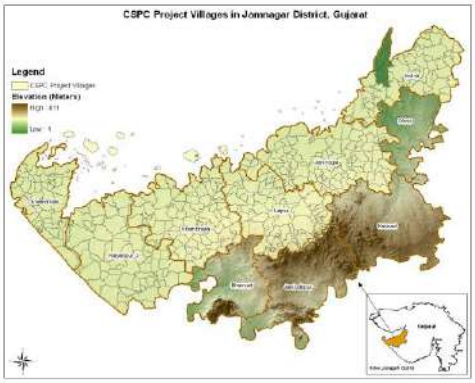
Coastal Salinity Prevention Cell (CSPC)

Jamnagar District

1. Introduction

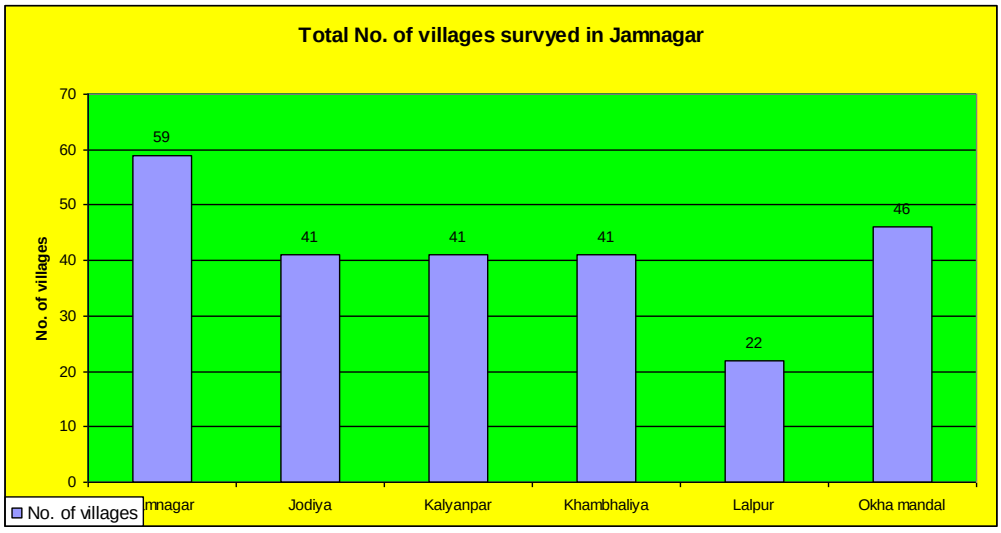
Jamnagar district lies between 21° 47' and 22° 57' north latitude and 68° 57' and 70° 37' west longitude in the peninsular region in the North West, in the state of Gujarat India, known as Kathiawar or Saurashtra. This district is bound on the North by the Rann and Gulf of Kutch, on the East by Rajkot district, on the South by Junagadh district and on the West by the Arabian Sea. Jamnagar district measures about 128.75 km. from North to South and about 167.37 km. from East to West. The area of the district is 10,921 sq. km

2. The coastal area in Jamnagar district



The Jamnagar district has 355 Km. long coast line adjoining to Arabian Sea and Gulf of Kutch. The coastline extending from Harshad in Porbandar to Bedi Bandar in Jamnagar taluka is characterized by open sea and gulf environment with expanding saline wasteland. Almost entire coast line has industrial development in form of mining, ports and chemical industries. The establishment of Reliance and Essar refineries in Jamnagar and Khambhaliya taluka has changed the status of the district as the Oil capital of the country.

Graph – 1 Taluka wise number of villages surveyed



The entire coastal area covering Lalpur, Jodiya, Khambhaliya, Jamnagar, Okhamandal and Kalyanpur taluka are affected by salinity. These taluka cover an area of 385,211.5 ha. which is forming 61% of total area of the district.

The coastal talukas have 248 (53% of villages in six talukas) affected by salinity problems. Compare to other talukas the highest number of villages fall in Jamnagar taluka. According to SIPC, salinity category classification, 127 villages are fully saline, 49 villages are partially saline and 74 villages are prone to saline. The highest number of fully saline villages (37) fall in Jodiya taluka, highest number of partial saline villages (12) are in Kalyanpur and highest number of prone to saline villages (34) are in Jamnagar taluka. The taluka wise number of villages in each category is given in table- 1 below.

Table-1 Distribution of villages according to salinity category

Details	Taluka	Salinity category			
		Fully saline	Partial saline	Probable	Total
No. of villages	Jamnagar	15	10	34	59
% of total villages		25.42	16.95	57.63	100
No. of villages	Jodiya	37	4	0	41
% of total villages		90.24	9.76	0.00	100
No. of villages	Kalyanpur	22	12	7	41
% of total villages		53.66	29.27	17.07	100
No. of villages	Khambhaliya	18	8	15	41
% of total villages		43.90	19.51	36.59	100
No. of villages	Lalpur	1	3	18	22
% of total villages		4.55	13.64	81.82	100
No. of villages	Okhamandal	34	12	0	46
% of total villages					
	Total-study area	**127**	**49**	**74**	**250**
		50.80	**19.60**	**29.60**	**100**

3. Characteristic of coastal Jamnagar

The coastal blocks of Jamnagar district covers western and Northern areas of the district and is characterized by dry climate all round the year. The temperature ranges between 42 and 12 degrees. The average rainfall varies from 350 to 700 mm rainfall occurring during south-west monsoon that occur in 15-30 rain-days during June to September. There are 14 rain gauge stations in the coastal Jamnagar. The numerous rivers draining from north brings water during monsoon in the coastal area.

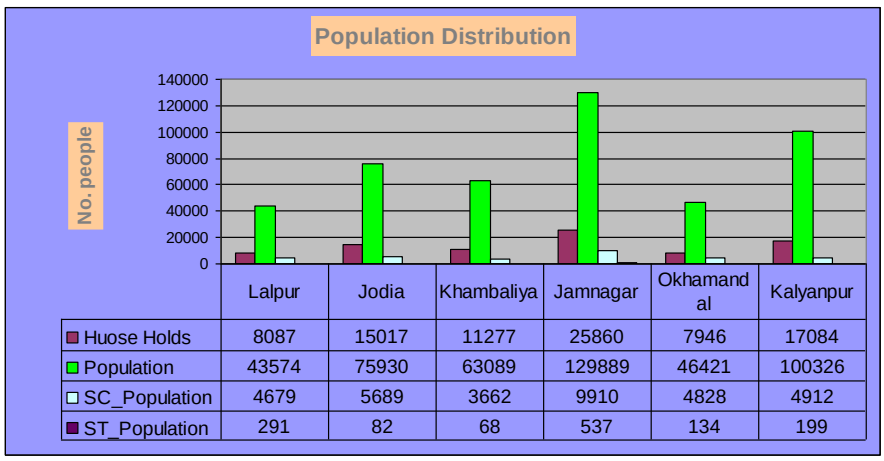
Table-2 Rainfall pattern in coastal taluka in Jamnagar

Taluka	Rainfall (mm)	No. of rain days
Okhamandal	378	15
Khambhaliya	614	13
Jamnagar	665	22
Jodiya	455	17
Lalpur	628	12
Kalyanpur	701	28

The coastal area has two distinct basins draining to north and south. The Northern basin drains river in to Gulf of Kutch, where as south draining basin drains in to Arabian Sea. Geologically, coastal Jamnagar has formation of Laterite, Bauxite, Gaj beds, Dwarka beds, and Miliolitic limestone and alluvium. This area is endowed with aquifers of varying thickness formed by limestone known as miliolitic limestone and clay beds. The coast line run NE-SW direction facing Arabian Sea and west-east on Gulf of Kutch is prone to pre monsoon heavy cyclones. (Refer annexure-1 for physical set up details)

The coastal area in Jamnagar district has become major destination for development of Special Economic Zones (SEZ) and other industrial development. The established industries of salt and mining are expanding with industrial growth. The coastal Jamnagar is also an important site for wind farming. The coastline from Harshad to Okhamadhi has number of wind farms. The oil refinery complex developed by Reliance and Essar are major industrial hubs in the district and coastal area. This has converted major parts of the district in Industrial area. Apart from industrial growth, the coastal area has well established fishing centers like Okha, Dwarka, Salaya and Sikka.

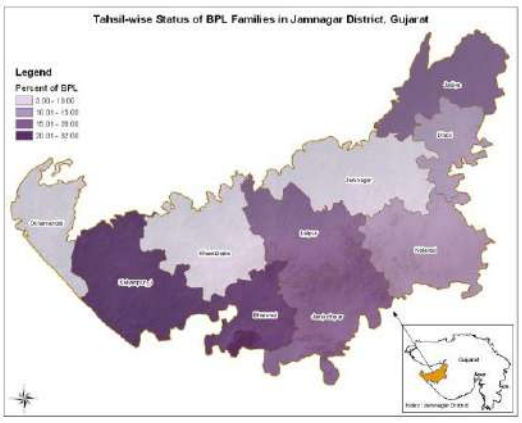
Graph – 2 Demographic details of the study area



The 245 villages cover 385,000 ha area forming 30.40% of total area covered under the study. Majority of them are located within 5 Km from the coats line. It has population of 459,000 persons and 85,271 families which is 25% of total population living in coastal area.

Table 3: Distance of surveyed villages from the coastline

Block	Upto5K.M	5.1 to10K.M	Above10K.M	Total
Jamkalyanpur	12	8	20	40
Jamnagar	20	15	21	56
Jodiya	22	6	15	43
Khambhaliya	22	14	8	44
Lalpur	1	6	15	22
Okhamandal	28	6	6	40
Total	**105**	**55**	**85**	**245**



All class and caste of the people live in these villages however majority of population belongs to Other Backward Caste (OBC) category having caste like Kolis, Rajputs, Charans, Ahirs, Rabaris and others. The schedule caste population includes Harijans and Chamars. The majority of people as in other districts belong to OBC having high dependency on natural resources. The population of general category is dominated by Mers, Patel, Rajputs and Muslims. The 85,271 household includes 20,400 families living below poverty line.

Table–4 Category wise Population

Caste	Kalyanpur	Jamnagar	Jodiya	Khambhaliya	Lalpur	Okhamandal	Grand Total
General	11,093	48,912	29,367	12,172	12,958	9,781	124,283
OBC	88,144	117,596	45,113	53,554	14,210	25,793	344,410
SC	5,216	16,768	5,079	3,966	3,400	4,742	39,171
ST	225	505	153	2,006	268	1,190	4,347

4. Occupation:

The coastal community earns their livelihood through agriculture, fishery and animal husbandry. The industries are providing some opportunities in service and wage employment. The coastal area has about 71,500 farmers. In Jamnagar, the small farmers are highest among the farming category followed by large land holders and marginal farmers. The agriculture labourers are less in number than the land holders. Majority of farmers have small land holding who also carry out animal husbandry for their livelihood. The coastal Jamnagar has many developed fishing centers like Salaya, Sikka, Dwarka and Okha. About 20,000 people are involved in fishing and fish processing industries.

Animal husbandry is carried out along with farming. There are about 13,000 families involved in livestock rearing in coastal area. The numbers of families conducting exclusive animal husbandry are reducing in Jamnagar. The number of families pursuing animal husbandry is more in Okhamandal, Jamnagar and Kalyanpur talukas.

The wage employment in salt production is another important income generation activity in Okhamandal and Jodiya. The number of person involved in various primary and secondary occupations is given in table below.

Table-5 Occupation details (number of person)

Occupation	Kalyanpur	Jamnagar	Jodiya	Khambhaliya	Lalpur	Okhamandal	Total
Big Farmer	5,507	3,906	6,384	3,900	4,105	4,053	27,855
Small Farmer	6,977	6,952	7,527	3,244	2,136	4,239	31,075
Marginal Farmer	2,984	3,464	3,572	1,325	1,180	920	13,445
Agri.Labour	7,172	8,133	3,043	3,991	6,331	3,428	32,098
Animal Husbandry	2,113	3,347	839	2,118	1,753	3,695	13,865
Coal Workers	50	15	187	15	00	2	269
Salt Workers	135	83	260	55	00	618	1,151
Fishermen	321	890	668	16,585	00	1,896	20,360
Small Business	535	2,309	619	467	206	229	4,365
Service	1,503	5,189	2,299	1,682	467	571	11,720
Misc.Labour	8,744	6,356	3,490	4,540	273	1,092	24,495
	36,041	40,644	28,888	37,922	16,451	20,743	180,698

5. Land use pattern

The total Geographical area of six study taluka is 631,542 ha out of which study villages have 385,000 ha (61% of total of taluka). The agriculture land is 242,000 ha. The agriculture land has 15% land which receives irrigation facility through surface and ground water. This area has 21% land not available for cultivation which includes land belonging to marine sanctuary, marshy land and land under other *gamtal* and land under industries.

Table-6 Land use pattern in study villages

Taluka	Area	Forest	Irrigated	Un-Irrigated	Cultivable waste	Not available for cultivation
Lalpur	28,527.51	134.74	2,471.75	16,405.41	2,581.41	6,934.20
Jodiya	72,819.51	2,441.23	6827.40	39,619.84	10,497.05	13,433.99
Khambhaliya	57,070.24	351.53	3,876.93	32,611.81	6,269.30	13,857.67
Jamnagar	65,765.45	545.74	13,258.47	29,444.24	8,059.73	13,997.27
Okhamandal	62,748.40	4,012.94	1,936.88	36,184.29	6,995.35	13,618.94
Kalyanpur	98,280.42	1,865.28	9,191.84	50,941.54	13,943.19	22,338.57
Total	**385,211.5**	**9,351.46**	**37,563.27**	**205,207.10**	**48,346.03**	**84,180.64**

(Source- Village information collection, August 2007)

The Kalyanpur taluka covers the largest geographical area and area not available for cultivation in coastal Jamnagar. Among the coastal talukas in Jamnagar, 1/3rd of the irrigated in coastal taluka fall in Jamnagar taluka. The Jodiya taluka has least irrigated area and highest amount of cultivable waste land.

6. Natural resource

The coastal Jamnagar has both ground water and surface water resources which are developed in the form of ponds, check-dams and bandharas and ground water structures like tube wells, wells and bore wells.

The river Aji, Und, Vanu, Panna, Vatur, Sosai and Fuljar passes through the districts before draining in to Arabian Sea or Gulf of Kutch. Majority of these rivers have been dammed to harvest rainwater. The major dams are constructed on Una, Aji, Fuljar, Vartu and Ghee rivers in study talukas. The water from these dams is carried through canal and pipeline for agriculture and drinking water purpose.

In this district the bore wells are drilled generally between 30 and 500 meters deep. In Okha Mandal taluka, bore wells are drilled by D.R. rig. In parts of Kalyanpur and Okha Mandal taluka, there is inherent salinity, except in few pockets where potable ground water is found. In this area 30 meters to 60 meters deep D.R. tube wells are constructed. The remaining talukas have ground water which was once providing potable water has become saline due to over exploitation. The water levels in the well have become saline at depth of 30 fts. to 100 fts.

The ground water assessment carried out by Gujarat Water Resource Development Corporation (GWRDC) in year 1997 showed potential condition of ground water in Jamnagar, Lalpur and Kalyanpur taluka, where as the ground water situation in Okhamandal, Khambhaliya and Jodiya was alarming. The field visits during study to coastal villages in these talukas show that the situation in coastal villages has deteriorated in last decade in Jamnagar and kalyanpur talukas. The ground water levels have gone down up to 20 to 25 m. and quality of water has become saline.

Table-7 Ground-water (GW) resource assessment in coastal talukas

Taluka Name	Gross Gw Recharge	Utilizable GW) Recharge	Gw Draft	Balance	Level of Development(%)	Category
	Million Cubic Meter/years					
Okhamandal	14.65	11.72	10.22	1.50	87.20	Gray
Khambhaliya	115.08	92.06	68.37	23.69	74.26	Gray
Jamnagar	111.51	89.21	60.85	28.36	68.21	White
Jodiya	31.02	24.82	19.71	5.11	79.42	Gray
Lalpur	124.68	99.74	45.84	53.90	45.96	White
Kalyanpur	77.11	61.69	24.07	37.62	39.02	White

(Source- GWRDC 1997)

The coastal area has three major soils – Desertic soils, coastal alluvium and sandy soils. The sandy soils which are shallow and covers maximum area, whereas the desert soils are found in Okhamandal and coastal alluvium soils which is saline in nature and is found in coastal areas in Khambhaliya, Jamnagar and Jodiya. Some coastal area in Kalyanpur taluka has black soils derived from basaltic rocks. In general soils have depth from 10cm to 50 cm, but along the river valley the depth increases to more than 100 cm. Maps showing details of soil characteristics are in annexure-2.

7. Agriculture

The majority of villages perform rain-fed agriculture except villages in Jamnagar, Jodiya and Kalyanpur receiving water from canal and ground water source. The cropping pattern includes all varieties of food, cash and horticulture crops. The major kharif crops includes Groundnut, cotton, castor and Bajara are major crops in the region along with Til, Moong, Moth and Udad crops. The Jowar is cultivated for fodder purpose. The Rabi crops include wheat, Garlic, onion and Jiru (cumin). The vegetable and horticulture crops are grown on 2% agriculture land. The present cropping pattern for the surveyed villages is given in table-8 below.

Table-8 Cropping pattern (area in hectare)

Crop type	Kalyanpur	Jamnagar	Jodiya	Khambhaliya	Lalpur	Okhamandal	Total
Food Crops	9,518	11,686	20,283	3,315	5,039	4,843	54,684
Oil Seeds	15,470	4,325	7,622	10,556	6,202	4,634	48,809
Cash Crop	2,478	9,209	2,862	1,847	3,098	1,564	21,058
Horticulture	0	8	589	69	25	370	1,061
Vegetable	184	700	541	119	300	330	2,174
Floriculture	0	9	0	0	0	0	9
Forestry	0	0	80	40	0	300	420
Total	**27,650**	**25,937**	**31,977**	**40**	**14,664**	**12,041**	**128,215**

(Source- Village information collection, August,2007)

Table-9 Present crops details

Crop type	Present major crops	Impacted by salinity	New crops adopted	Popular crops
Food	Wheat, Bajara	Wheat	Jowar	Jowar
Cash	Pluses, Cotton, Cummins, Raydo	Pulses, Cummins	Cotton, Raydo	Cotton
Oil seeds	G.nut, Til, Castor	G.nut, Til	Castor	Castor
Horticulture	Chickoo, Dadam, sitafal, watermelon	Watermelon	Dadam, chickoo	Dadam
Vegetable	Chilly, tomato, brinjal	Chilly		

Findings of the Study

- All type of crops (Food, Oil seeds, Cash, Horticulture etc.) is grown in the area.
- Change in agriculture season from three crops to one crop.
- Reduction in horticulture area.
- Crops like chilly and ground nut have reduced.
- Murum/sand is added in soil before ground nut sowing.
- Construction of stone wall in the field to protect groundnut crop damage from saline winds called “Ola” during June-July.
- Shift in cropping pattern in saline villages from horticulture and ground nut to cotton and fodder crops like Jowar.

- Agriculture in saline area demands high inputs and hence it is expensive.
- The increased salinity has affected the productivity as well as quality of sown crops.
- Use of Irrigation systems like sprinkler and drip is increasing surveyed villages.

8. Livestock

The six coastal talukas recorded 5.49 lakh animals including milch, drought, sheep and goat and other in 1997 animal census. This includes, 220,990, 134,912, 157,009 cows, buffalos and sheep & goat. The study villages covering 61% geographical area have recorded 47,076, 62,444 and 137,000 cows, buffalo and sheep. This shows that the surveyed villages have lower average population of milch animal while have higher average population of small animals.

On an average each village has 500-600 milch animals. In these villages buffalos are preferred for milk production. In majority of villages in Jamnagar, *Ghee* is sold instead of milk. The *Ghee* market of Khambhaliya is known all across Gujarat. The population of buffalos is 1.5 times of cows. The average milk production ranges from 5 to 6 liter/day in summer to 12 liter/day in winter season. The increasing salinity is creating health problem in the milch animals.

The sheep and goat rearing is very strong in coastal area across the villages. This is mainly due to availability of wasteland for grazing purpose. Its population is high Jamnagar, Kalyanpur and Jodiya talukas having canal irrigation. Table-10 below shows population of animals in villages covered under the present survey.

Table-10 Livestock population in study villages

Block	Cow	Buffalo	Bullock	Goat	Sheep	Camel	Poultry
Kalyanpur	8,329	12,185	17,159	9,323	13,445	174	500
Jamnagar	9,743	16,394	6,390	15,136	18,720	314	711
Jodiya	5,390	10,413	7,637	10,111	13,741	201	785
Khambhaliya	6,697	9,539	11,895	8,695	17,559	180	11,355
Lalpur	5,613	6,634	4,055	5,761	4,437	73	5
Okhamandal	11,304	7,279	9,282	9,836	10,562	499	870
Total	**47,076**	**62,444**	**56,418**	**58,862**	**78,464**	**1,441**	**14,226**

Table-11 Livestock population according to distance from the coastline

Distance	Jamnagar	Jodiya	Kalyan pur	Khamb haliya	Lalpur	Okham andal	Total
< 5 K.M	21,301	22,761	24,778	36,830	3,896	25,492	135,058
5.1To10K.M	23,387	7,599	7,826	9,219	6,346	13,221	67,598
> 10 K.M	21,470	17,918	28,470	9,066	16,336	10,919	104,179

Observations on animal husbandry

1. The population of animals is showing declining trends. However, in villages where new water sources are established the numbers of animals have increased due to availability of green fodder. E.g. villages in Jodiya taluka.
2. The largest livestock population is found living in villages located at distance of less than five Km from the coast line. The highest amount of livestock population is coastal villages less than 5 Km is found in Khambhaliya. This would be affected badly if salinity problem becomes critical.

3. Small animal rearing is found to be viable option due to availability of plenty of wasteland and drinking water facility.
4. Animal husbandry is done as a supplementary income generation activity along with agriculture. In Khambhaliya and Jamnagar Taluka “Ghee” is sold in the market.
5. The 245 villages covered under survey have 74 milk co-operatives. The Jodiya taluka have 30 milk co-operatives followed by Kalyanpur taluka.
6. Due to increasing salinity, the health of the animals is deteriorating by consuming salt through fodder and water. The major animal diseases are related to kidney and digestive system.
7. Due to salinity problem, the animal rearer are changing feed habit and adopting fodder management practices as major practices change. These changes are mainly observed in Jamnagar and Jodiya taluka. In Okhamandal 3-4 villages have shifted to small animal rearing. The villages in remaining three talukas i.e. Kalyanpur, Lalpur and Khambhaliya have not adopted any major changes in animal husbandry.
8. The drinking water for animal is major constraint in the coastal area. In the study villages animals are fed on water from creek, river, cattle troughs and ponds. None of these sources last round the year.
9. Shortage of fodder due to reduction in Groundnut crop area.
10. Growth of Prosopis has lead to reduction in availability of grasses from village waste land.
11. Rapid industrialization in Lalpur and Khambhaliya has reduced area of village guachar available for animal grassing.
12. Increase in Jowar cropping on saline land not suitable for cotton or ground nut.
13. Majority of families prefer to keep animals for in house consumption.
14. Major animal health problem in salinity affected villages leading to poor milk yield.
15. Reduction in number of Maldhari families.
16. Increase in animal husbandry in Jodiya is due to availability of canal water and fodder from waste land.
17. Buffalos are preferred animal for milk production across all villages.
18. Average milk production 8-10 liters.
19. The saline water create health problem.
20. Milk production during six-eight months in a year.

9. Fisheries

The coastal Jamnagar has established fishery centers like Okha, Dwarka, Salaya and Sikka. There are about 8,000 families involved in fishing business. Apart from this larges floating population from Junagadh, Porbandar and Amreli stay in these centers during fishing season. In local population fishing is restricted among Muslims and Kolis families. The production of fish is reducing because of construction of Bandhara, salt pans and mining activities in near shore area which result in reduction in fish catch in near shore area. The fishermen have to go for deep sea fishing, which result in increasing depends of the fishermen on money lenders. The information shared by fisheries department office indicates that there is a good potential for development of prawn cultivation in all talukas. The department has proposed a project for prawn farming in Jodiya taluka.

10. Irrigation

The coastal Jamnagar has 17% agriculture under irrigation. The Jamnagar and Kalyanpur talukas have relatively better irrigation facility than the other coastal talukas in Jamnagar district. The Okhamandal taluka having only 5% irrigated area is the poorest irrigated taluka.

Table-12 Irrigated agriculture in study talukas

Taluka Name	Agriculture Area (Ha)	Irrigated Land Area (Ha)	% Irrigated Area
Okhamandal	38,121.17	1,936.88	5.08
Khambhaliya	75,758.68	8,871.72	11.71
Jamnagar	72,966.46	23,356.85	32.01
Jodiya	57,676.27	9,026.48	15.65
Lalpur	61,916.67	7,405.57	11.96
Kalyanpur	88,938.45	18,903.33	21.25
Total	**395,377.70**	**69,500.83**	**17.58**

(Source- Census, 2001)

The information of irrigation sources shows that both surface water and ground water sources are used for irrigation. The use of ground water in Kalyanpur is much higher than all other talukas mainly due to potential ground water aquifer found in limestone strata at a shallow depth. The poor ground water quality in Khambhaliya has promoted farm ponds, check dams and irrigation ponds for providing protective irrigation to the crops. The wells are used as a main source of irrigation, however these wells do not yield adequate water, the well which were able to yield water for 8 to 10 hours are now yield water only for 2-3 hours and hence the net irrigated area through well has reduced sharply in Kalyanpur and Lalpur talukas. The quality of ground water becomes saline below 30-40 feet, however in absence of any other source, the farmers use well water for cultivation of salt resistant crops like Jowar and cotton. The use of saline water results in reduction in crop production during next season.

The water intensive cropping pattern like vegetables, wheat and cotton in Kalyanpur, Khambhaliya and Jamnagar reduces water productivity.

Table-13 Irrigation structures Type and numbers

Type	Kalyanpur	Jamnagar	Jodiya	Khambhaliya	Lalpur	Okhamandal	Grand Total
River	6	54	27	37	69	9	219
Irrigation Pond	28	41	46	26	72	24	237
Village Pond	16	54	33	54	18	74	264
Farm Pond	420	256	150	641	179	177	1,827
Canal	52	29	14	5	5	1	109
Check Dam	37	219	215	177	160	28	887
Bandhara	3	11	6	1	8	6	37
Bore Well	10,046	3,730	718	991	1392	155	17,553
Well	18,929	6,854	4,918	4,416	2,430	1,627	43,425

(Source- Village survey, August 2007)

Observations

- The depth of sea water intrusion varies across study area.
- The uncertain rainfall pattern has given way to large number of ground water structures in coastal area. This is a major cause of salinity ingress in water.
- Ground water in entire region is saline below 30 ft.
- The surface water storage turns saline as summer approaches.
- Almost no source of ground water is potable.
- High rate of rain water recharge in aquifers but people observe that recharging rainwater turn the wells saline.
- Majority of drinking water schemes are based on surface reservoirs

- The SIPC has constructed 48 Bandharas, 460 check dams and spreading channels under HLC-II in area from Madhavpur to Maliya. At present four major Bandharas named Beh, Bhogat, Balmbha and Jambuda work is going on.
- The SIPC face major conflict of interest with Marine National Park for construction of salinity control structure in coastal area of Khambhaliya, Jamnagar and Jodiya causing more and more land saline.
- Many Bandhara schemes have in fact increased salinity in the region. E.g. in village Bharana in Khambhaliya taluka construction of Bandhara has increased the salinity in surrounding area causing 50 well saline and 240 ha. land.

Table-14 Adaptation of water saving technologies

District	Application received		Work order issued		Work completed	
	No.	Hectare	No.	Hectare	No.	Hectare
Bhavnagar	943	1,200	788	940	821	1,042
Junagadh	3,524	4,603	3,255	4,056	3,100	3,752
Jamnagar	727	1,003	652	903	588	846
Amareli	897	1,447	510	675	419	567
Kutch	266	895	256	839	413	1,035
Total	**6,357**	**9,148**	**5,461**	**7,413**	**5,341**	**7,242**

(Source : Web site Gujarat Green Revolution Company-progress report)

As shown in table-14 above, as compare to other coastal districts, the promotion of drip irrigation is slow in Jamnagar district. Discussion with agent of Netafim-a company in drip irrigation business, those farmers using drip in coastal areas face problems of choking of tubes due to salinity. Due to this reasons farmers are not willing to adopt drip irrigation. To solve this problem the company has developed “Fertiliser injector” system which solves the problem of chocking of pipes. According to local people, about 80 ha land in Khambhaliya and Bhanvada is irrigated using drip irrigation system. The farmers growing vegetables show more interest in adopting drip irrigation.

11. Drinking water

The availability of fresh and potable drinking water is major concern in coastal villages in Okhamandal, Kalyanpur Jamnagar and Khambhaliya. The existing local drinking water resources have become saline which do not yield potable water. At present people are dependent on more than one type of water sources.

Table-15 Taluka wise number of sources of drinking water

Source	Kalyanpur	Jamnagar	Jodiya	Khambhaliya	Lalpur	Okhamandal	Total
Rivers-No. of villages	7	40	22	42	94	4	209
Pond	10	57	35	100	63	75	340
Open wells	4,298	1,935	1,694	1,193	108	1,228	10,456
Tube wells		14	18	335	55	175	597
Hand pump	50	194	84	131	182	59	700
Pipe Line	28	11	44	12	2	8	105
Rain Water Tank	5	59	305	114	1	793	1,277
Tanker	4	16	0	60			80
Grand Total	**4,402**	**3,435**	**6,627**	**1,987**	**505**	**2,342**	**19,298**

To tackle the drinking water problem, the state government is providing drinking water supply by pipeline in more than 105 villages covered under the survey. The information gathered for district level situation of drinking water shows that almost 50% villages are receiving drinking water from the pipeline supply connected with various surface water storages like Narmada water, Aji, Und and Panna water supply schemes. In coastal villages 14 R.O plants are proposed in villages of Jodiya (8), Okha (4), Kalyanpur (1) and Jamnagar (1).

Table-16 Status of drinking water supply in coastal talukas of Jamnagar district

Taluka	Total village	Type of scheme					
		Group	Individual	HP	Well	R.O	Total
Jamnagar	112	83	12	3	1	0	99
Jodiya	52	50	0	0	0	0	50
Kalyanpur	69	46	12	2	5	0	65
Khambhaliya	85	13	56	8	5	0	82
Lalpur	73	4	65	2	1	0	72
Okha	77	39	2	0	0	0	41
Total	**468**	**235**	**147**	**15**	**12**	**0**	**406**

At present 140 water supply schemes are sanctioned in Jamnagar district, more than 85% are completed and remaining are under progress.

Table-17 Status of drinking water schemes in coastal talukas of Jamnagar district

Taluka	Total villages	Present status			
		Sanctioned	Completed	Under process	Total
Jamnagar	112	18	9	9	18
Jodiya	52	52	52	0	52
Kalyanpur	69	17	9	8	17
Khambhaliya	85	20	18	2	20
Lalpur	73	10	7	3	10
Okha	77	23	23	0	23
Total	**468**	**140**	**118**	**22**	**140**

Findings of the survey

- Out of 245 villages, 150 villages face problem of adequate drinking water availability. All of them also face other problem like quality and variation in seasonal supply.
- 82 villages receive drinking water supply on regular basis.
- The roof rain water harvesting system is adopted in Okhamandal and Jodiya.
- The local water resource yield saline water as the season approach towards summer.
- The industrial establishment uses RO system for drinking water consumption in colony.
- In Mithapur, TCL recycle, the waste water to reduce the use of purified drinking water for domestic purpose.

12. Health

The villages in coastal Jamnagar are facing health problems such as Malaria, stone in Kidney, Florosis and gastric problems. The health problems like Malaria and water born diseases have increased after industrialization. According to health officer the patients with HIV-AIDS has also increased due to migratory population in the coastal areas.

The village level information collected from 245 villages shows that the health problems exist in all villages. The health problems associated with drinking water like kidney stone, Florosis and gastric problems are more in villages close to sea.

Table-18 Health problems in villages in relation to distance from coast

Diseases type	No. of villages at distance of		
	< 5 Km.	5 to 10 Km.	<10 Km.
Malaria	100	53	91
Water Born Diseases	85	40	78
Stone In Kidney	76	44	76
Florosis	47	29	41
Gastric Problems	79	47	64

- Greater impact of salinity on health status of the community is seen across all talukas.
- Poorest health indicators are observed in Okhamandal taluka.
- Kidney stone diseases reported across the study area indicating water quality problems.
- Skin diseases prevail in 40% of villages.
- Well spread out public and private health facilities.
- Malaria is major seasonal dieses occurring across all villages.
- The villages facing kidney stone and Florosis problem are more in Jamnagar, Khambhaliya and Okhamandal taluka.
- In Kalyanpur taluka, the number of villages having health problems is more away from the coastline.
- In Jodiya, the Florosis problem is high in villages located beyond 10 Km. from the coastline.

13. Migration

The migration is relatively low in coastal Jamnagar. About 5,500 persons out of 1 lakh families migrate seasonally. This may be due to industrial development and development of local industries like salt, fishing and edible oil industries. The majority of migratory population is small animal rearers and unskilled labourers.

14. Salinity Ingress

Patterns of salinity

The coastal villages in Jamnagar districts have reported salinity since more than 10 years. In last five years salinity ingress is felt in 89 villages across all talukas. The impact has increased in Khambhaliya taluka, where sixteen villages have observed salinity in last five years. Ten year back only 11 villages located at a distance more than 10 Km were facing salinity problem.

Reasons of Salinity

The salinity ingress has taken place due to various reasons. Generally, more than one reason contributed to salinity problem in Jamnagar district. The development of industries during last decade has accelerated the process of salinity ingress mainly due to increased use of ground water by industries, use of sea water for industrial processes. On other hand continued irregular rainfall after 1970 has lead to over exploitation of the ground water in areas where it was available at shallow depth. The reduction in mangroves plantation in

coastal area has resulted in salinity ingress particularly in Jodiya, Khambhaliya and Okhamandal talukas. The discussions with communities also indicate that at many locations, the poor construction of structures created for preventing salinity ingress has become reason for increasing salinity. In case of spreading channels, the water stored becomes saline which is used for irrigation by the farmers this has increased the soil salinity in the new area. The villages in Kalyanpur and Okhamandal have reported increase in salinity due to saline wind blowing from the salt pan as well as leakage of salt brine, transportation of salt etc.

15. Impact of salinity problem

The salinity ingress has impacted all type of resources as well as livelihood activities. The major impact is felt on drinking water and agriculture. The overall impact on these resources and livelihood is more in villages located in periphery of 5 Km from the coastline. Among all talukas, more impact is felt by villages in Jamnagar, Khambhaliya and Okhamandal taluka.

15.1 Impact-Drinking water

The drinking water resources are increasingly become rarer in the surveyed villages due to salinity ingress. The major issue with drinking water is the poor quality of water. All together 115 villages face drinking water quality problem. The water is supplied through various sources through group and local water supply schemes. The quality of drinking water is not potable. The second major problem is inadequate supply. 120 villages have reported problem of inadequate drinking water problem. The largest numbers of villages are in Jamnagar taluka. About 35 villages have no potable source left in the village. As a result of this impact, villages are dependent on the use of drinking water from more than one source, 19 village have to depend on water supplied through tanker and 39 villages purchase drinking water.

15.2 Impact on agriculture

The salinity ingress has major impact on agriculture in coastal village of Jamnagar. The crop productivity has reduced to a level that certain food crops cultivation becomes non-viable. The productivity of crops like cotton, Bajara having tolerance to salinity has reduced. The vegetable crops which were grown easily earlier have now reduced in the area. The coastal area in Jamnagar was known for chilly production, now the area under chilly has reduced drastically. The ground nut, the main crop of the area is now fast replaced by cotton due to salinity problem. In cotton the amount of pest attacks have increased. People are now looking for crop which can provide better economic returns. The farmers have started reduced cultivation of food crops, instead of which they prefer to cultivate castor, Jiru and cotton. Apart from salinity, the industrial pollution is also causing decline of agriculture in Khambhaliya, Lalpur, Okhamandal and Kalyanpur taluka.

The farmers are not able to cultivate their farms due to change in soil structure and texture. The soils have become hard which require high cost of cultivation. Due to fear of poor production the farmers use higher amount of seeds and fertilizers which in turn demand more water.

The horticulture crops ones found in all talukas are now restricted in few talukas which includes Jamnagar, Lalpur and Kalyanpur having some irrigation facility though canal. In other parts horticulture has vanished.

Overall, the agriculture in the coastal Jamnagar is reducing. The agriculture land which remains uncultivated for 2-3 years eventually becomes wasteland. The change in agriculture pattern has reduced availability of fodder for animals from the agriculture. This has reduced

animal husbandry in the area. The farmers are now waiting for industries to purchase their land in Jamnagar, Khambhaliya and Okhamandal talukas.

Those who are willing to continue with the farming activity try various solutions for maintaining the farm productivity. The major efforts are found in Jamnagar, Jodiya and Okhamandal, where farmers are implementing soil and water management practices, change crops and try out new varieties of seeds. The soil and water management practice change is a major initiative taken up by the farmers in this talukas. The other important remedial measure is crop change where farmers are shifting to salt resistant crops like cotton, Jiru and Jowar in place of groundnut and wheat.

15.3 Animal husbandry

The salinity ingress has reduced the fodder availability for the animals. The grasses grown on the common land has become saline. Consuming saline grass and water deteriorates the health of the animals. The milch animals become weak and their milk production capacity reduces. In many villages people have reported poor death of animals due to consumption of saline fodder and water. The average life of milch animal has been reducing lower than the animals in the non-saline villages.

Due to salinity, the livestock rearers are shifting to small animals in villages of Jodiya, Khambhaliya and Okhamandal taluka. The constraint of fodder has resulted in awareness about fodder and feed management in livestock rearer in these villages.

15.4 Fisheries

The salinity has impacted fisheries sector directly by reduction in fishing in near shore areas. The major impact on fisheries has happened due to industrial pollution causing changes in near shore area. The reduction in mangrove has also contributed to reduction in near shore area. The reduction in mangroves having capacity to control salinity in near shore area has resulted in change in water quality impacting the diversity of fish specifies in the sea.

16. Major Initiatives

- Initiatives taken up

By Government department

- By irrigation department (SIPC)-preventive structures as per HLC-2
    - Bandhara-Ghed, Bhogat, Balmbha, Jambuda
    - 184 check dams
    - By WASMO-drinking water pipeline & local resource enhancement
    - Watershed projects in Jamnagar & Lalpur
    - Promotion of Water saving device by GGRC
    - Subsidies procurement schemes for fishermen.
- Major Initiatives taken up

By Non-Government department

- Awareness about water conservation and mining activity
- Drinking water source enhancement
- Demonstrations of people oriented technologies
- Promotion of organic farming & drip systems.
- Water harvesting, promotion of alternative cropping
- Private companies for seeds, pesticides provide input as well as crop advices. (Rallis and other)
- Weather Insurance for groundnut crop by SAVA in coastal talukas.
- Farm ponds by CSPC and SAVE in Kalyanpur.

    - Pilot projects on Jethropha cultivation in saline wasteland in Okhamandal and Khambhaliya by Tata Chemicals Limited and D-one oils, Uk.
    - Mangroves plantation in Okhamandal.
    - Promotion of income generation program through art and craft resource center by TCSRD, Mithapur.
- Major Initiatives taken up by individual (farmers)
    - Adoption of less water intensive cropping
    - Adoption of salt tolerant crops like Cotton, Jowar.
    - Rain water harvesting-well recharge, RRWH, farm ponds
    - Farm Bunds
    - Farm drains for draining saline rain water in Khambhaliya and Kalyanpur taluka.
    - Construction wall around farm for protecting ground water and vegetable crops from saline winds.
    - Use of sand and gypsum for improving porosity of sand.
    - Sealing of saline well
    - Roof Rain water harvesting structures for drinking purpose.

17. Possible interventions

The salinity in coastal Jamnagar area has different impacts on livelihoods and natural resources. The survey has observed many possible interventions to prevent salinity. The topography, geology and soil structure is suitable for promotion of natural resource management programmes such as watershed development, wasteland development and grass land development. The government department of agriculture is running special programme called “ATMA” (Accelerating Technology and Management in Agriculture) which provides a good platform for linkage to develop technologies for saline area. Apart from this the saline area is also looked at as a potential area for energy plantation like Jethropha and other oil seeds. Different companies are exploring possibilities of cultivation of these crops in Jamnagar district. This may provide alternative cultivation to farmers having marginalised lands.

The opportunities found through discussions with various officials and experts are listed below.

- The agriculture land in Jamnagar district is stony, sloppy and undulating in nature which results in larger runoff flowing to sea during monsoon. On the other hand it provides good scope for water harvesting as well as well recharge.
- The village pond is an integral feature of villages of coastal Jamnagar. These ponds having green trees on the bank of ponds indicating fresh water in those ponds. These water sources can help in increasing water storage by excavation 15 to 20 feet depth with recharge bore well in the pond.
- The coastal tracks in Jamnagar have large number of stones and bauxite mines. After completion of mining activity, the mines/quarry sites are left as open pits. These abandoned mine/quarries sites could be utilized as recharging structures with small investments. The Gujarat Mineral Development Corporation (GMDC) has been giving direction for using abandoned mines for under ground water recharge purpose. Generally, it is believed that Bauxite mines are responsible for increasing salinity in land. However, people do not agree to this. Looking at the increasing salinity ingress private mine owners are giving permission to use abandoned mines for ground water recharge.
- In Kalyanpur taluka farm ponds are useful for providing protective irrigation to the ground nut crop. The pilot project done by SAVA has received very good response from the farmers. Farm pond helps in soil conservation as well as in providing protective irrigation

during critical stage in groundnut crops which leads to maintaining of crop productivity. According to farmers, lack of protective irrigation during critical stage of groundnut results in 50% reduction of outputs. The farm ponds also help in preventing soils salinity caused by use of saline water.

- The continuous use of chemical fertilizers in irrigated agriculture is one of the reasons for increasing soil salinity. In the study taluka, though farmers acknowledge the problem but do not use vermin compost manure and compost manure which would help in reducing the salinity in the land.
- The large amount of saline wasteland is a characteristic of coastal area in Jamnagar district. The increase in salinity in costal area is leading to increase in wasteland area. The agriculture land affected by salinity if kept un-cultivated for three to five years gets covered by *Prosopis Juliflora.* Similarly the grazing land affected by salinity results in uncontrolled growth of *Prosopis Juliflora*. A systematic management of *Prosopis* can help in converting the waste land in to fodder plots which can boost animal husbandry in the rural areas.
- The coastal area of Jamnagar district is muddy in nature which is suitable for mangrove plantation. This can help in preventing spreading of salinity. It is noted that the area behind natural mangrove forest are saved from saline winds which is one of the major factor in increasing salinity in Jodiya taluka. The mangrove forest will also help in promoting fisheries and provide protection against cyclone which is a major threat along this coastline.
- The former rulers of Jamnagar had constructed a salinity protection bund all along the coastline. This bund acts as a barrier between the sea water and agriculture land behind the coast. In 1979, the floods in Machhu River had broken the bund at number of locations, which has allowed sea water ingress in agriculture land converting thousands of acres of agriculture land saline in Jodiya taluka. The local people informed that the repairing and converting the existing bund can help in reducing salinity and also distance between Jamnagar to Kutch. The people from Jodiya suggested that if the bund is developed as toll road, the expenditure can be recovered from toll tax and also help in restrict expansion of saline area.
- The salinity levels in many villages of Jodiya, Khambhaliya and Okhamandal has reached high levels which has made cultivation of traditional crops like Bajari, groundnut and wheat economically unviable. In these villages, farmers have left saline fields uncultivated allowing it to become wasteland. The experience in other saline land indicates that such land can be used for cultivation of Kasumbi, chickoo and Jowar which could be grown with less water. In Khambhaliya taluka D-one oils, a UK based company producing Biodiesel from Jethropha has started pilot project on 200 acre land.
- The villages having good potential of ground water in Okhamandal, Khambhaliya, Jodiya and Kalyanpur needs to change irrigation methodology by using water saving technologies like drip and sprinkler. This can lead to reduction in ground water consumption in water intensive crops like vegetables, ground nut and wheat.
- The promotion of dairy network under Saurashtra-Kutch dairy project in coastal areas provides a good opportunity in promotion of animal husbandry in coastal villages. This opportunity can only be harnessed by improving availability of fodder and drinking water for animals. According to people from these villages, fodder can be managed by cultivation of salinity resistant fodder crops like Jowar, however, they are facing major problem of drinking water for animals. If animals drink saline water it will have lead to health problems or untimely death of animals. In such areas, promotion of roof rain water harvesting structures for animals can serve a good option for storage of fresh water for animals. These structures can also help in storage of purchased fresh water.
- The villages in Jamnagar, Jodiya and Khambhaliya taluka have good opportunities for promotion livestock rearing. In Okhamandal rearing of small animal can be strengthen by providing better infrastructure for vaccination and veterinary care services.

- The wool based crafts can be promoted as non-farm sector income generation activity in Okhamandal and Kalyanpur taluka.
- In Khambhaliya taluka people cultivate vegetable crops particularly tomatoes during winter season. The promotion of drip system among farmers cultivating tomatoes will help in water conservation. The quantity of tomatoes would be enough to establish processing units which can provide employment as well as ensure better returns to farmers.
- The farmers believe that increase in use chemical fertilizers has contributed to increase in salinity. In this context, a practice of using mix of chemicals and organic fertilizers in salinity affected villages can be useful to control soil salinity.
- The major hurdle in well recharge using rain water as observed by local people is that, salinity goes along with rain water in the wells. Using this water for recharge contaminates the ground water. Due to this reason people do not pursue well recharge.
- The strong winds bellowing from the sea and salt pans area cause salinity in larges coastal tracts. For preventing this wind breaker plantation such as Saru should be carried out along the farm boundaries in the sea coast of Kalyanpur and Okhamandal.
- In Okhamandal taluka, large number of ice factories use ground water and dispose saline waste water which mixes with ground water causing water salinity. Action should be taken to stop this practices as well encourage them to adopt rainwater harvesting.
- The coastal area in Jamnagar has presence of corporate giants like Tata chemicals, Reliance, Essar, GSFC, Birla etc. running their corporate social responsibility programmes. There is a good opportunity to establish linkages for skill development and natural resource management programmes for local youth.
- The Reliance industries have developed their own horticulture venture in this area for marketing of mangoes.

ANNEXURES

Maps, Tables & Graphs

Annexure – 1

1. Physical features

1.1 Geomorphology

The coastline from Diu extends northwestward right up to Dwarka, is remarkably straight. The famous miliolitic formations are found along this part of the Saurashtra coastline. In this segment the coastal plains are 5.50 km. wide, sloping very gently towards the sea and seen traversed by quite a few longitudinal - parallel stabilized miliolite dunal ridges.

The present day shoreline comprises partly submerged dunes, cliffs, wave-cut platforms. Above the high water line all along the shoreline prominent coastal ridges are seen. At certain places where the river mouths cut the shoreline, the sandy ridges form well defined spits and bars with lagoonal patches behind them. The beach or lower foreshore is narrow varying from 5 to 150 m. in width, with the backshore sandy ridge rising to almost 15 m. above the berm line. A salient feature of the foreshore and near off-shore is the presence of numerous submerged and dissected stabilized miliolite ridges either form rocky platforms or project out as steep cliffs of 8 to 10 m height from a veneer of loose beach sands.

The coastline is indented by a number of inflowing rivers their mouths typically forming tidal creeks with lagoons. All these creeks are characterized by sandy spits and are giving rise to linear backshore lagoonal mudflats behind the coastal ridge. The coastline from Dwarka to Meda is intermittently rocky.

1.2 Hydrogeological situation

This coastal block directly face an open ‘Arabian Sea' characteristically marked with less tidal variations, strong long shore drift current and wave actions. This block comprises highly fertile land and so the inhabitants have over utilized the terrain resources, water in particular. This has witnessed an unprecedented problem of salinity ingress and the entire coastal tract between Harshad and Okha became the main front of sea water intrusion.(Refer map-1 &2)

The diversity in hydro geological environments along this segment is attributed to its geomorphic characteristics, offering numerous landform characters viz. cliffy shoreline, tidal creeks, coastal dunal ridges, point bars, large surficial depressions etc. Here also the miliolitic limestone forms the potential aquifer for groundwater supply. On account of over exploitation, the water table has witnessed a sharp decline in its level. In the span of seven years it has reduced by 4 -15 m. causing saline water ingress up to 10-20 km. inland areas. The average depth to water table is in the range of 8-20 m. The area adjacent to Madhavpur Navi Bandar (i.e. Bhadar river creek), though agriculturally potential, constitutes a low lying regional depression, causing flooding and inundation problems.

The depth to the water level in the northern parts i.e. area around Porbandar - Miyani - Dwarka - Okha shows variation which is attributed to near vicinity of the sea and the aquifers composition viz. limestone, basalt etc.

This gulf coast is significant from the point of view number of ports, harbours, industrial settlements, and major urban centers. This coastal tract is represented by variety of lithological formations governing aquifer development. The dominant ones are limestone’s; Deccan traps Quaternary sands and gravels, sandstones etc.

The disposition pattern of limestone - clay formations of Gaj-Dwarka beds in and around Okhamadhi result in wide range of variation in water table in relatively small area facing the Gulf of Kutch.

The coastal between Bhatiya and Jodiya is predominated by the basalts overlain by the coral reefs and alluvial cover. Here the variations in depth to water table indicates northerly gradient. However, due to perennial inundation problem, the water table around Bhatiya is still shallower and is influenced by the high level of salinity rendering use of ground water for farming and drinking. The shallow water table is marked by salinity levels as high as 8,000 ppm.

The northern coast bordering gulf of Kutch extending through Maliya - Kandla - Mandvi is characterized by the geomorphic features comprising of raised and intertidal mudflats, creeks, little Rann of Kutch, coastal dunes etc. Apart from the Rann, rest other features form a part of narrow pediplains comprising Mesozoic group of rocks at their base.

The average depth to the water table is 10 m however the deeper aquifers are also present. The most important and productive aquifer occurs in the Bhuj sandstone in depth of less than 10m to 300m. The salinity distribution in the phreatic aquifers is rather uniform with low values in the uplands. The values increase towards the areas of discharge. The segment shows deterioration in groundwater quality. The quality tends to be unfavorable (saline) below 150 m.

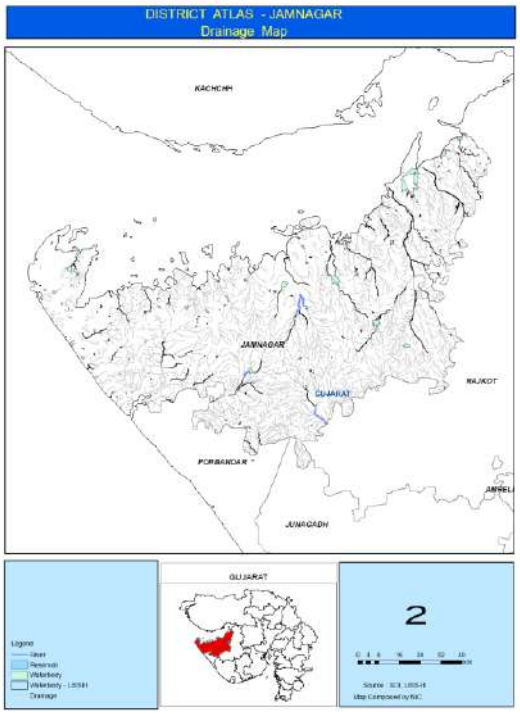
1.3 Geo-environment

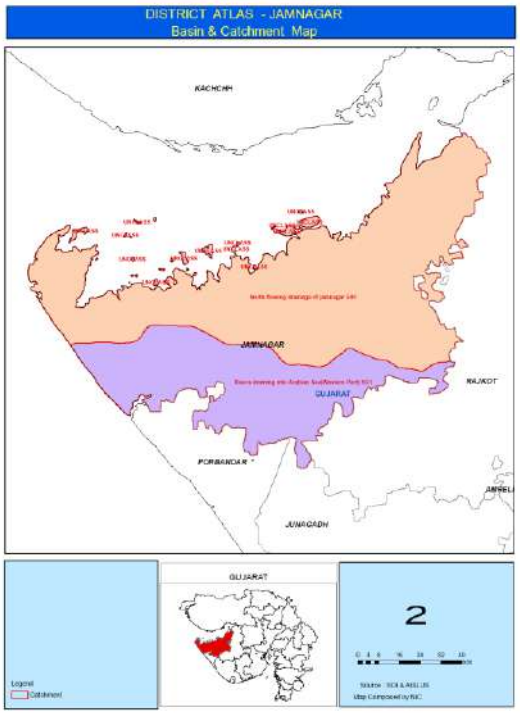
This coastal segment is almost straight and trending NW-SE and characterized by uneven substrate of submerged miliolitics. This coast experiences the maximum impact of powerful breakers and resulting surf action due to strong southwesterly and westerly winds. This high energy coastal segment is also seen to experience considerable erosion and formation of submerged miliolitics. The various rivers do not carry much sediment load and hence have minimum turbidity. But, the river water contains $CaCO_3$ thus augmenting to the $CaCO_3$ content of the sea waters.

This coastal segment form the Gulf of Kutch region, comprises of coral reefs, bets, extensive mudflats. Adjoining little Rann of Kutch with its salty waste land is conspicuous in this segment. The Gulf environment has high tidal energy but low wave energy conditions when compared with the open-sea coastal environment. The tides are moderate as compare to that in the Gulf of Cambay. The height of the tides is around 4 to 8 M. The coastal segment between Little Rann of Kutch and Mandvi is marked by mudflats. The presence of tidal flats are necessitated by the presence of creeks through which tidal waters enters the river channels carrying low detritus load.

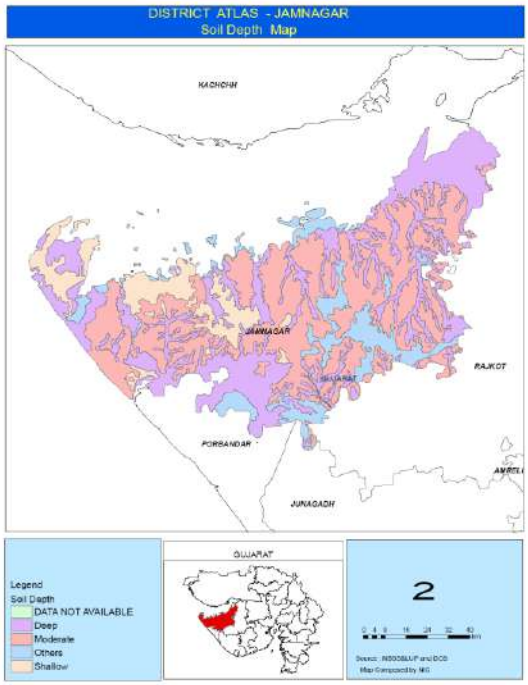
Annexure-2

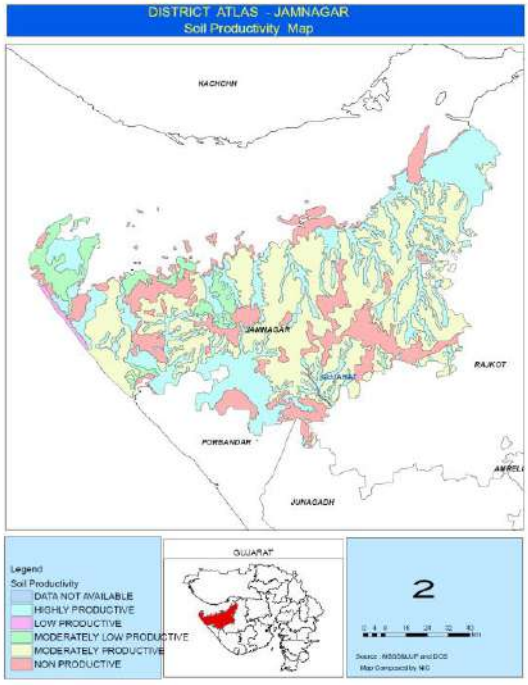
Map – 1 & 2 Maps showing drainage & basin of Jamnagar District



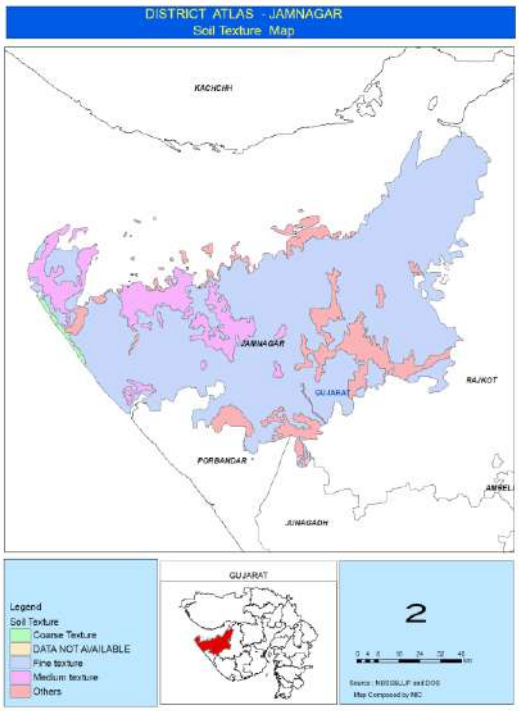


Map – 3 Soil characteristics of coastal area in Jamnagar district

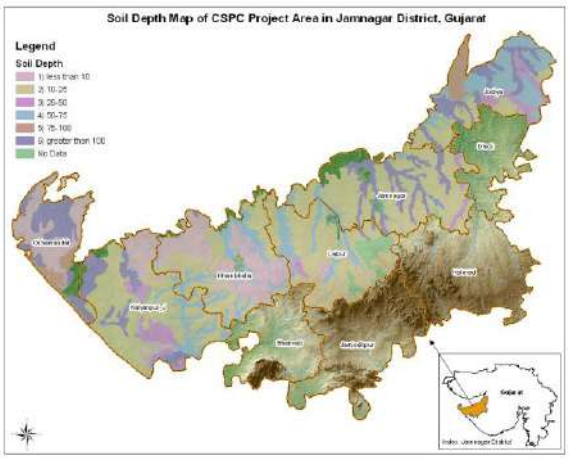




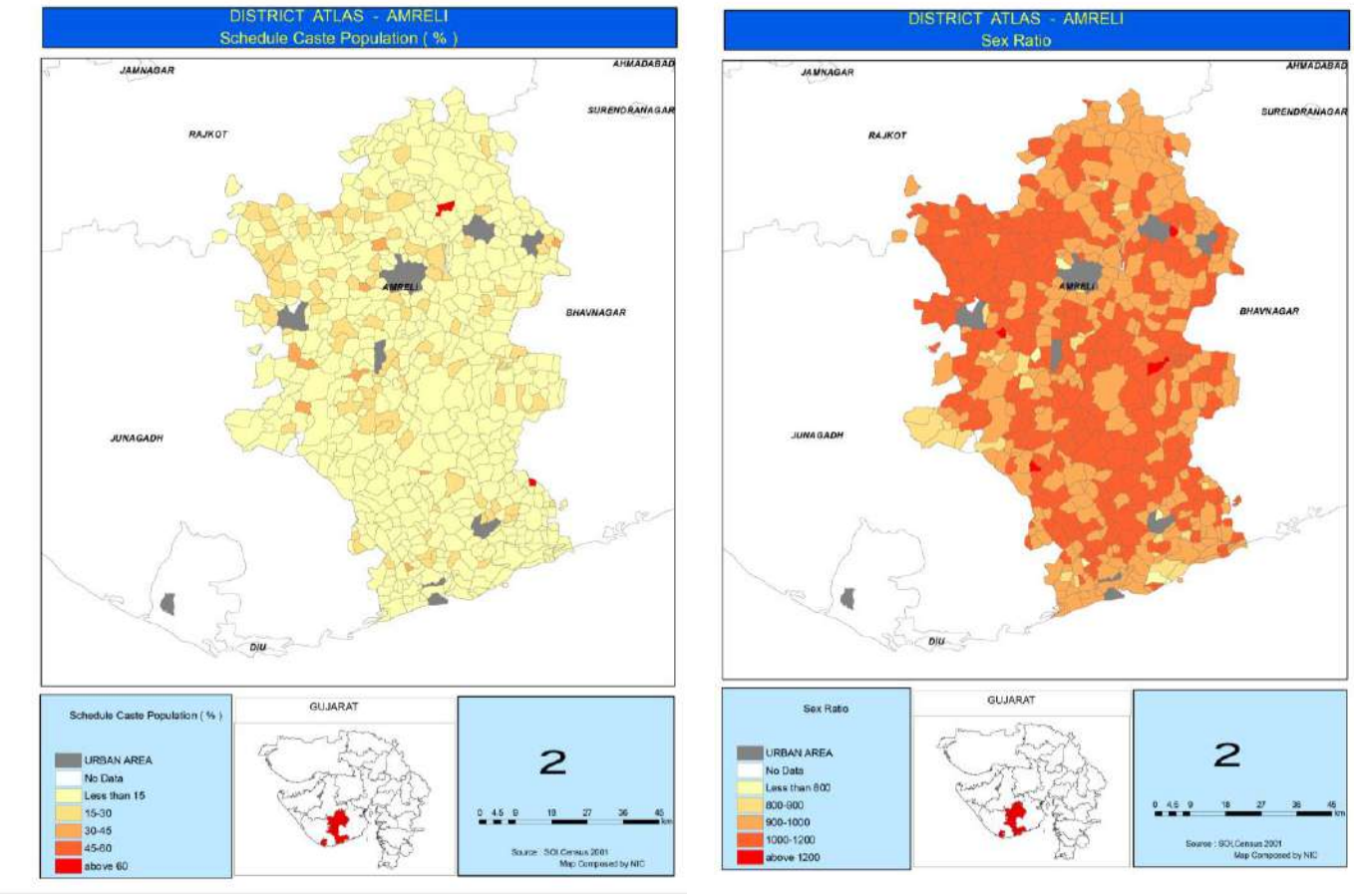
Map – 4 Soil texture of coastal area in Jamnagar district



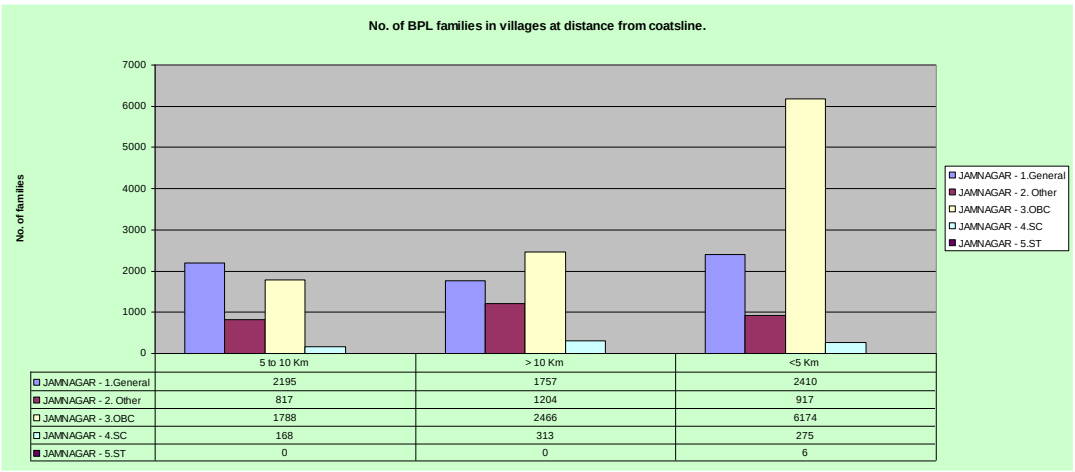
Map – 5 Map showing Soil depth of project area in Jamnagar district



Map-6 & 7 Village wise percentage of schedule caste population and sex ratio in study villages



Graph – 1 Population below Poverty Line according to distance from sea coast



	5 to 10 Km	> 10 Km	<5 Km
JAMNAGAR - 1.General	2195	1757	2410
JAMNAGAR - 2. Other	817	1204	917
JAMNAGAR - 3.OBC	1788	2466	6174
JAMNAGAR - 4.SC	168	313	275
JAMNAGAR - 5.ST	0	0	6

Annexure-3

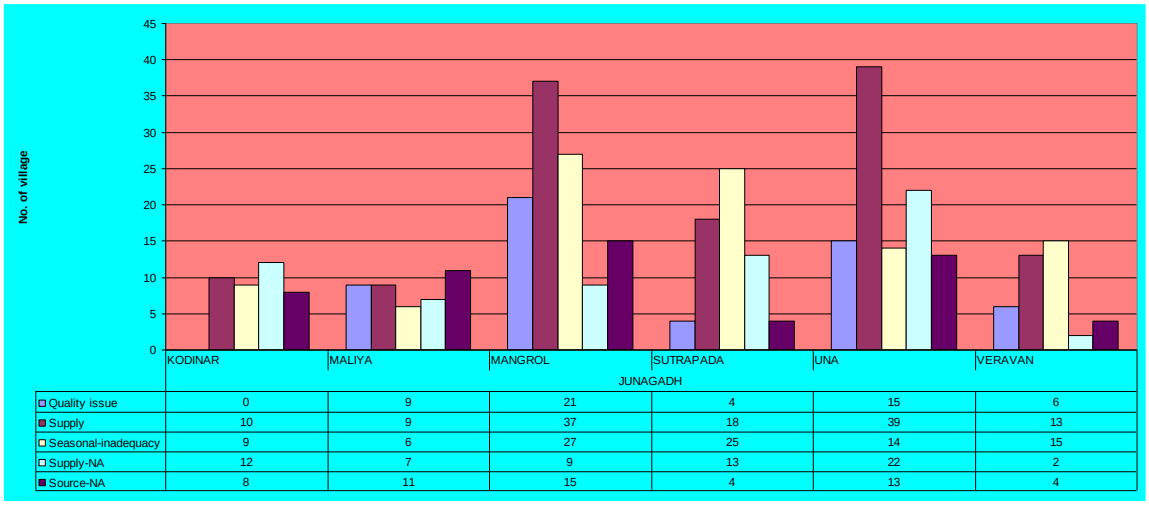
Agriculture

Table-1 Crop grown and its production (1000 Kg)

Crop name	Kalyanpur	Jamnagar	Jodiya	Khambhaliya	Lalpur	Okhamandal
Bajari	77,050	53,500	9,120	177,760	8,350	4,505
Castor	8,600	38,450	4,380	36,880	3,000	1,500
Chana		9,500	4,575	17,350		1,875
Choli			25			
Cotton	72,600	74,925	15,255	287,294	4,900	700
Dhana		3,000	200			
Fodder				650		
Groundnut	88,550	51,500	15,180	319,657	6,500	7,350
Guwar			650			
Isabgul		9,150	1,500			
Jiru		16,245	4,800	12,400		
Jowar	62,125	32,250	3,760	14,000	10,000	2,790
Garlic	30,800	2,000		19,411		
Maize		4,550		1,440		0
Moong		2,700	520	11,925		20
Onion	52,600			1,615		
Potato		350				
Pulses		5,950	3,550	5,000		
Raydo		17,250	4,700	16,370		
Sugarcane	0	0	200		45,215	
Til	11,980	23,850	5,705	32,488	100	575
Tuver			200			
Udad		1,795	400	2,325		
Vegetable				653		
Wheat	19,500	73,900	8,170	261,186	8,600	4,045

Drinking water

Graph – 2 Type of water problems



Graph – 3 Variation in drinking water problems in villages according to distance from the coastline

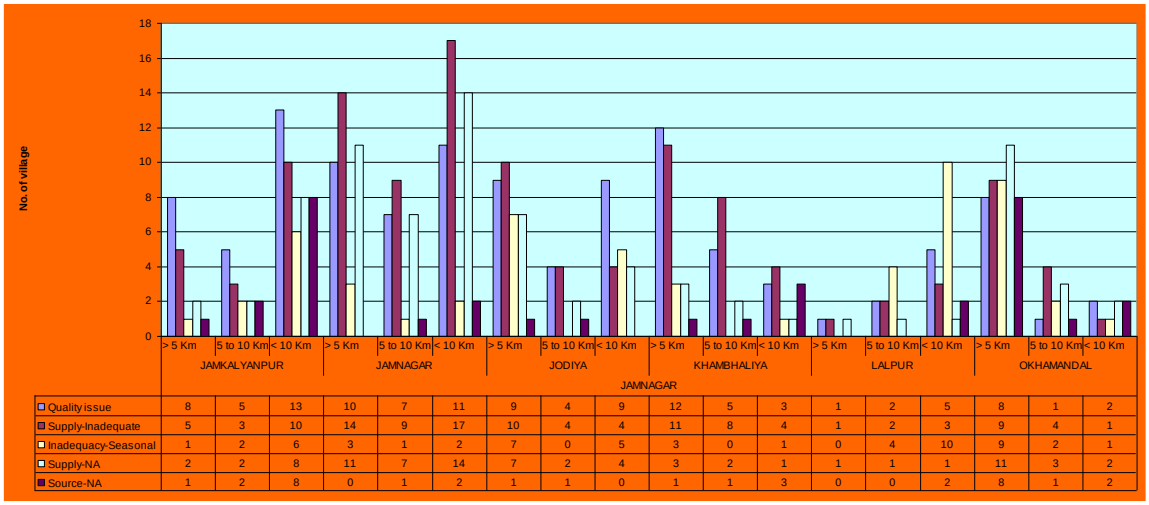


Table – 2 Adequacy of drinking water

Block	Yes	No	Can't say	Grand Total
Jamnagar	45	8	2	56
Jodiya	37	3	0	43
Kalyanpur	10	29	1	40
Khambhaliya	20	20	4	44
Lalpur	22	0	0	22
Okhamandal	16	16	7	40
Total	**150**	**76**	**14**	**245**

Table – 3 No. of villages facing drinking water problem

Block	Yes	No	Can't say	Grand Total
Jamnagar	42	11	2	56
Jodiya	18	18	3	43
Kalyanpur	30	9	1	40
Khambhaliya	33	10		44
Lalpur		21	1	22
Okhamandal	27	12		40
Total	**150**	**81**	**7**	**245**

Table – 4 Regularity of drinking water

Block	0	1	2	3	Grand Total
Jamnagar	3	8	37	8	56
Jodiya	5	20	14	4	43
Kalyanpur	4	5	28	3	40
Khambhaliya	3	15	20	6	44
Lalpur	1	20	1		22
Okhamandal	6	14	18	2	40
Total	**22**	**82**	**118**	**23**	**245**

Graph – 4 Impact on drinking water source

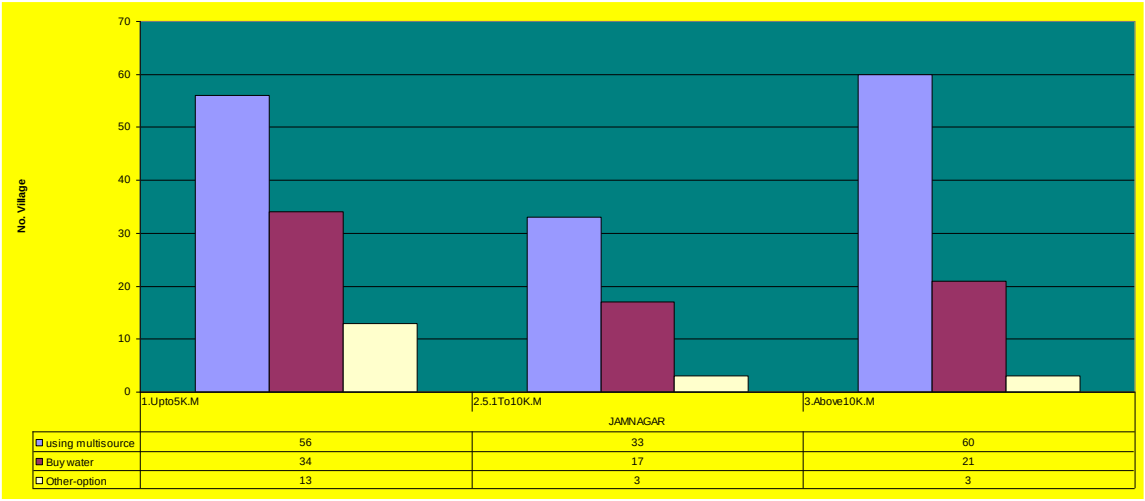
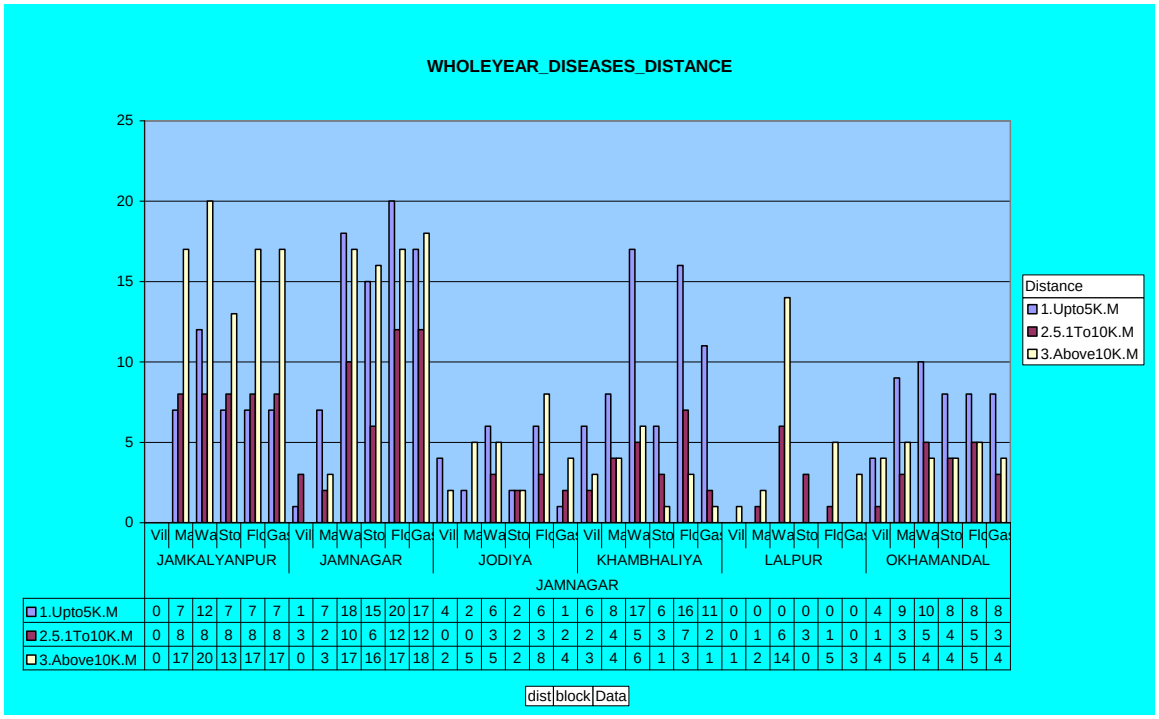


Table – 5 Status of Drinking water

BLOCK	Distance	Use Multi Source	Tanker	Pipe supply	Buy water	Supply-NA
Jamnagar	Upto5K.M	8	1	15	4	0
	5.1To10K.M	6	1	6	2	0
	Above10K.M	11	3	15	4	1
Jamnagar Total		25	5	36	10	1
Jodiya	Upto5K.M	5	2	21	1	0
	5.1To10K.M	2	0	5	0	0
	Above10K.M	7	2	11	1	1
Jodiya Total		14	4	37	2	1
Kalyanpur	Upto5K.M	3	2	2	5	1
	5.1to10K.M	1	0	2	4	0
	Above10K.M	10	2	6	2	2
Kalyanpur Total		14	4	10	11	3
Khambhaliya	Upto5K.M	9	1	8	1	0
	5.1to10K.M	7	1	2	0	0
	Above10K.M	5	0	1	1	0
Khambhaliya Total		21	2	11	2	0
Lalpur	Upto 5K.M	1	0	0	0	0
	5.1To10K.M	5	0	2	0	0
	Above10K.M	15	0	3	0	1
Lalpur Total		21	0	5	0	1
Okhamandal	Upto 5K.M	3	3	6	12	9
	5.1to10K.M	0	0	2	1	3
	Above10K.M	2	1	0	1	0
Okhamandal Total		**5**	**4**	**8**	**14**	**12**

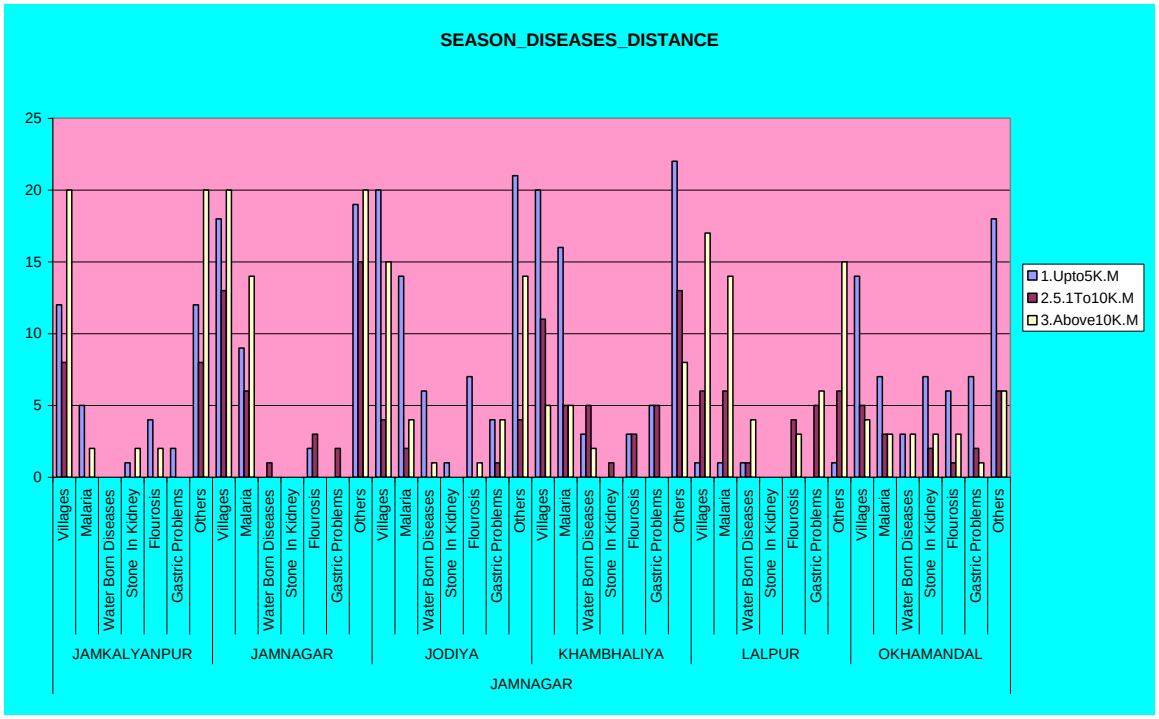
Graph–5 Relationship between distance from coast and disease pattern throughout the year



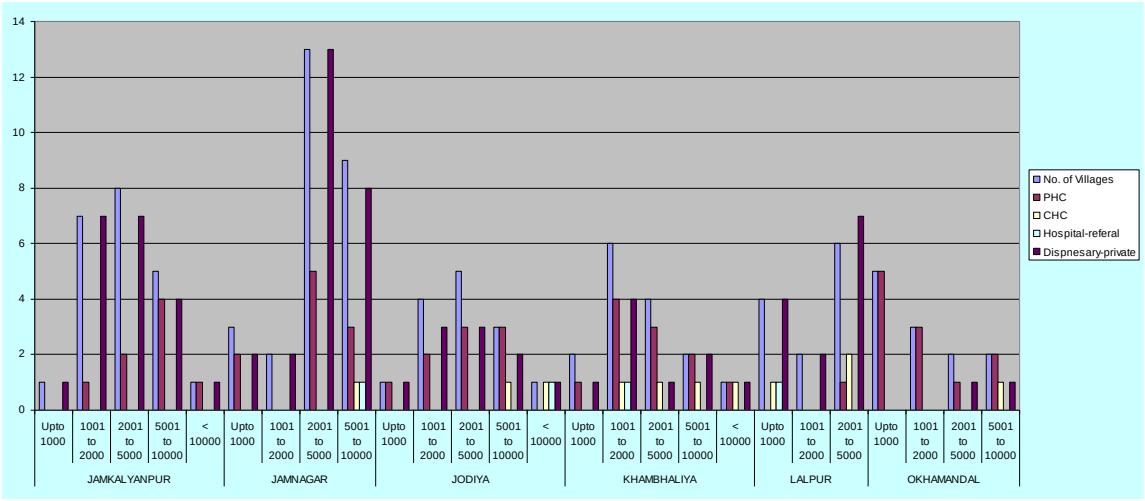
	JAMKALYANPUR							JAMNAGAR							JODIYA						
	Vil	Ma	Wa	Sto	Flo	Gas		Vil	Ma	Wa	Sto	Flo	Gas		Vil	Ma	Wa	Sto	Flo	Gas	
1.Upto5K.M	0	7	12	7	7	7	1	7	18	15	20	17	4	2	6	2	6	1	6	8	17
2.5.1To10K.M	0	8	8	8	8	8	3	2	10	6	12	12	0	0	3	2	3	2	2	4	5
3.Above10K.M	0	17	20	13	17	17	0	3	17	16	17	18	2	5	5	2	8	4	3	4	6

	KHAMBHALIYA							LALPUR							OKHAMANDAL						
	Vil	Ma	Wa	Sto	Flo	Gas		Vil	Ma	Wa	Sto	Flo	Gas		Vil	Ma	Wa	Sto	Flo	Gas	
1.Upto5K.M	6	16	11	0	0	0	0	0	0	0	0	4	9	10	8	8	8				
2.5.1To10K.M	3	7	2	0	1	6	3	1	0	1	3	5	4	5	3						
3.Above10K.M	1	3	1	1	2	14	0	5	3	4	5	4	4	5	4						

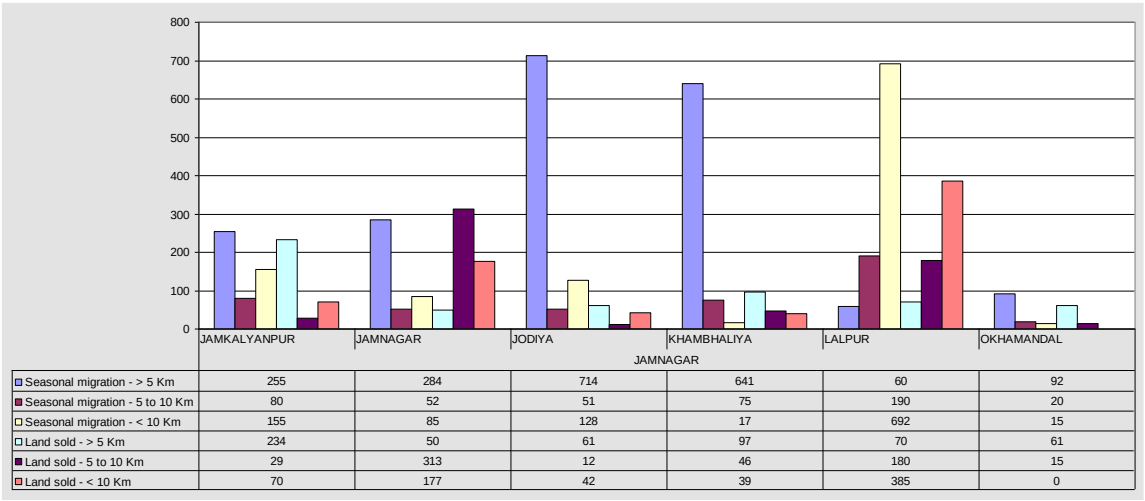
Graph – 6 Relationship between distance from coast and seasonal disease pattern



Graph – 7 Health facilities in villages with different population class



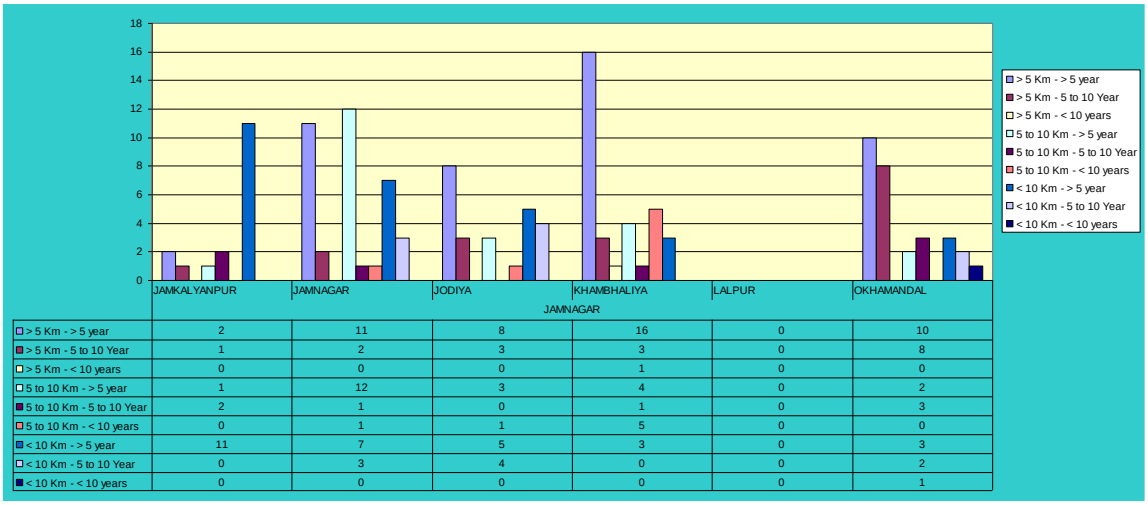
Graph – 8 Present status of No. of people conducting seasonal migration and sold land in the study villages



	JAMKALYANPUR	JAMNAGAR	JODIYA	KHAMBHALIYA	LALPUR	OKHAMANDAL
Seasonal migration - > 5 Km	255	284	714	641	60	92
Seasonal migration - 5 to 10 Km	80	52	51	75	190	20
Seasonal migration - < 10 Km	155	85	128	17	692	15
Land sold - > 5 Km	234	50	61	97	70	61
Land sold - 5 to 10 Km	29	313	12	46	180	15
Land sold - < 10 Km	70	177	42	39	385	0

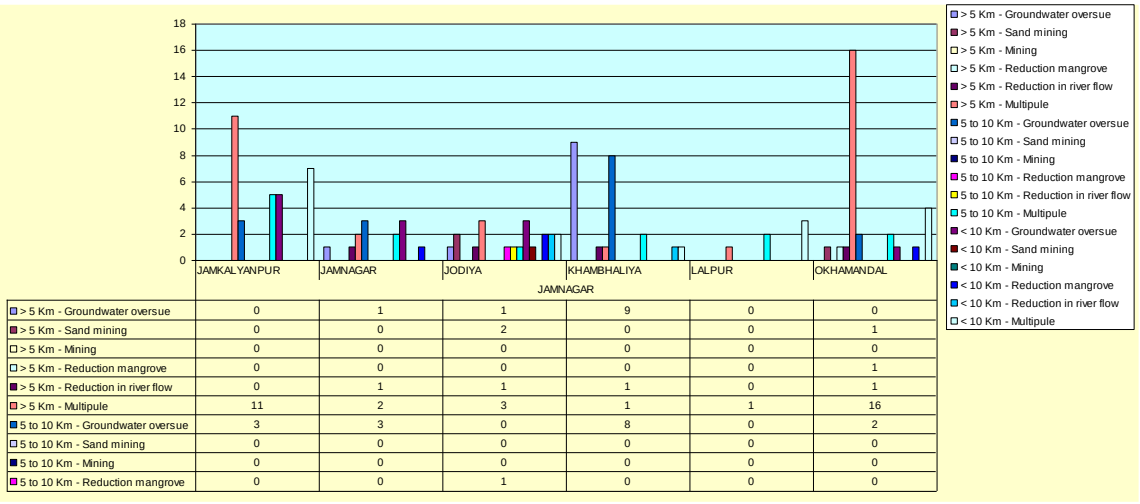
Salinity Ingress

Graph – 9 Distance wise variation in appearance period of salinity



	JAMKALYANPUR	JAMNAGAR	JODIYA	KHAMBHALIYA	LALPUR	OKHAMANDAL
> 5 Km - > 5 year	2	11	8	16	0	10
> 5 Km - 5 to 10 Year	1	2	3	3	0	8
> 5 Km - < 10 years	0	0	0	1	0	0
5 to 10 Km - > 5 year	1	12	3	4	0	2
5 to 10 Km - 5 to 10 Year	2	1	0	1	0	3
5 to 10 Km - < 10 years	0	1	1	5	0	0
< 10 Km - > 5 year	11	7	5	3	0	3
< 10 Km - 5 to 10 Year	0	3	4	0	0	2
< 10 Km - < 10 years	0	0	0	0	0	1

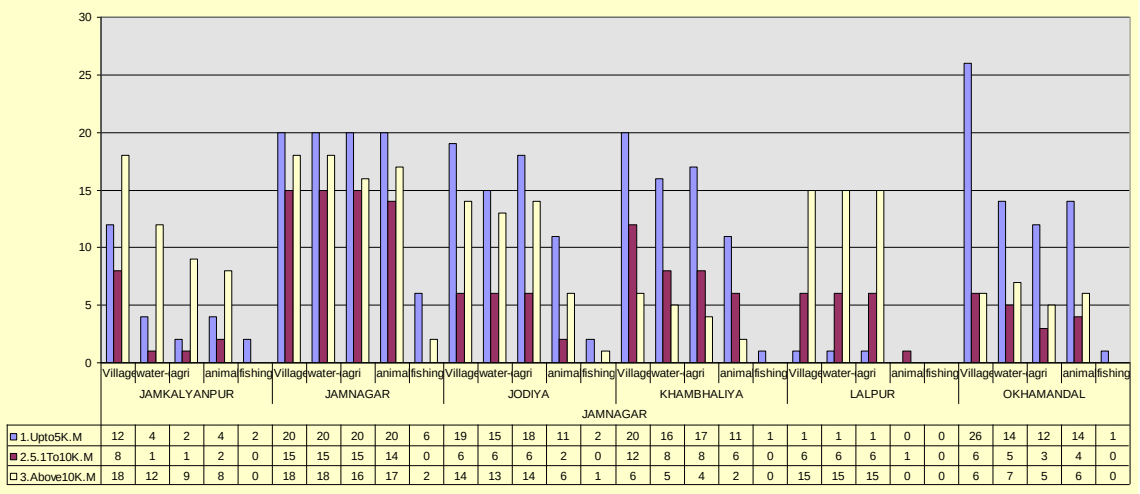
Graph – 10 Reasons for salinity ingress according to distance



	JAMKALYANPUR	JAMNAGAR	JODIYA	KHAMBHALIYA	LALPUR	OKHAMANDAL
> 5 Km - Groundwater oversue	0	1	1	9	0	0
> 5 Km - Sand mining	0	0	2	0	0	1
> 5 Km - Mining	0	0	0	0	0	0
> 5 Km - Reduction mangrove	0	0	0	0	0	1
> 5 Km - Reduction in river flow	0	1	1	1	0	1
> 5 Km - Multipule	11	2	3	1	1	16
5 to 10 Km - Groundwater oversue	3	3	0	8	0	2
5 to 10 Km - Sand mining	0	0	0	0	0	0
5 to 10 Km - Mining	0	0	0	0	0	0
5 to 10 Km - Reduction mangrove	0	0	1	0	0	0

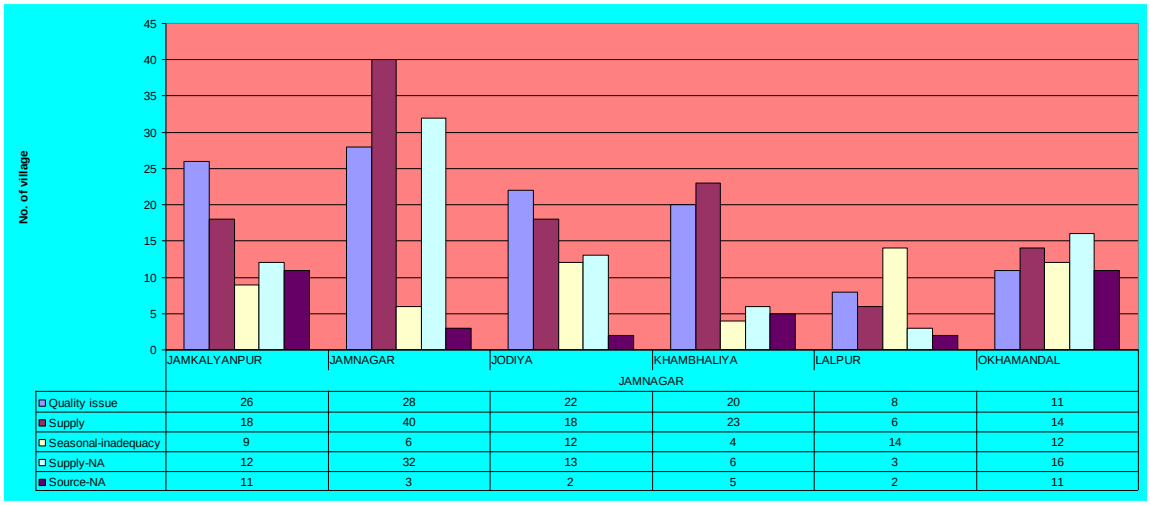
Salinity Impacts

Graph – 11 Impact of salinity on livelihood



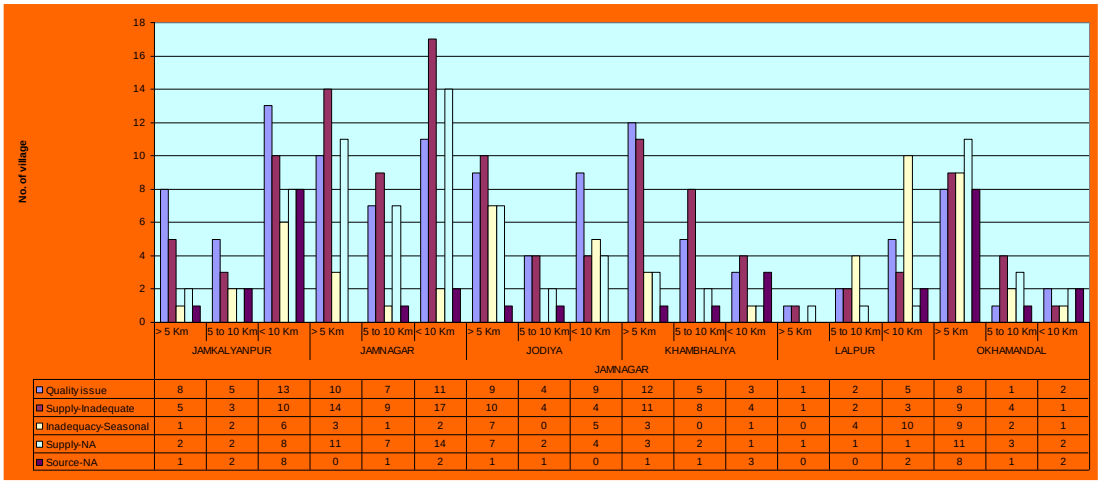
	JAMKALYANPUR					JAMNAGAR					JODIYA					KHAMBHALIYA					LALPUR					OKHAMANDAL				
	Village	water-	agri	anima	fishing	Village	water-	agri	anima	fishing	Village	water-	agri	anima	fishing	Village	water-	agri	anima	fishing	Village	water-	agri	anima	fishing	Village	water-	agri	anima	fishing
1.Upto5K.M	12	4	2	4	2	20	20	20	20	6	19	15	18	11	2	20	16	17	11	1	1	1	1	0	0	26	14	12	14	1
2.5.1To10K.M	8	1	1	2	0	15	15	15	14	0	6	6	6	2	0	12	8	8	6	0	6	6	6	1	0	6	5	3	4	0
3.Above10K.M	18	12	9	8	0	18	18	16	17	2	14	13	14	6	1	6	5	4	2	0	15	15	15	0	0	6	7	5	6	0

Graph – 12 Impact of salinity on drinking



	JAMKALYANPUR	JAMNAGAR	JODIYA	KHAMBHALIYA	LALPUR	OKHAMANDAL
Quality issue	26	28	22	20	8	11
Supply	18	40	18	23	6	14
Seasonal-inadequacy	9	6	12	4	14	12
Supply-NA	12	32	13	6	3	16
Source-NA	11	3	2	5	2	11

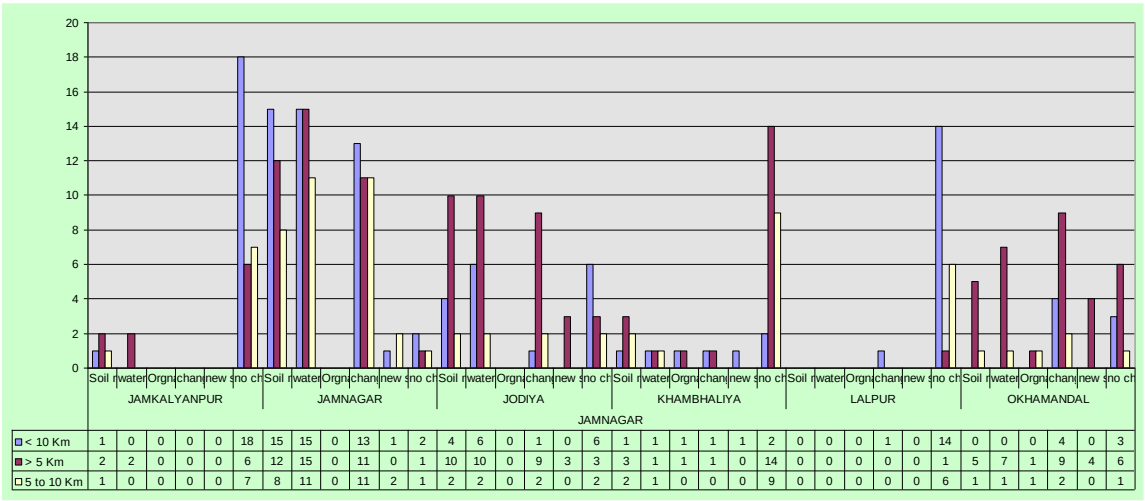
Graph – 13 Impact of salinity on drinking water source according to distance



	JAMKALYANPUR			JAMNAGAR			JODIYA			KHAMBHALIYA			LALPUR			OKHAMANDAL		
	> 5 Km	5 to 10 Km	< 10 Km	> 5 Km	5 to 10 Km	< 10 Km	> 5 Km	5 to 10 Km	< 10 Km	> 5 Km	5 to 10 Km	< 10 Km	> 5 Km	5 to 10 Km	< 10 Km	> 5 Km	5 to 10 Km	< 10 Km
Quality issue	8	5	13	10	7	11	9	4	9	12	5	3	1	2	5	8	1	2
Supply-Inadequate	5	3	10	14	9	17	10	4	4	11	8	4	1	2	3	9	4	1
Inadequacy-Seasonal	1	2	6	3	1	2	7	0	5	3	0	1	0	4	10	9	2	1
Supply-NA	2	2	8	11	7	14	7	2	4	3	2	1	1	1	1	11	3	2
Source-NA	1	2	8	0	1	2	1	1	0	1	1	3	0	0	2	8	1	2

Solutions

Graph – 14 Agriculture solutions in villages located at different distance from coast.



	JAMKALYANPUR						JAMNAGAR						JODIYA						KHAMBHALIYA						LALPUR						OKHAMANDAL					
	Soil	water	Orgn	chan	new	no ch	Soil	water	Orgn	chan	new	no ch	Soil	water	Orgn	chan	new	no ch	Soil	water	Orgn	chan	new	no ch	Soil	water	Orgn	chan	new	no ch	Soil	water	Orgn	chan	new	no ch
< 10 Km	1	0	0	0	0	18	15	15	0	13	1	2	4	6	0	1	0	6	1	1	1	1	1	2	0	0	0	1	0	14	0	0	0	4	0	3
> 5 Km	2	2	0	0	0	6	12	15	0	11	0	1	10	10	0	9	3	3	3	1	1	1	0	14	0	0	0	0	0	1	5	7	1	9	4	6
5 to 10 Km	1	0	0	0	0	7	8	11	0	11	2	1	2	2	0	2	0	2	2	1	0	0	0	9	0	0	0	0	0	6	1	1	1	2	0	1

Baseline Study of Coastal Villages affected by Salinity ingress in Rajkot District

May-07 to March-08

Prepared by:

Saline Area Vitalization Enterprise Ltd. (SAVE)

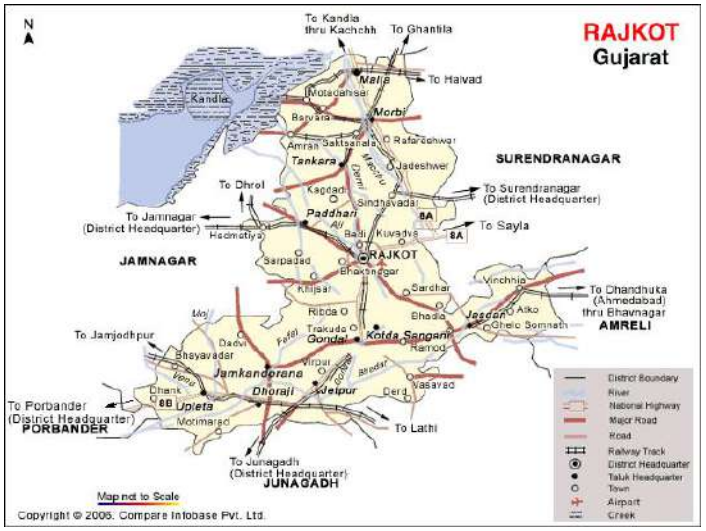
Prepared for:

Coastal Salinity Prevention Cell (CSPC)

Rajkot District

1. Location

The Rajkot district located between 23° 08' North latitude and 20º 58' North latitude and 71º 40' East longitudes and 70º 20' East longitudes is considered industrial capital of Saurashtra. The district has a central location in the area called the Kathiawar peninsula. Bhavnagar and Surendranagar surround the district in the east, Junagadh and Amreli in the south, Kutch in the north and Jamnagar in the west. Rajkot district is divided in 14 talukas with headquarter at Rajkot. Out of fourteen talukas, Maliya taluka located in Northern part of the district is a coastal taluka.



2. The coastal area in Rajkot district

The Maliya-miyan taluka is totally 100% salinity affected area. All 47 villages in this Taluka having a geographical area of 76,998 ha. (7.32% of district area) are facing salinity problem of more or less degree. Of the total 47 villages, 20 villages are located at a distance of less than five Km. from the coastline. The remaining 27 villages are located within 5 to 10 Km and above 10 Km. distance. The Mahendragadh located at a distance of 30 Km. is the farthest village from the seacoast in the taluka. (Refer table-1)

3. Climate & Rainfall

The climate in Rajkot district is hot and arid in nature. The summer spans from March to June. The temperature at this time varies between 24°C and 42°C. The rainy season spans from July to September, which brings an average rainfall of 509 mm within 30 average rain days.

4. Physical features

4.1 Geomorphology

This coastal segment represents the Gulf of Kutch. The gulf region comprises on its northern part belonging to Kutch while the southern part to Saurashtra croton. The southern coast of the gulf forms a highly irregular concave shaped coast. This coast is characterized by almost a flat stretch of land consisting of oval shaped bet regions and the width of the stretch gradually decreases from west to east. There is an extensive occurrence of mudflats, mangrove swamps.

The coast in Maliya on wards up to Mandvi shows increasing development of tidal flats in its eastern parts. The tidal flats gradually merge with the little Rann of Kutch. This coastal segment is marked by the presence of creeks along which the high tide water enters through the river channels, which have low detritus load. The mudflats support the growth of mangrove vegetation. Saltpans are seen developed in this region, which are formed by the high tide water entering through the river channels.

4.2 Hydrogeological situation

This coast is significant from the point of view number of industrial settlements and saltpan and fisheries activities. This coastal tract is represented by variety of lithological formations governing aquifer development. The dominant ones are Deccan traps, Quaternary sands and gravels, sandstones etc. The rivers originating within district flows northward to meet gulf of Kutch. The Macchu and Ghodadhroi are two major rivers flowing through Maliya Taluka**.** (Refer map-1 & 2)

The average depth to the water table is 10 m, however the deeper aquifers are also present. The most important and productive aquifer occurs in the Bhui sandstone in depth of less than 10m. to 300m. The salinity distribution in the phreatic aquifers is rather uniform with low values in the uplands. The values increase towards the areas of discharge. The segment shows deterioration in groundwater quality. The quality tends to be unfavorable (saline) below 150 m.

4.3 Geo-environment

This coastal segment form the Gulf of Kutch region, it comprises salty wasteland. The Gulf environment has high tidal energy but low wave energy conditions when compared with the open-sea coastal environment. The tides are moderate as compare to that in the Gulf of Cambav. The height of the tides is around 4 to 8 M. Mudflats mark the coastal segment between Little Rann of Kutch and Mandvi. The presence of tidal flats are necessitated by the presence of creeks through which tidal waters enters the river channels carrying low detritus load. The Geo-environment of the talukas has given adequate opportunities for development of salt pan and fisheries in Maliya taluka.

5. Study findings

5.1 Demographic

1. The Maliya taluka covering 6% of geographical land recorded population of 83,471 persons in 2001, which was 4.56% of total population in Rajkot district. In present survey total population of 1,02,468 was recoded in surveyed villages i.e. an increase of about 15,000 persons in population during 2001 and 2007.
2. There are 3644 families living below poverty line in Maliya taluka.
3. The taluka has population density 108 person/Sq.Km, which is lower than the average population density of 144 person/Sq.Km for the coastal area covered under the study. This is mainly due to poor environmental condition and inherent salinity, which has limited livelihood resources. (Refer-table-2)
4. The population living in Maliya taluka belongs to various caste and religion. The majority of population belongs to Koli, Muslims and Patel community. As shown in table-3 below the main population belongs to general and other backward classes.
5. The population covered under the study lives in villages having population between 2000 to 5000 person. The maximum population lives in village, which located at a distance more than 10 Km. from the coats line. (Refer table-4)
6. Majority of villages have sex ratio between 900 and 1000 female per 1000 male, with some anomalies having sex ratio around 800. (Refer Map-3)
7. The population shows wide variation in literacy. The villages close to the coastline have poor literacy rate between 20-40%, while remaining villages have literacy rate between 60-80%. (Refer Map-4)

5.2 Occupation

1. Agriculture, animal husbandry, fisheries, agriculture labour, labouring in salt pan and charcoal making are main occupation in Maliya taluka.
2. In all there are more than 11000 farmers in study village. Farmer's classification according to land holding shows that in Maliya taluka the large land holders forms nearly 40% of the total farmers.
3. Animal husbandry is carried out along with agriculture. The no. of families earning exclusively on animal husbandry is low.
4. Small fraction of people temporary engaged as a contract labour in ceramic industries in Morbi town.
5. The electronic industries development around Haripur provides wage employment.
6. Charcoal making is carried out as a part time activity by landless agriculture labourer due to availability of prosopis juliflora in surrounding area.
7. The activity of charcoal making has increased due to high demand in furnaces in ceramic units in Morbi.
8. The coastal villages are having large number of salt production units, which are providing employment for six to eight months. Mainly Talapda Kolis families are performing saltpan activity.
9. Fishing is a seasonal activity carried out during September to December by Mulsim families living in Maliya, Hanjiasar and Haripar.
   (The occupational profile details for Maliya taluka are given in table-5)

5.3 Soils

1. The Maliya taluka has black and sticky soil having deep profile derived from basaltic rocks.
2. The soil has moderate to low productivity. (Refer Map- 5 & 6)
3. The soils in village Kajarada, haripar, Hanjiasar, New Navlakhi have inherent salinity in all soils. Remaining villages have salinity in soil ranging from 30% to 50%
4. The soils are suitable for growing cotton, bajara and pulses.

4.4 Water resource:

1. The Maliya taluka face acute shortage of water for drinking, irrigation and animal water needs.
2. The ground water resources in Maliya Taluka are entirely saline with no potable water.
3. The villages are provided drinking water through pipeline carrying Narmada water.
4. The Machhu and Ghoda Dhroi are two main rivers flowing through the Maliya Taluka.
5. The rainwater is harvested through village ponds and check dams on the streams.
6. The industrial water demand is fulfilled by Narmada water supply pipeline connecting to Kutch area. (Refer map-7 & 8)

4.5 Land use

1. The agriculture land is the main land use unit in Maliya Taluka. Total 68% of the land (51,986 ha.) is covered under agriculture.
2. Only 1 % of total land (500ha) is irrigated. The remaining land is used for rain fed agriculture.
3. The non-cultivable landform 20% of the total area of the study villages. This land includes marshy land, land covered under mangroves and salt pan land.

4. The non-cultivable land includes 230 ha. saline land having inherent salinity due to movement of seawater.
5. The cultivable wasteland is available to the extent of 7600 ha. This land is used for animal grazing and construction of water harvesting structures.
6. About 145 ha. land is converted under industrial use located mainly along the national high way.
7. The taluka virtually do not have any forest area. Some plots of *Prosopis Juliflora* are available as forest.

The detail break up of land use according to census-2001 and baseline survey, 2007 in Maliya is given in table-5 & 6.

4.6 Agriculture

1. The rainfed crops like Bajara, Jowar, Maize, Cotton and Pulses dominate in cropped area.
2. The land under food crop, cash crop and oil seeds crop is almost equal.
3. There are no horticulture crops in the taluka. Vegetables are grown on small scale to fulfill own needs.
4. Bajari is main food crops which has high resistant to salinity. Areas with irrigation facility cultivate wheat crop.
5. Pulses like Moong, Udad is cultivated in small area.
6. The cropping of cash crops like cotton and castor has increased in recent years.
7. Seventeen out of 47 villages have replaced traditional crops with other crops. Majority of them are villages located away from coastline.
8. among the villages where crop change has occurred, majority of them have shifted to cash crop like cotton and castor. (Refer table- 7 to 10)

4.7 Irrigation facility

1. The villages have irrigation in range of 1 to 20%.
2. There are 592 structures for irrigation, which is benefiting about 1,000 farmers and irrigating 677 ha. land.
3. Maximum number of irrigation structures are located in villages at a distance more than10 Km from the coastline.
4. The Number of farm ponds has increased in villages. At present there are 140 farm ponds in 15 villages.
5. The irrigation is done mainly through surface water by lifting water from rivers and canal.
6. The ground water structures for irrigation like well and bore wells are restricted to 5 to 7 villages. (Refer table- 11)

4.8 Livestock rearing

1. The livestock population suggests that No. of Milching animals are increasing in the taluka. (Refer Graph- 1)
2. On an average each village have 200-300 milch animals. (Refer table- 12)
3. As against other districts, the number of cows are more than buffalo in Maliya taluka.
4. The rearing of small animals (goat and sheep) is also found in Maliya taluka.
5. The Maliya taluka has milk co-operative structures since 2003. At present 31 villages have milk producer groups.
6. The milk production in the study villages reduced from 110,920 liter/day during monsoon to 57,150 liter/day in summer. (Refer Graph- 1)
7. The availability of fodder through grassland is a major advantage for livestock rearing in Maliya taluka.

8. Ponds and *Havadas* are widely used for feeding water to the animals. However, a pond does not provide water through out the year.

4.9 Drinking water

1. 35 out of 47 villages surveyed in the taluka have pipeline as a source of drinking water. Seventeen villages are receiving water from Narmada based pipeline.
2. Almost 50% villages also use river water for drinking purpose.
3. 19 villages have problem of inadequate supply. The situation of drinking water in Maliya is better than the other coastal talukas covered in study area.
4. Less than 25% villages have to use more than one source of water and only one village is have to buy drinking water.
5. The sector reform program, Swajaldhara program of central Government and WASMO program are implemented in the taluka since 2003. (Refer table-13)
6. Except eight villages all other villages have no source of drinking water within a distance of 1 Km from the village. Eleven villages have nearest source from drinking water located at a distance between 10 to 20 Km. (Refer table-14)

4.10 Institutions

The heterogeneity in caste, class and occupation of the population has restricted development of community-based organizations in Maliya. However, the post earthquake rehabilitation program has brought people together to some extent to form CBOs, SHGs and Pani samitis. The post earthquake period has also brought NGOs in Maliya Taluka. There is still more efforts are required to build community based organization, which collectively address salinity. The details of number of grass root organisation instructions available in Maliya are given in table-15.

4.11 Salinity Ingress Problem

4.11.1 Reasons for salinity

1. The coastal villages have inherent salinity, while salinity problem have occurred in other villages within last 10 years.
2. Seven villages located at a distance more than 10 Km are facing salinity since last five years. (Refer Graph- 3)

4.11.2 Period of salinity problem

1. The increase in salinity is taking place due to more than one reason in ten villages.
2. The villages closer to coastline have expressed mangrove cutting, sand mining from riverbed and ground water over use as major reasons for salinity ingress. (Refer Graph- 4)

4.11.3 Impact of salinity

1. Impact of salinity is found more on agriculture and local drinking water resources.
2. Almost all villages have impact on agriculture.
3. 37 villages have impact on local drinking water sources.
4. 30 villages show impact on animal husbandry.

5.12 Impact of Salinity ingress and for major livelihood activities.

1. Agriculture

a. The rainfed agriculture with erratic rainfall pattern result in agriculture one of the most risk business.
b. Impact on groundnut, til and bajari crops are seen.

c. The average production rate of Bajara, Jowar, castor and cotton are almost half of the standard production rates. (Refer table-16)
d. The farming requires more seeds input.
e. Farming in saline area requires sowing more than once.
f. Many time crop grown suddenly starts drying due to moisture stress.
g. Farmers growing groundnut and bajara shifted to cotton and castor.
h. The coconut plantation existing in some villages has been completely destroyed.

2. Animal husbandry

a. The Maliya taluka is the only taluka that has reported less impact on animal husbandry. This is mainly because the majority of animals are indigenous animals.
b. The vast wasteland and grassland provide adequate grassing for animals.
c. The dairy network is providing health and supplementary food for the animals.
d. 70-80% families are involved in livestock rearing in Maliya taluka.

3. Fisheries

a. No major impact on fisheries due to salinity problem is occurring in fisheries.

4. Economic status

a. The communities living in Maliya are poor due to poor natural resources. The salinity ingress has increased their debtness due to failure of crops.
b. The increasing shift towards cash crop, which demand high input has increased financial requirement of the farming community.
c. The survey has recorded more than 4500 agriculture loan seeker (more than 50% of total farmers).
d. More than 2000 person are defaulters.
e. Banks have stopped providing credit for crops like groundnut and Bajara.
f. 1500 person are doing migration for period of 3 to 6 months for labour work in Morbi. (Refer table-17)

5. Drinking water

a. The entire taluka is dependent on Narmada water supply for drinking water.
b. Twenty-two villages have severe shortage of drinking water.
c. The villages are facing problems such as quality, seasonal variation in supply, no source and no supply. There are 19 villages, which are having pipeline but are not receiving supply on regular basis. Similar number of villages are also facing problem of seasonal variation in water supply.
d. Three villages have reported quality problem. (Refer Graph-4)
e. Majority of villages facing water problems are located at distance less than 5 Km and more than 10 Km. from the coastline.
f. In all 35 villages out of 47 villages surveyed have to depend on more than one source for drinking water. Three villages have reported purchase of drinking water. (Refer Graph-5)

6. Health

a. There are total 21 villages recorded which have health problems. The major problem is water born problems like gastric problem and Malaria.
b. Six villages are facing Florosis problems, of which five are located on the coast.

c. Some villages located at a distance of more than 10 Km have shown health problems like Florosis, stone in Kidney. (Refer table-18)

7. Major initiatives for salinity problem

The salinity in Maliya is a way of life. People are used to live with salinity problem. However, the hardship of coastal communities for drinking water has reduced due to successful implementation of drinking water supply program in the taluka.

There are no systematic efforts done to prevent expansion of salinity but people on their own are fighting out at individual level to reduce further deterioration of their land and animals. The farmers adopt the farm level interventions such as farm bunding, border plantation and deep ploughing.

For drinking water, people are opting for RRWH and ponds for human and cattle water needs.

8. Scope for activities in Maliya taluka

Though large area of Maliya taluka is facing salinity problem since long, no efforts have been made to bring change in agriculture practices. The lack of knowledge about use of fertilizer and pesticides in the agriculture reduce the profit margin of the farmers. Simple inputs like soil testing can help in reducing the unwanted inputs in farming.

As mentioned earlier, there are no horticulture crops in Maliya taluka. However, according to the agriculture experts the land having deep soil profile has good potential for horticulture plantation like Bor and industrial crop like Guwar. The forestry plants like Bawal can also grow in this soil. There is a need to explore possibility of various industrial, medicinal and horticulture crops for this area.

The prawn fishing is a unique feature of Maliya taluka which needs market information and awareness about various government schemes available for fishing community. The fishery has potential to be developed as a cluster business in Maliya due to its strategic location.

The animal husbandry initiative by NDDB through formation of Milk Producing Institutions is a success story in Maliya taluka. This can be further strengthen by promoting grass land development project on wasteland which is being cleared for charcoal making by charcoal makers. A small pilot project of adoptability of various grass species on experimental basis will be useful for promotion of fodder bank concept in almost all villages.

ANNEXURES

Maps, Tables & Graphs

Rajkot District

Table-1 Village location with reference to distance from sea

Distance - From Sea Coast	No. of villages
Up to 5K.M	20
5.1 to10K.M	9
Above10K.M	18
Total	**47**

Table-2 Sex wise population details for villages covered in Maliya

District	Maliya	Coastal area	% of total study area
Area (ha)	76,998	1,267,241	4.89
No. household	17,703	330,227	4.68
Population	83,471	1,829,241	1.23
Pop. density	108	144	NA
Ave. household size	4.72	5.54	NA

Table-3 Category wise population in villages covered under Maliya taluka

Caste	Maliya (Miyana)	% of population living in study area
General	20,988	20.48
OBC	77,870	75.99
SC	3,432	3.35
ST	178	0.17
Grand Total	102,468	100.00

Table-4 Distribution of population according to population classes

Distance from Sea	Village with Population					
	Up to 1,000	1001 to 2,000	2001 to 5,000	5001 to 10,000	More Than 10,000	Total
Upto 5 K.M	7	6	5	2	0	20
	4,093	8,642	17,617	13,150	0	43,502
5.1 to10 K.M	3	4	1	0	0	8
	1,856	5,657	2,022	0	0	9,535
Above10 K.M	5	7	4	1	1	18
	2,526	10,776	10,687	5,192	20,250	49,431

Table-5 Details of Occupation profile for Maliya taluka (Number of person)

Occupation	Maliya (Miyana)
Big Farmer	4,411
Small Farmer	3,942
Marginal Farmer	2,794
Total farmers	11,147
Agri. Labour	6,933
Animal Husbandry	217
Fishing	1,381
Coal Workers	87
Salt Workers	1,057
Service	1,677
Small Business	355
Misc. Labour	2,562

Table -6 Land use pattern in Maliya taluka, 2001 (area in hectare)

Details	Area (ha)	% of Total Geographical Area
Geographical Area	76,998.10	100
Forest	1,937.72	3
Agriculture	51,986.06	68
Irrigated	637.74	1
Unirrigated	51,348.32	99
Cultivable waste	7,601.20	10
Non-cultivable	15,473.12	20

(Source: Census-2001)

Table –7 Detail Land use pattern in Maliya taluka, 2007 (area in hectare)

Land type	Area in ha.
Geographical Land	83,383
Land- Saltpans	901
Muddy Land	121
Land- Mining	156
Land- Kharpat	230
Agri. Land	53,891
Unirrigated Land	33,494
Forest Land	948
Fodder Land	4,587
Wasteland	14,229
Gamtal Land	15,821
Village Pond Area	787
Land Under Industries	145

(Source: Village baseline study, 2007)

Table -8 Cropping pattern (area in hectare)

Crop type	Area in ha.
Food Crops	10,191
Oil Seeds	10,287
Cash Crop	14,757
Vegetable	100

Table-9 Major crops cultivated and its production in study villages

Crop	Production in '000 Kg.
Bajari	172,057
BT Cotton	4,278
Castor	138,773
Cotton	849,887
Groundnut	80,106
Jiru	33,992
Jowar	137,059
Maize	625
Moong	4,977
Moth	350
Pulses	5,020
Til	145,521
Udad	725
Wheat	75,550

Table -10 Numbers of villages showing change in crop in study area

Details	< 5 Km	5 to10K.M	> 10 Km	Total
Nos. of villages	4	3	10	17
Area of village	9,390	8,780	54,646	72,816
Village Nos. change food crop	3	3	10	16
Village Nos. change cash crop	2	5	8	15
Village No. change horticulture	0	0	0	0
Village No. change forestry	0	0	0	0

Table-11 Type and Number of Irrigation structure available in study villages

Type	Unit	Maliya (Miyana)
River	Village	16
Irrigation Pond	Nos.	4
Village Pond	Nos.	21
Farm Pond	Nos.	154
Canal	Village	11
Check Dam	Nos.	9
Bandhara	Nos.	2
Bore Well	Nos.	16
Well	Nos.	127

Table-12 Village wise average number of livestock in study villages and number of villages having particular type of livestock in Maliya taluka

Type	Unit	Average nos. in each village
Cow-milch	Nos.	37
	No. of Village	47
Cow-non milch	Nos.	43
	No. of Village	46
Buffalo	Nos.	45
	No. of Village	47
Buffalo-non milch	Nos.	37
	No. of Village	47
Bullock	Nos.	39
	No. of Village	46
Goat	Nos.	115
	No. of Village	45
Sheep	Nos.	155
	No. of Village	42
Camel	Nos.	06
	No. of Village	16
Poultry	Nos.	199
	No. of Village	18

Table – 13 Number of villages and type of source of dinking water

Type of sources	No. of villages
Rivers	25
Pond	44
Open Well	52
Tube Well	5
Hand pump	2
Pipeline	42
Rainy Water Tank	2

Table – 14 Number of villages & location of nearest source of drinking water

Distance of nearest drinking water source	No. of villages
Within village	6
0 to 3 Km	13
3 to 5 Km	10
5 to 10	7
More than 10 Km.	11

Table-15 Type and number of village institutions available in study villages of Maliya taluka

Organization type	Maliya (Miyana)
SHG	30
CBO	3
Water Committee	24
Watershed Groups	1
Voluntary Org.	15
Satsang Mandal	16
Yuvak Mandal	21
Caste Mandal	18

Table-16 Comparison between standard and actual (average) production rates of major crops grown in study villages of Maliya taluka

Crop	Unit	Standard-production Kg/ha	Maliya taluka production Kg/ha
Groundnut-Veldi	Kg/ha	1800-2200	1200-2500
Wheat	Kg/ha	4000-5000	6000
Cotton	Kg/ha	2500-4000	900-1600
Castor	Kg/ha	2500-4000	1100-1500
Bajari	Kg/ha	2000-2500	600-1300
Jowar	Kg/ha	1500-2000	800-1400
Til	Kg/ha	400-800	700-800

Table-17 Economic status of villages in Maliya taluka

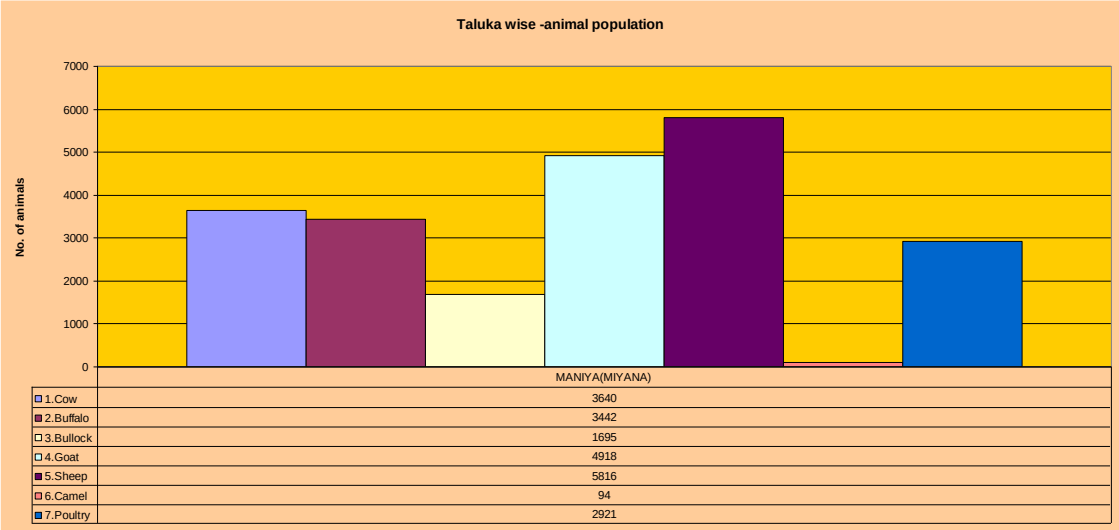
Description	No. of person
Bank creditor	7,336
Motor Boat-Fisherman	84
Conventional Boat-Fisherman	615
Cottage Industry	4
Bank defaulters	2,056
Bank-Depositor	1,201
Agri. Loan	4,594
Animal Loan	438
Fisheries Loan	44
Seasonal Migration	1,500
Land Selling Farmers	203
Land Purchaser Farmer	95

Table-18 Distance wise number of villages facing various type of diseases in Maliya

Diseases type	< 5 Km.	5 to 10 Km.	<10 Km.
Malaria	18	8	13
Water Born Diseases	9	2	30
Stone In Kidney	4	3	5
Flourosis	1	1	4
Gastric Problems	10	5	6

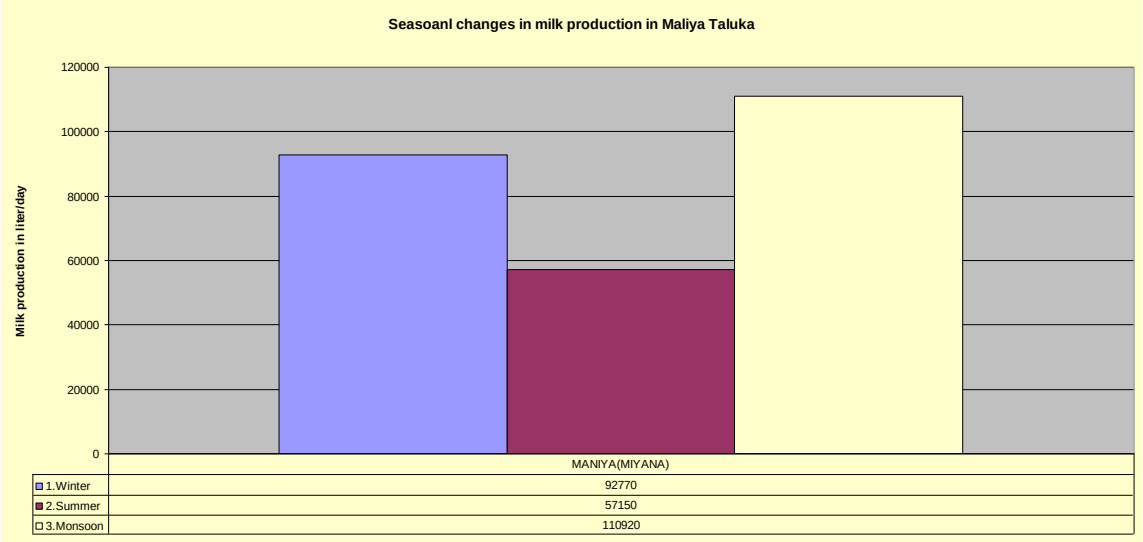
Important tables and graphs

Graph-1 Type wise livestock population in villages covered under study in Maliya taluka



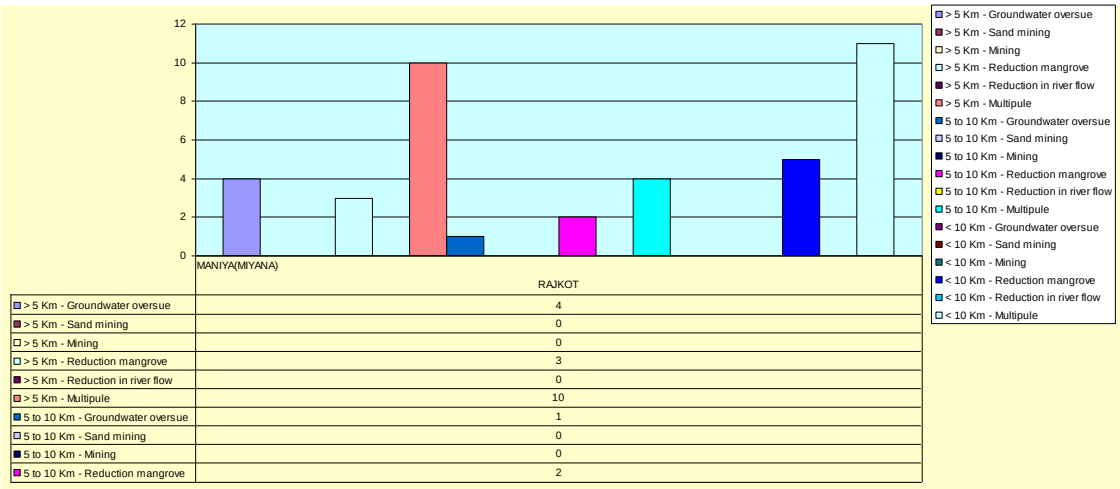
	MANIYA(MIYANA)
1.Cow	3640
2.Buffalo	3442
3.Bullock	1695
4.Goat	4918
5.Sheep	5816
6.Camel	94
7.Poultry	2921

Graph-2 Seasonal changes in milk production in Maliya taluka



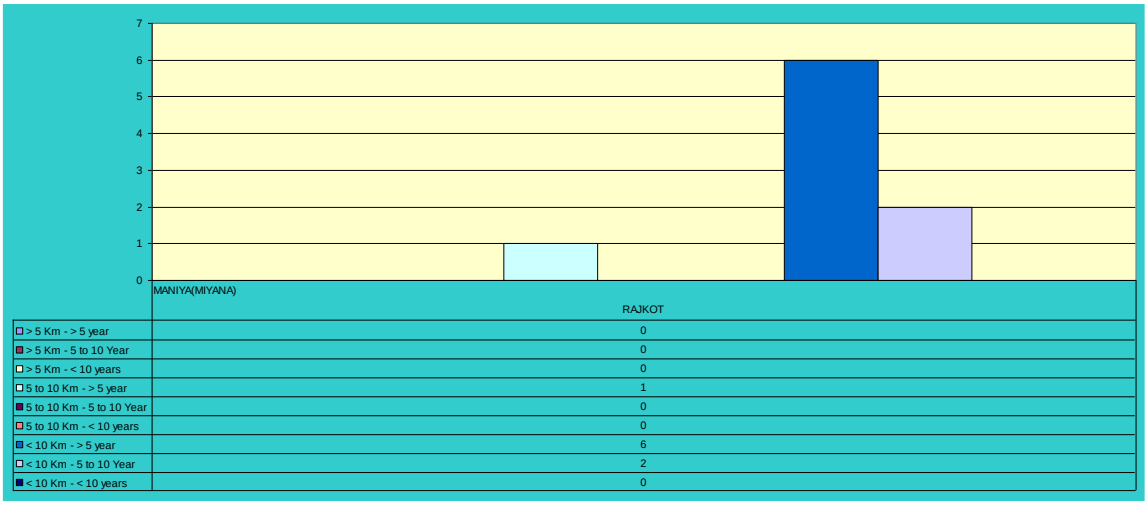
	MANIYA(MIYANA)
1.Winter	92770
2.Summer	57150
3.Monsoon	110920

Graph – 3 Distance wise variation in reasons for salinity expressed by the villages in Maliya taluka

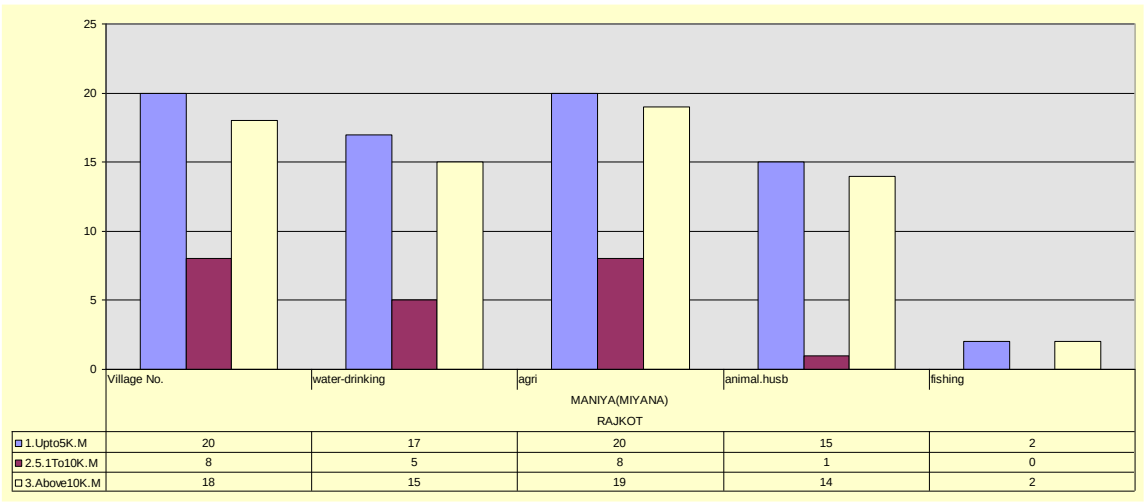


	MANIYA(MIYANA)
> 5 Km - Groundwater oversue	4
> 5 Km - Sand mining	0
> 5 Km - Mining	0
> 5 Km - Reduction mangrove	3
> 5 Km - Reduction in river flow	0
> 5 Km - Multipule	10
5 to 10 Km - Groundwater oversue	1
5 to 10 Km - Sand mining	0
5 to 10 Km - Mining	0
5 to 10 Km - Reduction mangrove	2

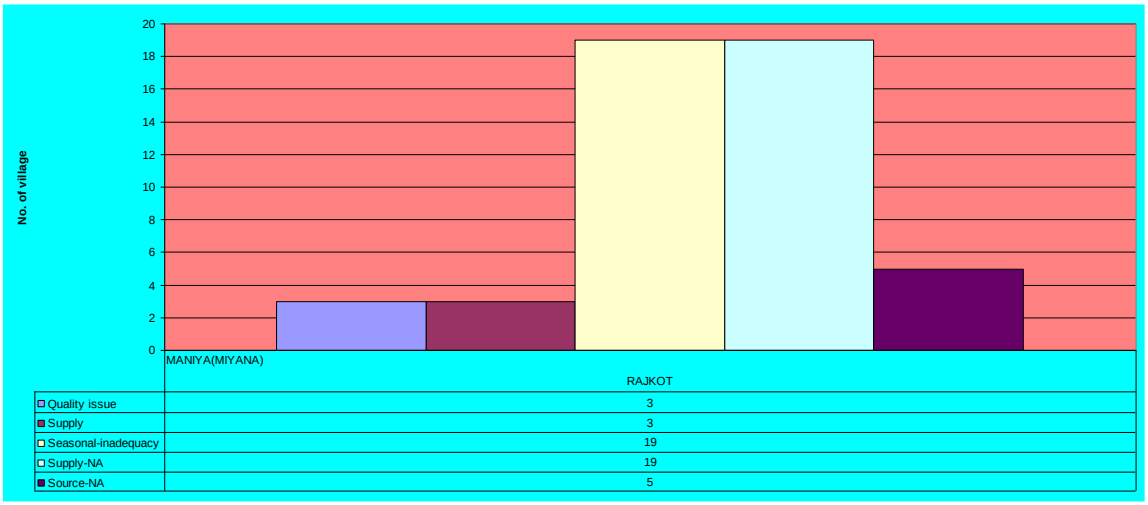
Graph – 4 Number of villages experiencing salinity problem located at various distance from coastline.



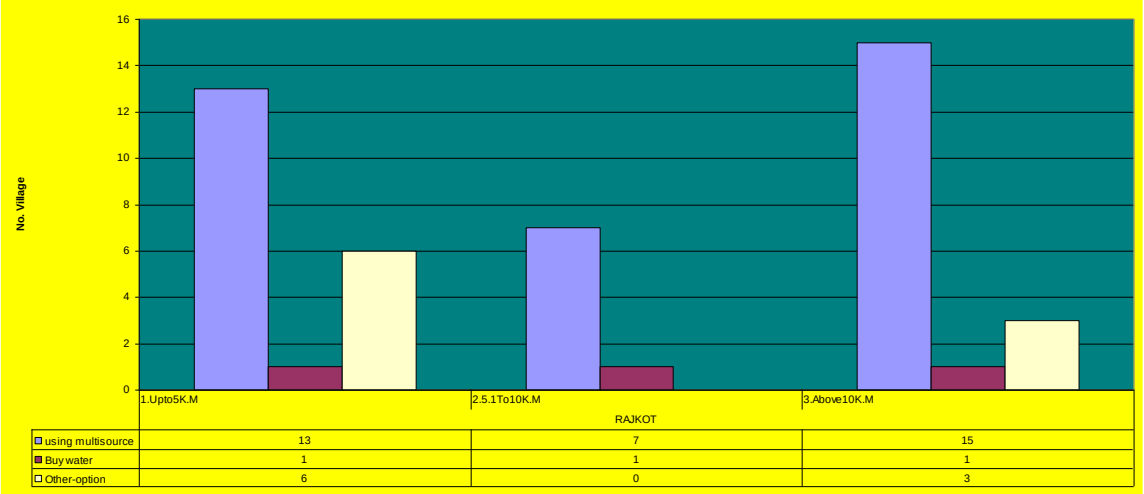
Graph – 5 Number of villages facing impacts of salinity on various income generation activities and drinking water availability.



Graph – 6 Impact-Drinking water

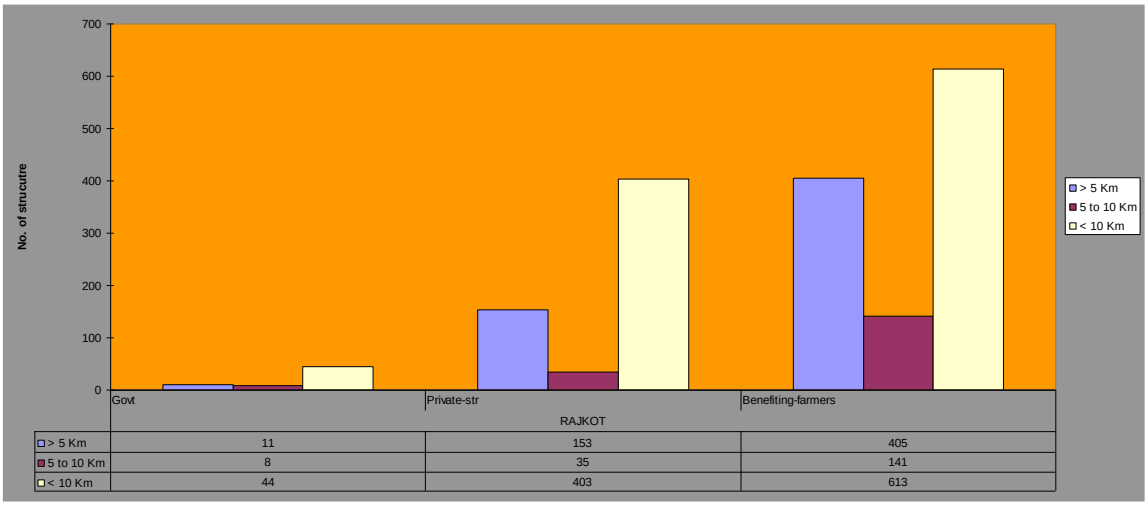


Graph – 7 Variation in drinking water status in villages located at various distance from the coastline.



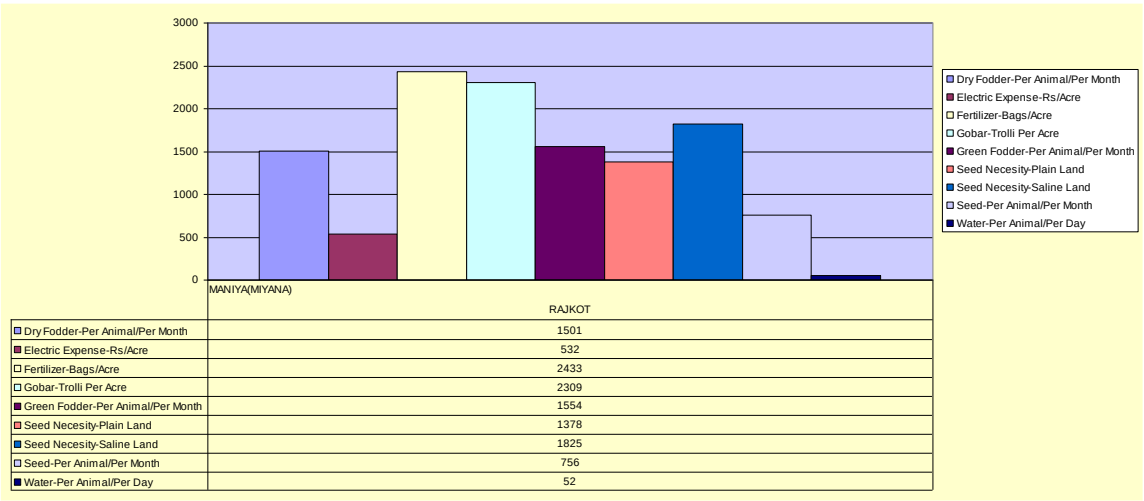
	1.Upto5K.M	2.5.1To10K.M	3.Above10K.M
using multisource	13	7	15
Buy water	1	1	1
Other-option	6	0	3

Graph – 8 Irrigation source



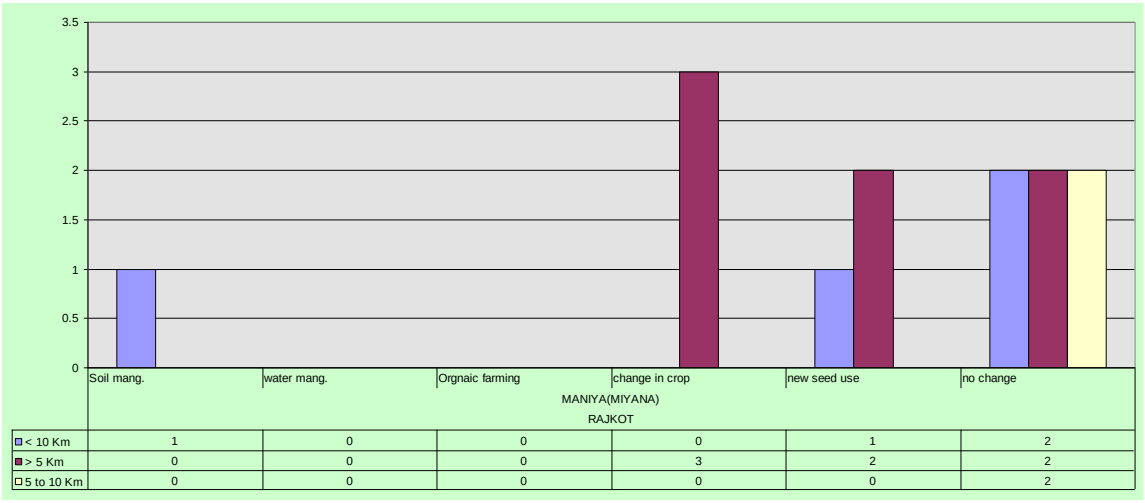
	Govt	Private-str	Benefiting-farmers
> 5 Km	11	153	405
5 to 10 Km	8	35	141
< 10 Km	44	403	613

Graph – 9 Input cost

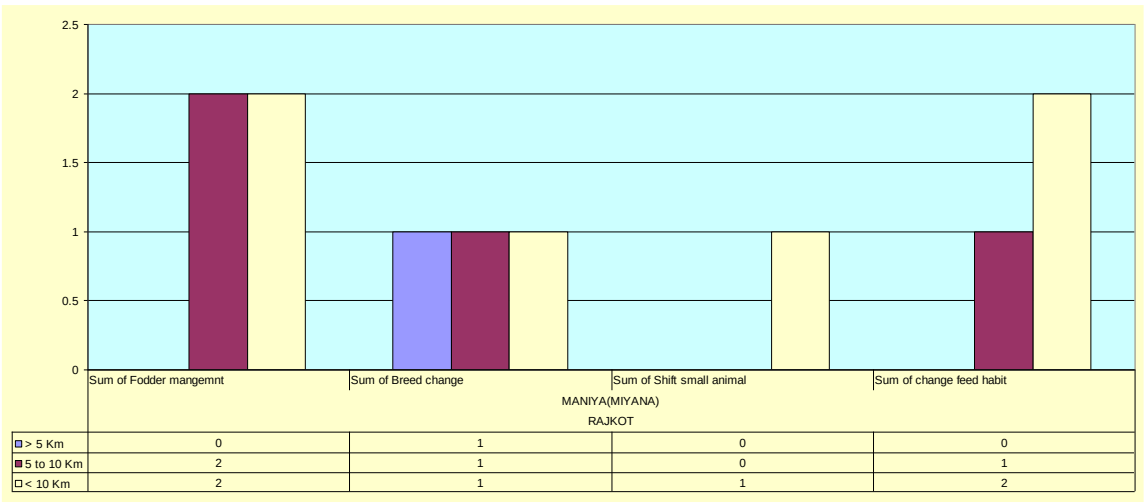


	MANIYA(MIYANA)
Dry Fodder-Per Animal/Per Month	1501
Electric Expense-Rs/Acre	532
Fertilizer-Bags/Acre	2433
Gobar-Trolli Per Acre	2309
Green Fodder-Per Animal/Per Month	1554
Seed Necesity-Plain Land	1378
Seed Necesity-Saline Land	1825
Seed-Per Animal/Per Month	756
Water-Per Animal/Per Day	52

Graph – 10 Solution-agriculture



Graph – 11 Solution-animal husbandry



Additional Tables

Table – 1 Asset holding of the villagers in coastal area

Block	Tractor	Water Purifier	Irriga -tional Facilities	Fodder Plot	Fodder Trader	Fodder Depot	Goods Carriage	Public Vehicles	Provision Stores	Private Doctor	Agricultural Input Shop	Agricultural Equi. Repair Stores	Animal Husbandry-Help	Two Wheelers
MALIYA (MIYANA)	1001		40	39	7	5	222	122	218	15	15	26	20	2640

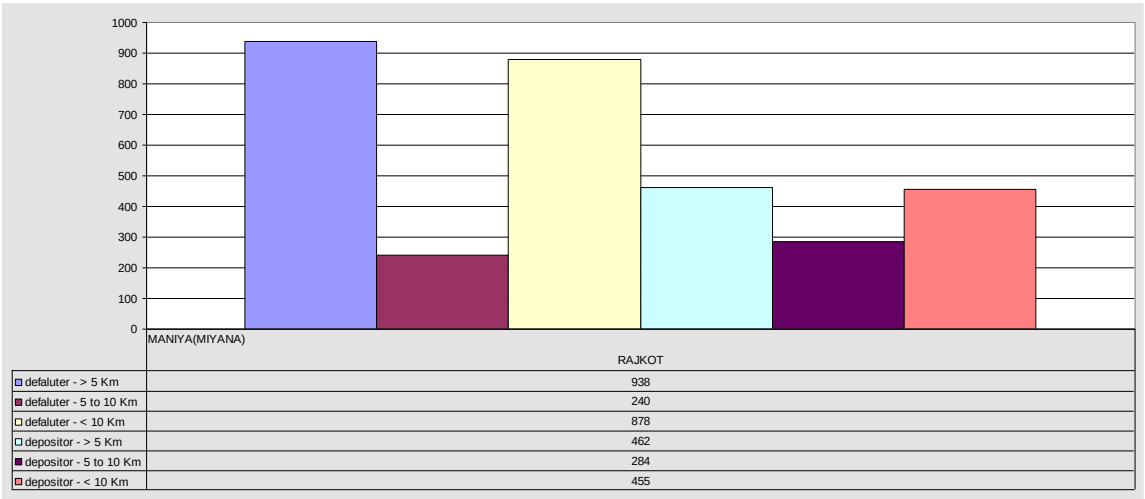
Table – 2 Educational details (Number of students enrolled under each institution)

Institution	Maliya (Miyana)
1to4	2,763
5 to7	1,922
8 to10	940
11 to12	212
Anganvadi	2,766
Grand Total	**8,603**

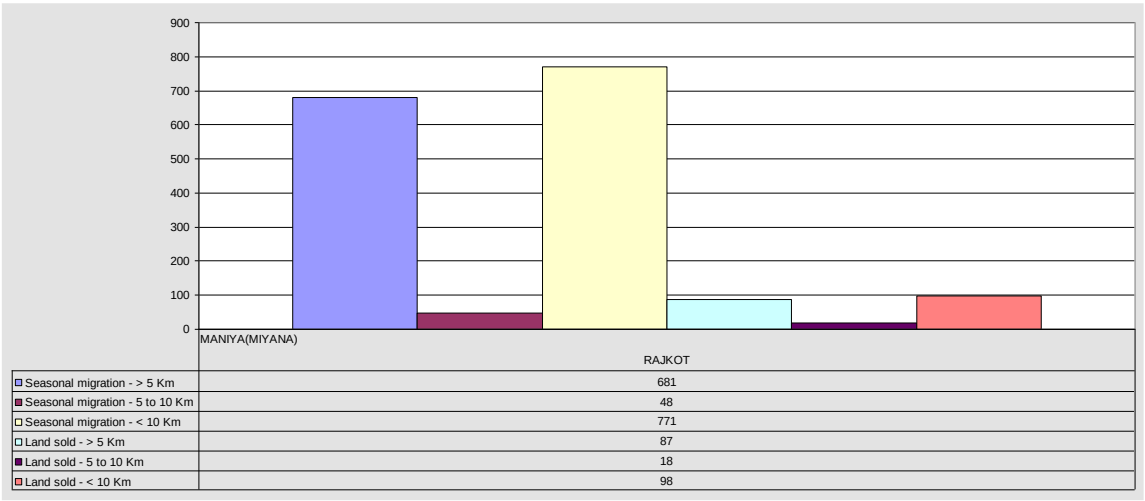
Table – 3 No. of villages having facilities for sanitation and good living condition in villages.

Facility	Maliya (Miyana)
Stand Post	21
Toilets	4
Bathroom	3
Drainage System	2
Soak Pits	4
Street Lights	5
Internal Road	25
Crematoriums	32
Burial Grounds	17

Graph – 1 Present status of banking and land selling in the study villages

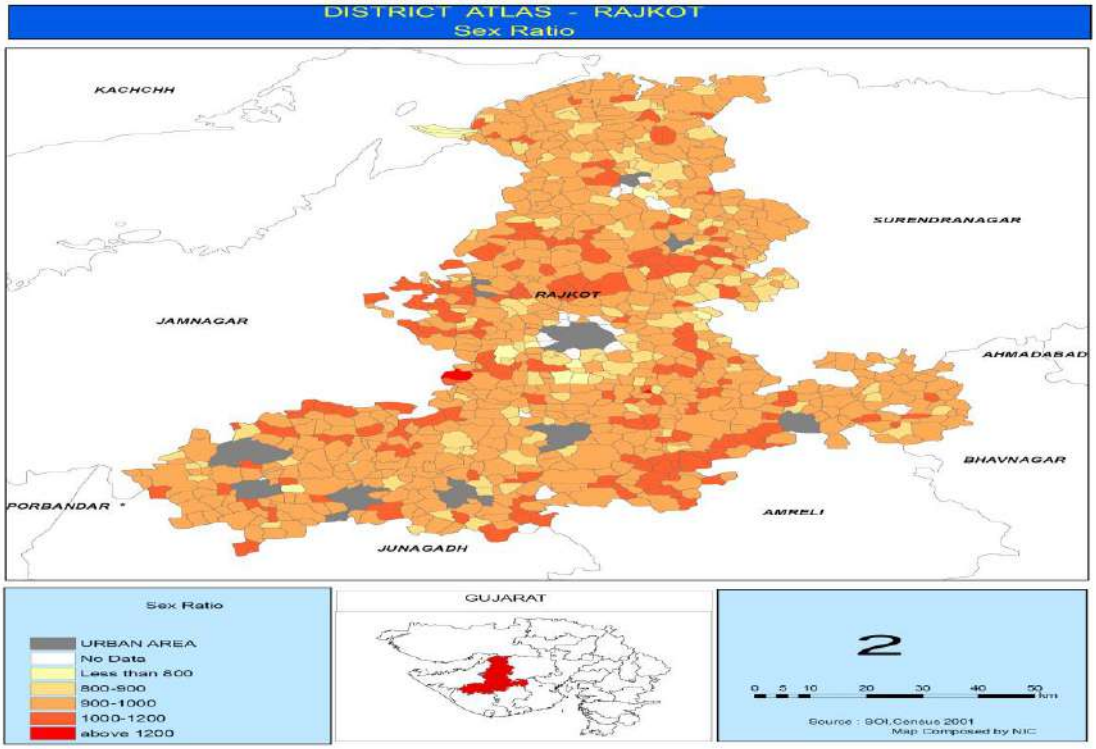


Graph – 2 Present status of migration in the study villages

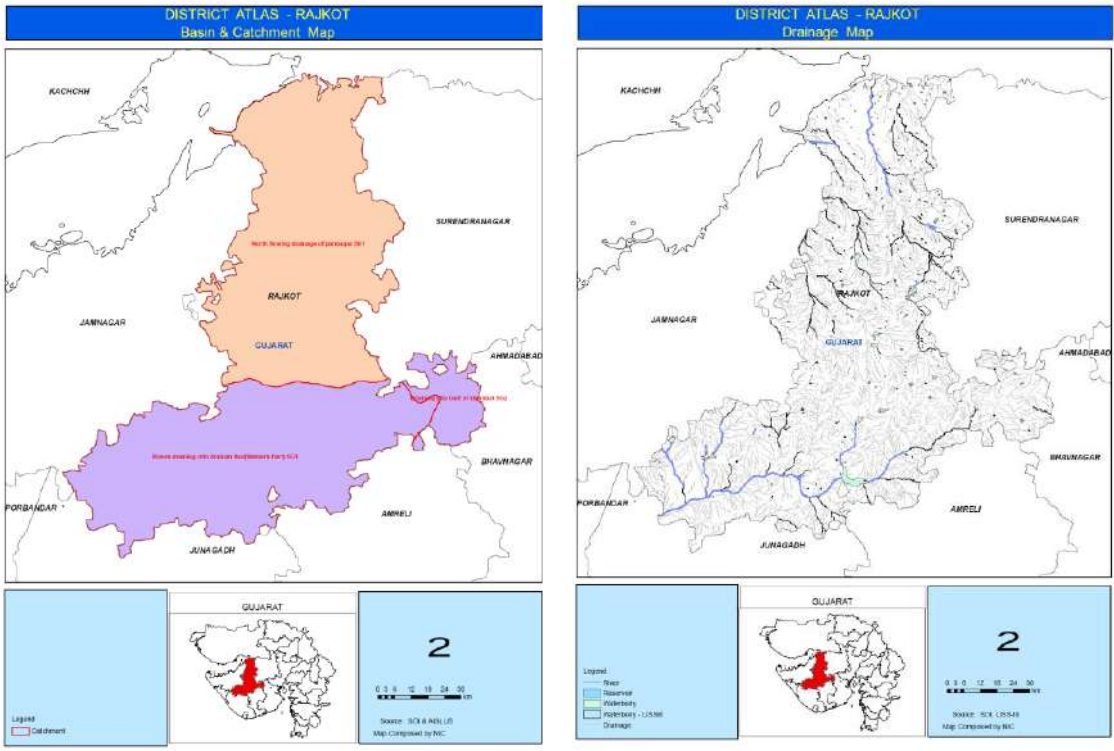


Maps

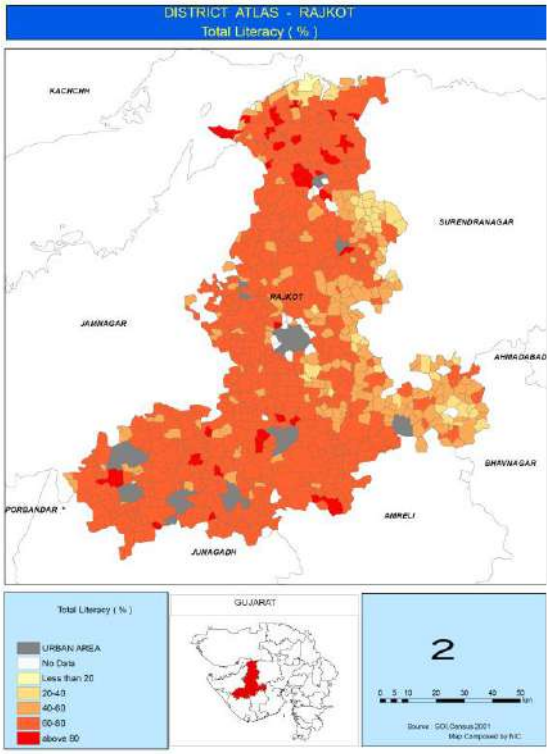
Map – 1 & 2 Maps showing basin & catchment and drainage of Rajkot District



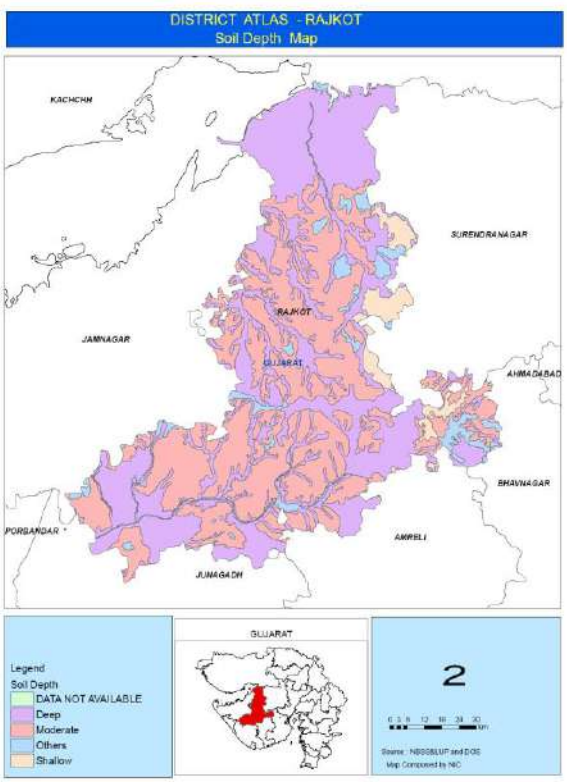
Map-3 Map showing villagewise sex ratio in Rajkot District

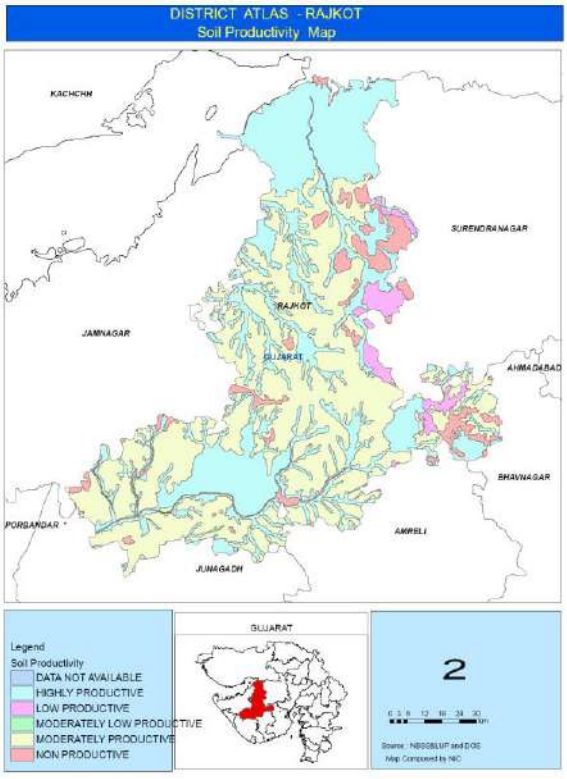


Map-4 Map Showing village wise total literacy (%) in Rajkot District

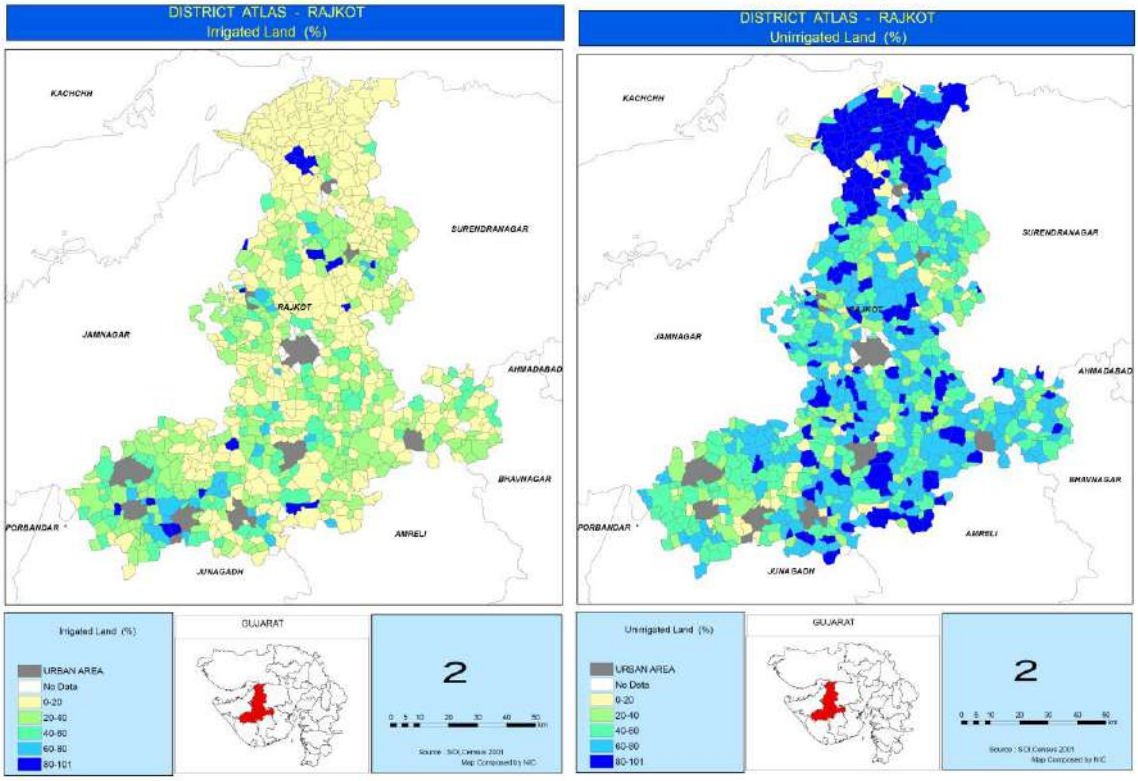


Maps – 5 & 6 Maps showing soil depth and productivity in Rajkot District

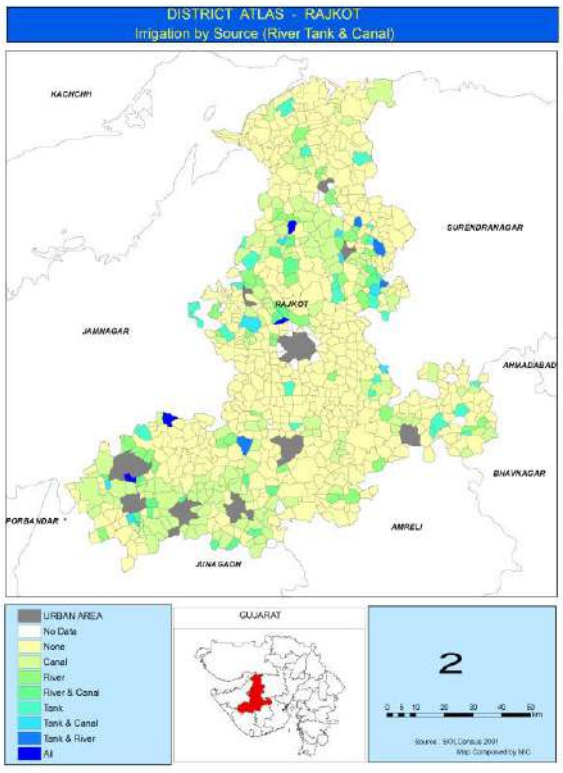




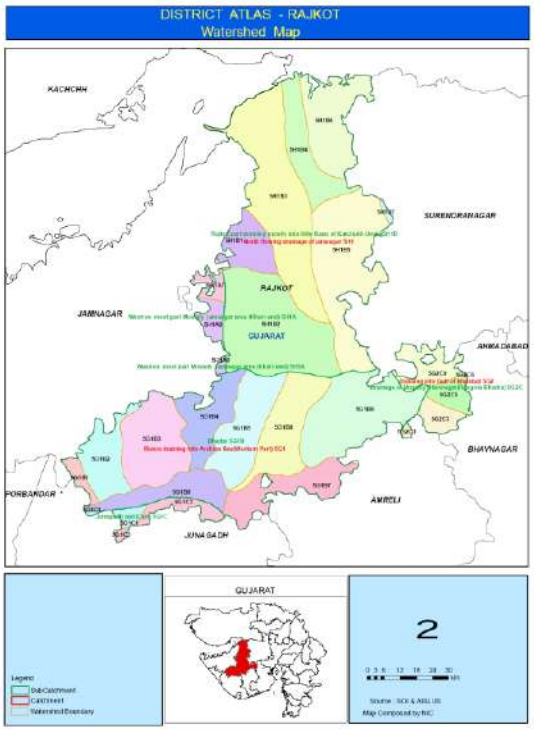
Map – 7 & 8 Maps showing village wise irrigation status of Rajkot District



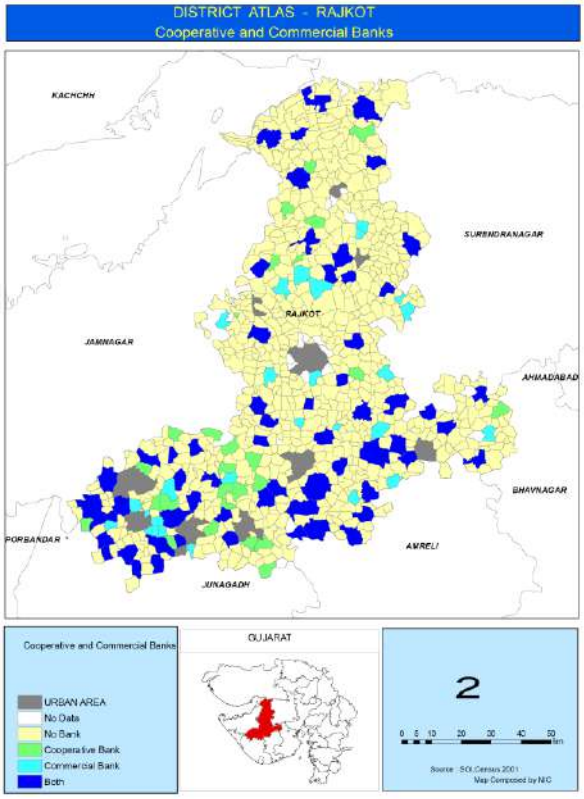
Map – 9 Maps showing village wise irrigation source in Rajkot District



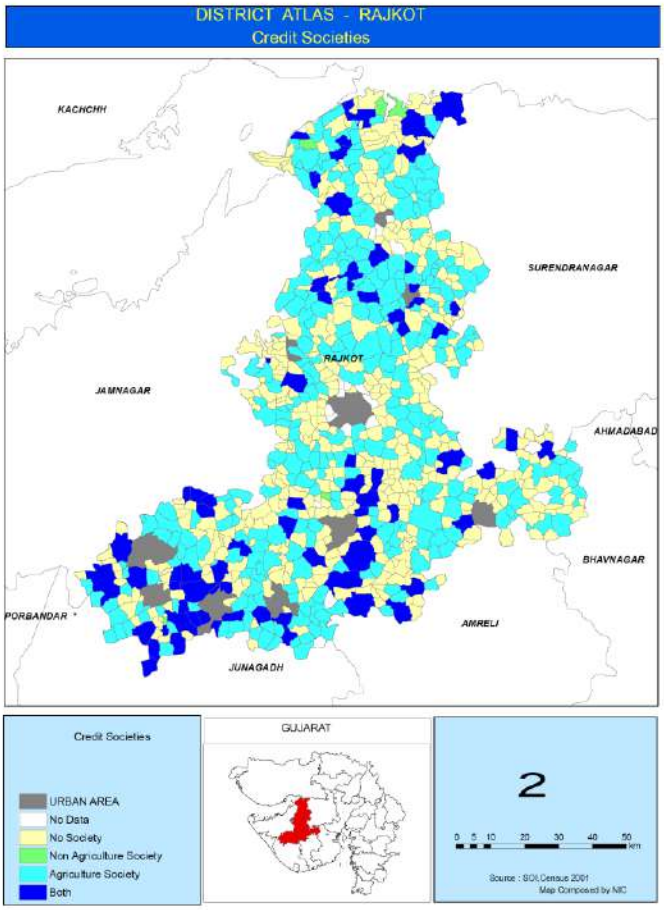
Map –10 Maps showing watershed demarcations in Rajkot District



Map – 11 Maps showing village wise cooperatives and commercial banks of Rajkot District



Map –12 Maps showing village wise credit societies of Rajkot District



Baseline Study of Coastal Villages affected by Salinity ingress in Kutch District

May-07 to March-08

Prepared by:

Saline Area Vitalization Enterprise Ltd. (SAVE)

Prepared for:

Coastal Salinity Prevention Cell (CSPC)

Kutch District

1. Introduction

Kutch district is the largest dist. in Gujarat having total area of 45,612 sq. km. It lies between 22°44'08" to 24°41'30" North Latitudes and 68°7'23" to 71°04'45" East Longitude. The total population, as per 2001 Census, is 1582,759 souls with livestock rearing being the principal livelihood for people of the district. This has resulted in a total livestock population of 14.13 lakhs (1992 livestock census). Overstocking exerted enormous pressure on the grasslands and the other habitats by way of overgrazing, top soil loss. Intensive agriculture in the areas with ground water resources has led to salinity ingress, which along with low rainfall and frequent drought has led to degradation of the habitats. Further, increasing industrial development has also contributed to habitat loss.

Topography of the district is uneven and about 50 % of area is covered by flat, marshy, saline Rann, while remaining area is occupied by two major hill ranges Jhara and Laki hill ranges.

Kutch district is traversed by 97 minor and major rivers all of them are nonperennial, band most of these flow from Central high land area to South direction. Average Rainfall of last 10 years the district is 312 mm.

2. Administrative set up

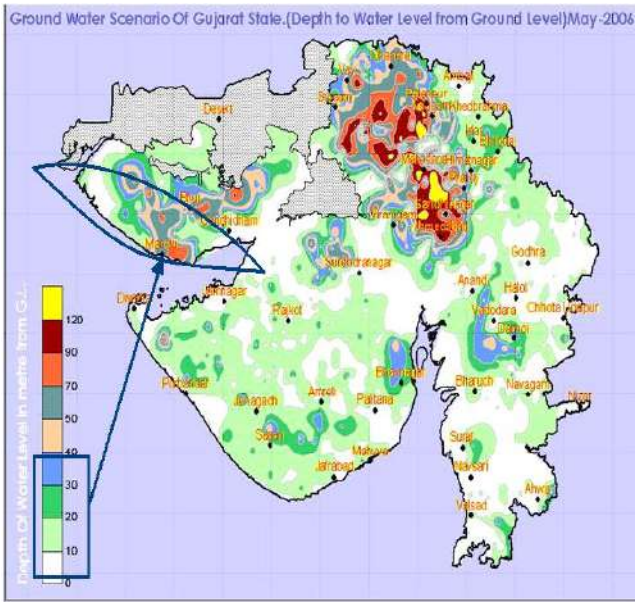
The Kutch district having 1,705,828.45 hectare area is administrated through 11 taluka, out of which seven talukas namely Lakhpat, Rapar, Bhachau, Anjar, Abdasa, Mandvi and Mundra are coastal talukas. The coastal talukas cover an area of 1,255,732.94 hectare. The administrative headquarter for the district is located in Bhuj.

3. Climate & Rainfall

Kutch falls in the arid tract and has a tropical monsoon climate. It experiences extremes of weather conditions with winter starting from mid November to end February with the temperature going down to the average minimum of 4.6oC in January. Summer extends from March to June with maximum temperature varying from 39-45oC. The estimated average annual rainfall is 326mm and highly erratic leading to protracted droughts, which are common phenomena. The evapo-transpiration rates are very high, with 2.25m in a year. Wind velocity is generally light to moderate.

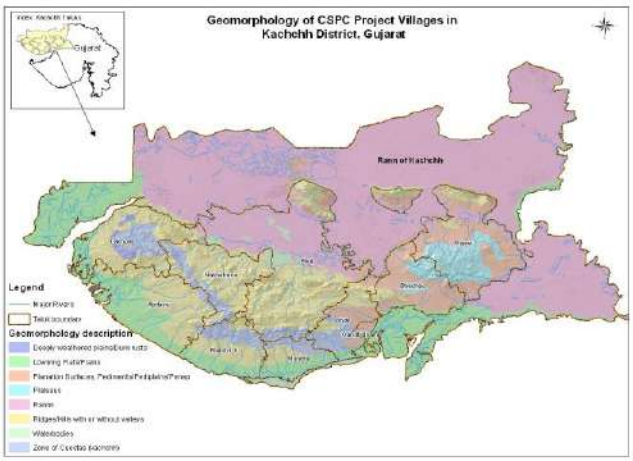
4. Physical features

4.1 Geology



Geologically, district comprises of old lower Jurrassic formation to recent alluvial formation. The extreme Northern part comprises of great saline Rann. In South, along seacoast, it is represented by recent alluvial formation and in West Tertiary formation is seen in Lakhpat & Abdasa talukas. Saline formation is seen in the Rapar taluka. Central & Southern part of the district is covered by basalt. Groundwater in most area is brackish to saline. Central part and East – west portion of district, yield potable water, and the southern area yields potable to brackish water from confined aquifers. The Central & Southern part of district occupied by Basaltic formation yield limited quantity of potable water from unconfined aquifer. The average depth of source ranges between 75 – 125m in east & West part and in central part it ranges between 135 – 180m.

4.2 Geo-morphology



This coastal segment represents the Gulf of Kutch. The gulf region comprises on its northern part belonging to Kutch while the southern part to Saurashtra craton.

The development of Rann of Kutch took place due to sea level changes.

The coastal region of the Gulf of Kutch making Kutch coastline is a WNW-ESE trending straight coast. In contrast with the Saurashtra coast which is characteristically muddy in nature, this coast is sandy. All along this coast few rivers drain into the gulf. The rivers carry small quantity of water are broad flatted with the river bed mostly comprises coarse sand and gravel. Geomorphologically, the coastline of Kutch is divided in to two broad segments.

1. Maliya to Mandvi
2. Mandvi to Koteshwar

The coast between Maliya to Mandvi shows increasing development of tidal flats in its eastern parts. The tidal flats gradually merge with the little Rann of Kutch. This coastal segment is

marked by the presence of creeks along which the high tide water enters through the river channels which have low detritus load. The mudflats support the growth of mangrove vegetation. Salt pans are seen developed in this region which is formed by the high tide water entering through the river channels. The dominance of tidal flats are seen to decrease towards Mandvi. The actual shoreline is crenulated on account of numerous river mouths.

The coastal plains overlooking the Gulf of Kutch and the Arabian Sea form the southern part of the mainland Kutch. From the sea level the plains rise rather gradually to an altitude of 80 m. beyond which they tend to show a rather more conspicuous rise, merging into the Central highland with a steeper gradient. The major rivers in this part of the Kutch region show meandering just above 25 to 30 m. altitude below which up to the coastline they show almost a straight course.

The coast between Mandvi and Suthri is rather straight trending WNW-ESE and is marked by wide sandy beaches flanked at the back by narrow coastal dune ridges and bound on both sides by extensive tidal flats. The river mouths dissect the shoreline, by which the sandy ridges appear to form spits and bars with lagoonal patches of tidal mud behind the ridge. The beach is narrow but well defined, varying in width from 50-100m with the backshore sandy ridge rising abruptly to almost 5-10m above the bermline.

The coastline between Suthri and Koteshwar is muddy characterized by extensive foreshore tidal flats. The shoreline is cut by numerous creeks and is highly crenulated. Kori creek is the passage through which the high tidal water enters the Great Rann of Kutch and inundates it. The course of time had given rise to vast stretch of salty wasteland. The sluggish streams like Kankawati, Vengdi, Kharod, Rukmawati, Nagvanti, Bhukhi etc.; carry low detritus load which had given rise to a thin veneer of sediments that make up the entire coastal stretch.

4.3 Hydrological situation

This gulf coast is significant from the point of view number of ports, harbours, industrial settlements, and major urban centers. This coastal tract is represented by variety of lithological formations governing aquifer development. The dominant ones are lime stones, Deccan traps, Quaternary sands and gravels, sandstones etc.

The coast bordering Kutch extending through Maliya - Kandla - Mandvi is characterized by the geomorphic features comprising of raised and intertidal mudflats, creeks, little Rann of Kutch, coastal dunes etc. Apart from the Rann, rest other features form a part of narrow plain comprising Mesozoic group of rocks at their base.

The average depth to the water table is 10m however the deeper aquifers are also present. The most important and productive aquifer occurs in the Bhuj sandstone in depth of less than 10m to 300m. The salinity distribution in the phreatic aquifers is rather uniform with low values in the uplands. The values increase towards the areas of discharge. The segment shows deterioration in groundwater quality. The quality tends to be unfavorable (saline) below 150 m.

The entire coast from Mandvi to Koteshwar comprises miliolitic limestone and dunal sands with occasional tidal creeks, The Kori creek forming entrant to the Great Rann of Kutch is characterized by the mudflats and the alluvium. The aquifers are predominantly saline and the salinity tends to increase with the depth.

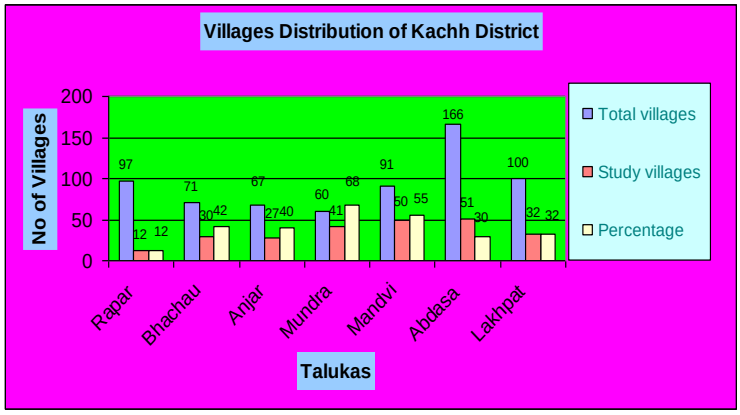
4.4 Geo-environment

This coastal segment comprises coral reefs, bets, extensive mudflats. Adjoining little Rann of Kutch, with its salty waste land. The Gulf environment has high tidal energy but low wave energy conditions when compared with the open-sea coastal environment. The tides are moderate with the tides height around 4 to 8 M. The coastal segment between Little Rann of Kutch and Mandvi is marked by mudflats. The presence of tidal flats are necessitated by the presence of creeks through which tidal waters enters the river channels carrying low detritus load.

The coastal segment between Mandvi to Koteshwar is characterized by open-sea conditions. The coastline is indented by numerous river channels which have low detritus load. Tidal flats are common near the Koteshwar region due to the presence of numerous creeks. The coastal parameters include high wave energy and low tidal energy.

5. The study coverage

Graph-1 Details of villages covered under study in Kutch



The present study covered seven taluka in Kutch district. The study has covered 243 (37%) coastal villages out of total 652 villages. The taluka wise villages covered in the study includes 12% in Rapar, 42% in Bhachau, 40% in Anjar, 68% in Mundra, 55% in Mandvi, 30% in Abdasa and 32% in Lakhpat. More than 50% villages affected by salinity ingress are located in Mundra and Abdasa taluka. As shown in table-1 below, the villages covered under the study covers 440,721 ha. area residing population of 3.22 lakh and 65,532 households. With the average population density of 73 person/sq.Km, the study villages show lower population density than that of the Kutch district. The population density is less than 50% as compare to the coastal region covered under the study. i.e. coastal area in Saurashtra and Kutch.

Table-1 Comparison between study area in Kutch district and coastal Saurashtra & Kutch region

District	Study area				
	Area-ha	No. Villages	No. Household	Population	Pop. density
Kutch district	1269,918	660	224,625	1108,963	87
Study villages	440,721	255	65,532	322,846	73
Total-Coastal talukas	2494,168	1873	827,328	4511,161	181
Total-Coastal talukas villages covered under study	**1267,241**	**998**	**330,227**	**1829,241**	**144**

The study villages covered in the Kutch district, comprise 34% of total study area, 38.64% villages but only 29% population.

Table-2 Comparison between study area in Kutch and coastal Saurashtra & Kutch region in percentage

District	Study area				
	Area	Villages	Houses	Population	Pop. density
Kutch	34.70	38.64	29.17	29.11	87
Total-Coastal talukas under study	50.81	53.28	39.91	40.55	181
Total-Coastal talukas villages covered under study	1267,241	998	330,227	1829,241	144

As shown in table-3, the 255 study villages have 1.64 lakh male, 1.50 lakh female. The population also includes 0.47 lakh children.

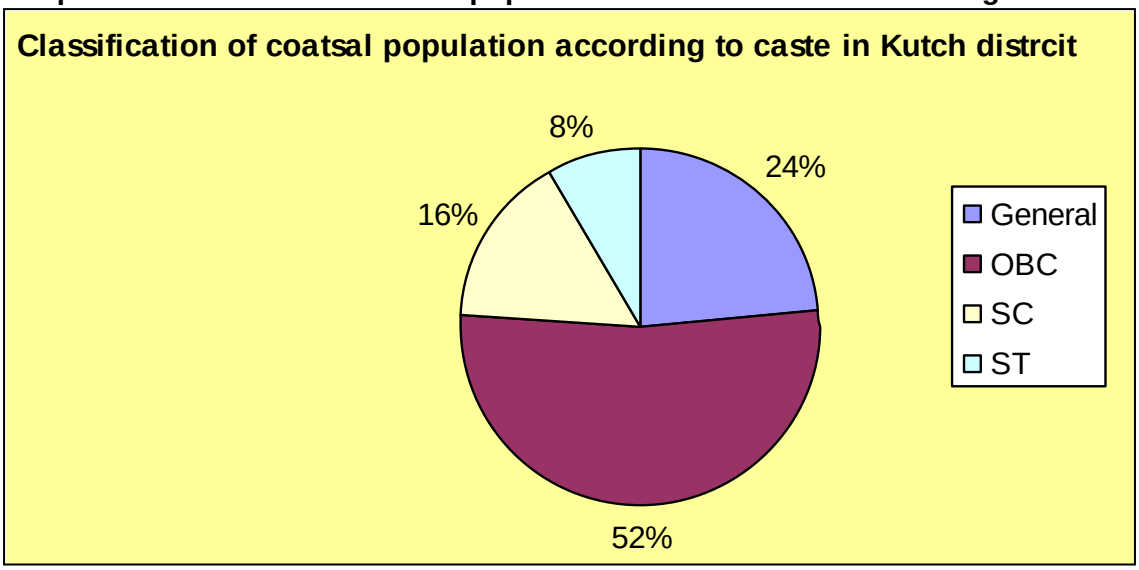
Table- 3 Demographic details of study villages

Block	Children	Female	Male	Total
Abdasa	7,720	17,075	16,943	41,738
Anjar	10,783	33,371	39,710	83,864
Bhachau	9,921	22,703	26,546	59,170
Lakhpat	2,145	5,125	5,675	12,945
Mandvi	3,246	39,398	39,935	82,579
Mundra	8,072	25,613	27,978	61,663
Rapar	5,620	6,945	7,580	20,145
Grand Total	**47,507**	**150,230**	**164,367**	**362,104**

6. Population Characteristics

The 76% of total population belong to other backward community which includes mainly Koli, Ahir, Maheshwari, Bharvada Rabari and Muslims. The general population having Rajputs, Jains, Patels and Brahmins form 12% of total population. The remaining population consists of schedule caste and schedule tribes. The schedule caste population has Harijan and Hadiya community. Villages with Muslim population are common in many villages.

Graph-2 Classification of coastal population in Kutch district according to caste



30.11% of the total families live below poverty line in coastal Kutch area. 52% of them are OBC category. The BPL families are spread across the surveyed villages. According to survey analysis 27%, 24% and 48% BPL families lives in villages located at distance less than 5 Km, 5 to 10 Km and more than 10 Km from the coastline respectively.

As shown in table-4 below, the highest population is located in Mandvi taluka followed by Anjar and Mundra taluka. The Abdasa block has highest population belong to general category, while Mandvi taluka has the highest population belongs to OBC category among the study villages.

Table-4 Taluka wise distribution of population according to category

Category wise Population	Block						
Caste	**Abdasa**	**Anjar**	**Lakhpat**	**Mandvi**	**Mundra**	**Rapar**	**Grand Total**
General	20,680	8,308	4,220	22,842	14,417	5,505	75,972
OBC	11,910	50,236	6,263	62,558	28,324	11,172	170,463
SC	3,975	12,326	1,656	11,235	11,212	3,528	43,932
ST	1,319	8,123	171	2,503	3,209	20	15,345
Total	**37,884**	**78,993**	**12,310**	**99,138**	**57,162**	**20,225**	**305,712**

7. Village characteristics

The 255 villages are located at a distance from coastline to maximum up to 20 Km. from the coastline. Maximum Number of 109 villages are located at a distance more than 10 Km from the coast line while 77 villages are located at a distance less than 5 Km from the coast line. The highest number of villages closest to sea belongs to Abdasa taluka having 17 villages located at a distance of less than 5 Km.

Table-5 Taluka wise distribution of villages according to distance from coastline

Taluka	Less than 5 Km.	5.1 to 10K.M	Above 10K.M
Abdasa	17	9	25
Anjar	8	5	15
Bhachau	2	10	18
Lakhpat	16	9	9
Mandvi	15	19	19
Mundra	11	12	20
Rapar	8	5	3
Total	**77**	**69**	**109**
%	**30.20**	**27.06**	**42.75**

8. Occupation

The livelihood in the Kutch as a whole and coastal region in particular is mix and match type, in which families are involved in more than one occupation. The agriculture is main occupation with around 48,000 farming families in 255 villages. The farmers are supported by around 31,000 agriculture labourers who are also dependent on agriculture in the coastal area. Animal husbandry is one of the main occupation among many families living in the coastal areas. The survey has recoded 11,000 families exclusively involved in animal husbandry which include animal rearing and selling as well as animal rearing for Milching.

Apart from these two major occupations, the coastal Kutch has families involved in charcoal making, fisheries and salt making. Though the Kutch is the largest center for salt production, the majority of salt labourers are from out side the Kutch area. Apart from farm sector large population is engaged in handicraft like embroidery, leather, metal work etc.

The industrial development around Mundra, Anjar and Bhachau provides opportunity for services like transport, wage labour and skilled employment in industries. The taluka wise details of the major occupation carried out in surveyed villages are given in the table-6 below.

Table-6 Occupational profile of study villages

Occupation	Abdasa	Anjar	Bhachau	Lakhpat	Mandvi	Mundra	Rapar	Total
Big Farmer	3,219	3,570	1,371	546	12,441	2,332	392	23,871
Small Farmer	2,251	2,618	1,652	282	5,922	1,208	498	14,431
Marginal Farmer	1,309	1,175	1,297	148	4,381	1,233	725	10,268
Agri. Labour	5,017	3,932	2,864	2,225	9,041	6,001	2,235	31,315
Animal Husbandry	695	2,148	1,432	539	1,663	3,466	1,460	11,403
Coal Workers	1,262	150	168	68	459	85	1,345	3,537
Fishing	1,026	1,710	40	157	855	2,049	00	5,837
Salt Workers	411	1,011	155	00	4	80	201	1,862
Small Business	313	485	292	51	834	286	77	2,338
Service	543	2,497	513	307	929	536	88	5,413
Misc. Labour	4,798	7,212	3,487	670	4,562	4,826	522	26,077
Total	**20,844**	**26,508**	**13,271**	**4,993**	**41,091**	**22,102**	**7,543**	**136,352**

The agriculture land holding information for Kutch district given in table-7 below indicate that highest amount of land is hold by farmers having land holding between 10 to 20 hectare which makes the district unique among the coastal district. The 15% farmers having land more than 10 ha own 61% of total agriculture land in the district. As compare to state, Kutch district has lower percentage of land holders in low land holding category. The land holding among small and marginal farmers (holding land less than 2 ha) is only 7% of total agriculture land in the district.

Table-7 Landholding pattern in Kutch district

Class	District	No.s/ ha.	Percentage	
			Kutch	State
Below 0.5	No.	3,942	2.39	12.18
	Area	1,125	0.15	1.29
0.5- 1.0	No.	9,851	5.97	15.16
	Area	7,692	1.04	4.38
1.0-2.0	No.	33,201	20.14	27.97
	Area	49,811	6.71	15.67
2.0-3.0	No.	30,040	18.22	16.28
	Area	73,875	9.95	15.15
3.0-4.0	No.	21,242	12.88	9.27
	Area	73,325	9.88	12.20
4.0-5	No.	18,528	11.24	6.22
	Area	82,134	11.07	10.58

Class	District	No.s/ ha.	Percentage	
			Kutch	State
5.0-7.5	No.	23,226	14.09	7.50
	Area	140,729	18.96	17.32
7.50-10	No.	11,299	6.85	3.01
	Area	97,006	13.07	9.81
10-20	No.	12,186	7.39	2.23
	Area	161,476	21.76	10.92
20.00 & above	No.	1,364	0.83	0.18
	Area	55,028	7.41	2.67
Total	**No.**	**164,879**	**100.00**	**100.00**
	Area	**742,201**	**100.00**	**100.00**

9. Land use

According to census 2001, the coastal area in Junagadh district covers an area of 45,652 sq. Km area. This includes 6.27% forest, 36% under barren and wasteland, 36% cultivable waste and 10% land under cropping and 1.5% as current fellow land. The cropping intensity was 104% which is less than the state average of 112%.

According to irrigation statistics for year 2002-03, the Kutch district has 199500 ha. gross irrigation potential of which 27892 ha fall in study villages. The Mandvi and Mundra talukas have more than 10% of its geographical area under irrigation. The lowest irrigation is found in Lakhpat taluka.

Among the talukas, Abdasa taluka has highest geographical area as well as area not available for cultivation while lowest percentage of same are found in Rapar taluka.

The taluka level analysis shows that highest unirrigated area is found in Bhachau which is 60% of total geographical area.

Table-8 Taluka wise land use pattern in Kutch district (area in hectare)

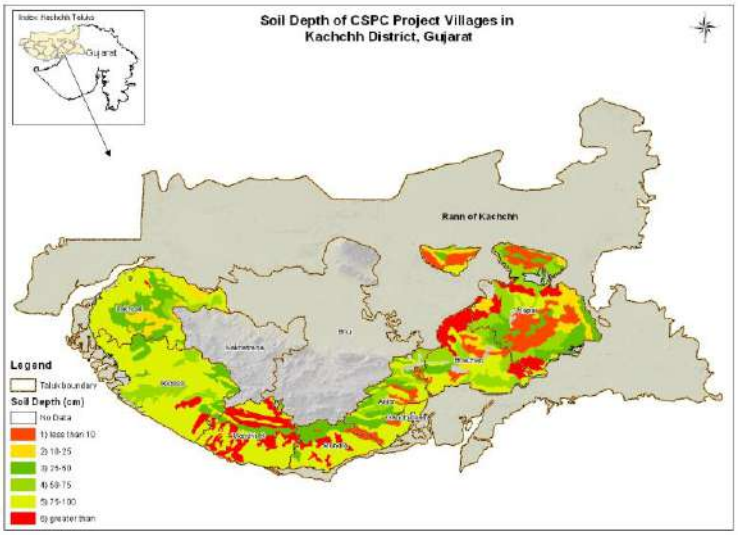
Taluka	Area	Forest	Irrigated	Unirrigated	Cultivable waste	Not available for cultivation
Bhachau	76,678.17	5,536.98	3,190.67	46,064.73	6,803.08	15,082.71
Mandvi	77,451.25	2,530.58	14,050.64	33,274.14	13,186.79	14,409.10
Abdasa	88,066.07	1,005.20	1,182.16	27,913.00	25,518.23	32,447.48
Anjar	59,291.61	541.99	1,885.94	32,736.70	7,020.73	17,106.25
Rapar	27,703.56	1,228.80	891.17	9,611.51	7,746.26	8,225.82
Lakhpat	53,575.67	4,,883.16	219.31	6,896.78	2,612.43	35,809.51
Mundra	57,955.01	1,517.73	6,472.46	30,371.81	9,649.06	9,943.95
Dist-Kutch	440,721.34	17,244.44	27,892.35	186,868.67	72,536.58	133,024.82

Table-9 Taluka wise Land use pattern with % of each land use (area in hectare)

Taluka	Area	Forest	Irrigated	Unirrigated	Cultivable waste	Not available for cultivation
Bhachau	100	7.22	4.16	60.08	8.87	19.67
Mandvi	100	3.27	18.14	42.96	17.03	18.60
Abdasa	100	1.14	1.34	31.70	28.98	36.84
Anjar	100	0.91	3.18	55.21	11.84	28.85
Rapar	100	4.44	3.22	34.69	27.96	29.69
Lakhpat	100	9.11	0.41	12.87	4.88	66.84
Mundra	100	2.62	11.17	52.41	16.65	17.16
Dist-Kutch	100	3.91	6.33	42.40	16.46	30.18

10. The natural resources

10.1 Soils

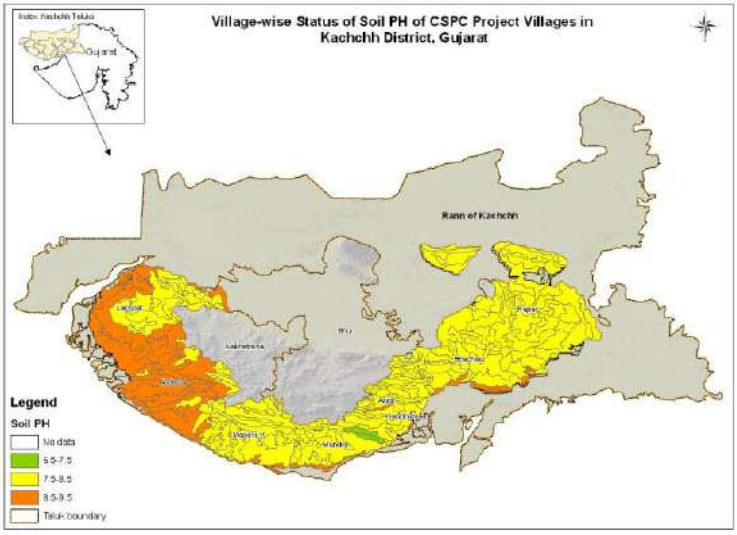


The coastal tract of Kutch district is having soils classified as desert soil, sandy loam soil and coastal alluvium soils with deep to moderate depth. The area close to Little Raan of Kutch and Kori creek has desert soils. The large portion running east-west along the coastline is having sandy loam soils, which dominates the area parallel to the coastline. This area is intermingled with patches of coastal alluvium soil between Mundra and Abdasa.

The majority of area has soil depth ranging between 75-100 cm. with patches of shallower soil depth around Abdasa and deeper soil around Mandvi and Rapar taluka.

10.2 Soil characteristics

The soils in coastal Kutch region shows two distinct areas based on the soil PH. The area on western side has soil PH in range of 8.5 to 9.5, while remaining area has soil PH between 7.5 to 8.5.



Considering physical and chemical characteristics of the soils like salinity, sodium absorption%, PH, soil texture and water level, the entire region is classified in to five types as shown in table 10 below.

Table-10 Variation in soil characteristics depending on physical and chemical parameter

Type	Taluka includes	Salinity (DC/m)	Sodium absorption %	Ph	Soil texture	Water level (monsoon)
Type-1- Land with heavy soil, Acidic in nature having shallow water levels	Maliya-Miana	0.09-10.0	1.1-61.0	7.8-9.3	Clay to silt clay	Less than 1.5 m
Type-5- Land with heavy soil texture, saline having shallow water levels	Greater Raan of Kutch (Lakhpat)	0.3-20.2	1.2-39.6	7.6-8.5	Sandy clay loam	Less than 1.5 m
Type-8- Land having medium soil texture, saline having shallow water levels	Mandvi, Abdasa	3.2-7.6	10.7-13.00	8.7-8.9	Silty loam	Less than 1.5 m.
Type-9- Land having light soil texture, Acidic saline having shallow water levels	Rapar	1.9-13.00	18.7-50.2	8.3-9.3	Sandy-Sandy clay loam	Less than 1.5 m.
Type-10- Land having light soil texture, saline having deep water levels	Gandhidham, Bhachau, Mundra	0.1-11.00	7.2-22.00	7.7-8.7	Sandy to sandy loam	More than 1.5 m

10.3 Soil productivity

The map below shows the productivity of soils across Kutch district. As shown in the map, the productivity of soils in coastal region shows wide variation from non-productive soils to highly productive lands. Large portion of land adjoining to Little Raan of Kutch and along the creeks inundated by the sea water are non-productive. The area in western Kutch covering villages of Mundra, Anjar and Mandvi taluka are having moderately low productivity.

10.4 Ground water

The ground water is available in the coastal aquifer formed by alluvium and clays, limestone and sandstone in a sequence as one move away from the coastline. The aquifers formed in limestone and sandstones have depth in range of 100-250m, in contrast to the aquifer in alluvium and clays which have depth of 50 to 100m. The ground water quality shows increasing value of TDS as the depth increase in alluvium and limestone bearing aquifers. The availability of groundwater has promoted large number of shallow and deep wells all along the coastal tract except in Lakhpat and part of Abdasa where the ground water is saline in nature.

As shown in table below, the major talukas in the costal Kutch are over exploited its ground water potential converting four talukas i.e. Rapar, Bhachau, Anjar and Mandvi in to over exploited category having ground water draft more than recharge. The remaining two talukas i.e. Lakhpat and Abdasa have ground water saline in nature and hence not utilized at large.

Table -11 Taluka wise ground water potential

Taluka Name	Gross Ground Water Recharge (Mcm/Year)	Utilizable Ground Water Recharge (Mcm/Yr)	Total Ground Water Draft (Mcm/Yr)	Ground Water Balance (Mcm/Yr)	Level Of Ground Water Development (%)	Category
Lakhpat	39.11	31.29	8.57	22.72	27.39	White
Rapar	65.82	52.66	52.80	-0.14	100.27	OE
Bhachau	52.36	41.89	46.99	-5.10	112.18	OE
Anjar	50.64	40.51	56.41	-15.90	139.24	OE
Abdasa	22.38	17.90	14.21	3.69	79.37	Gray
Mandvi	81.31	65.05	65.62	-0.57	100.88	OE
Mundra	55.26	44.21	39.32	4.89	88.94	Gray

The Kutch district is the only coastal district having tube-well in Saurashtra and Kutch coastal region. The district has more than 33,743 ground water structures used for irrigation and drinking water purpose. Majority of the structures are masonry structures in the form of open dug wells and dug cum bore wells. (Refer table-12 below)

Table-12 Number of tube wells and dug wells in operation (Year-2006)

		Numbers of structures
Number of Tube wells	Public	219
	Private	-
Number of dug wells for irrigation purpose	Masonry	25,879
	Non-masonry	2,709
	Total	2,858
Number of dug well used for domestic purposes only		1,953
Number of wells not in use		2,983
Total Number of wells including Tube wells		33,743
Number of Oil engines for irrigation		10,649
Number of electric motors used for irrigation purpose		22,521
Total Number of oil engines and electric motors for irrigation purposes		**33,170**

During early 80's and up to mid 90's, the thirst for irrigation water has lead to development of large number of open wells followed by bore wells in coastal Kutch. According to the farmers the ground water depth started increasing in mid 90's and the wells started yielding saline water which is not suitable for irrigation. The drought period during late 80's has increased the ground water structures as well as draft.

At present, the irrigation is done using both ground water and surface water with 90% irrigated area covered by ground water. The increase in number of check dams and medium irrigation scheme has provided about 10% area with facility of surface water irrigation source. (Refer table-13 below). The surface irrigation situation in Mandvi, Mundra and Rapar is enhanced by the individual structures like farm ponds and check dams promoted under various government schemes for water harvesting. In present situation, the ground water structures are still used for irrigation in Mandvi and Mundra having aquifers in limestone and sandstone.

Table -13: Taluka wise number of irrigation sources used in study villages

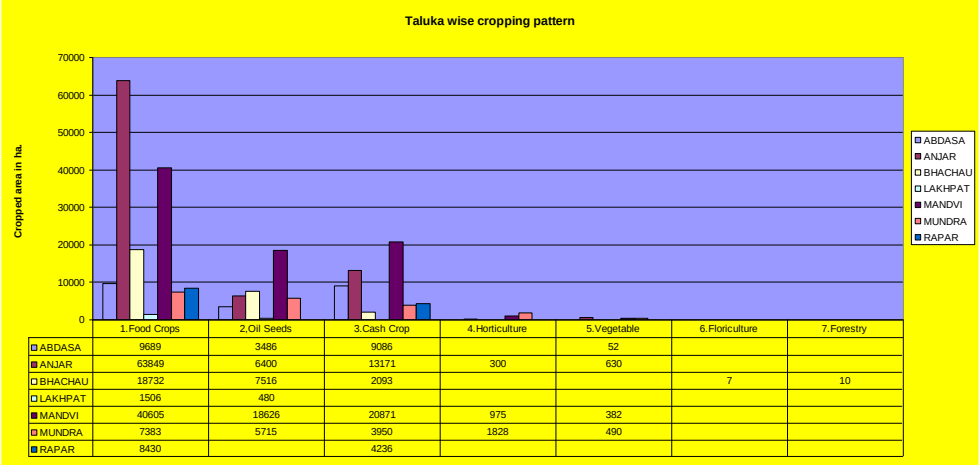
Type	Abdasa	Anjar	Bhachau	Mandvi	Mundra	Rapar	Total
River	2	5		20	29	15	71
Irrigation Pond	1			13	17	25	56
Village Pond	14	19	4	21	28	7	93
Farm Pond	19	6		60	227	60	372
Canal				12	14		26
Check Dam	3	20		89	86	22	220
Bandhara	2			2			4
Bore Well	977	66	247	2,571	1,061	2	4,924
Well	93	262		415	297	57	1,124
Total	**1,111**	**378**	**251**	**3,203**	**1,759**	**188**	**6,890**

11. Livelihoods

11.1 Agriculture

The agriculture in coastal villages of Kutch district is characterized by diversity. The majority of agriculture is rainfed in nature supporting cultivation of food grains like Bajara and Jowar; oil seeds crops like ground nut, cotton and castor. The major irrigated crops include wheat and horticulture crops. The agriculture is dominated by oil-seeds crops mainly ground nut and cotton crop. The Guwar seeds are grown only in coastal Kutch area among the coastal Saurashtra and Kutch. The study area has reported the highest amount of food grain cultivation in Anjar and Mandvi taluka. The Mandvi taluka dominates in oil seeds while Mundra taluka dominates in horticulture among coastal talukas in Kutch. (Refer graph-3 below)

Graph : 3 Cropping pattern in coastal talukas of Kutch district.



	1.Food Crops	2,Oil Seeds	3.Cash Crop	4.Horticulture	5.Vegetable	6.Floriculture	7.Forestry
ABDASA	9689	3486	9086		52		
ANJAR	63849	6400	13171	300	630		
BHACHAU	18732	7516	2093			7	10
LAKHPAT	1506	480					
MANDVI	40605	18626	20871	975	382		
MUNDRA	7383	5715	3950	1828	490		
RAPAR	8430		4236				

11.2 Animal husbandry

The animal husbandry is a traditional occupation of the people living in the costal Kutch. The Kutch region has distinction of having animal population larger than that of human population. The animal census-2007 has recorded more than 17 lakh heads. In Kutch, the animal rearing is done as exclusive occupation as well as along with farming. The animal husbandry in the Kutch region also has distinction in terms of its nature. In contrast to other coastal region, the animal husbandry in Kutch is done for selling animals along with milk and wool production. The large

population of Maldhari's villages are found in coastal areas from Bhachau to Lakhpat doing exclusive animal rearing.

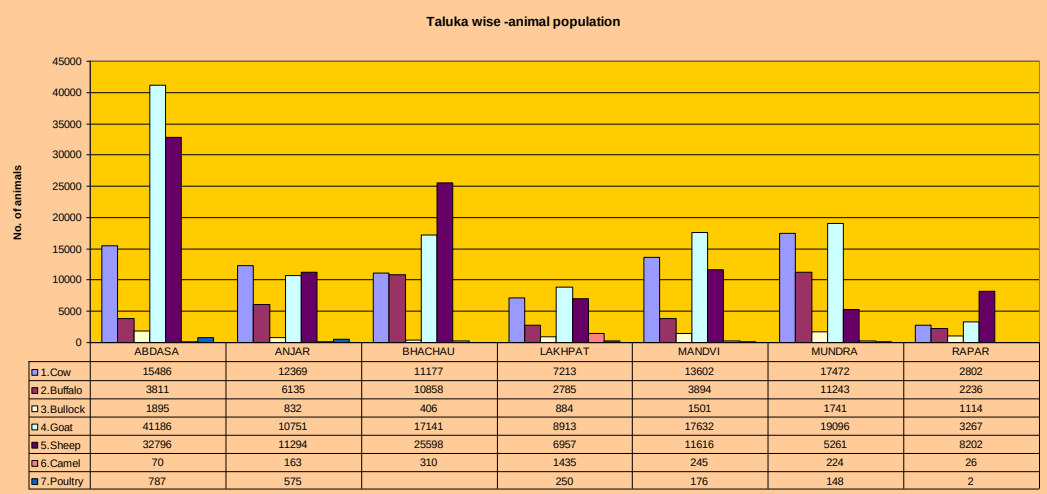
The information of animal population during 2000-2005 shows that in at the district level cross breed cows are replacing indigenous cows and buffalo. The population of buffalos shows fluctuation with over all decreasing trend. This is mainly due to reduction in water and fodder availability. The population of small animals like goat and sheep has not changed over the past six-seven years. The small animals like Goat and Sheep and poultry units have recorded little change during 2002 to 2005.

Table-14 Detail of livestock population change in Kutch district

Year	Cross Bred Cow (Nos.)		Indigenous Cow ('00 Nos.)		Buffalo ('00 Nos.)		Goat ('00 Nos.)		Total Sheep ('00 Nos.)	Poultry ('00 Nos.)		Total Layer ('00 Nos.)
	Inmilk	Milch	Inmilk	Milch	Inmilk	Milch	Female	Total		Desh i	Improved	
1999-00	366	691	1,059	1,728	567	903	1,696	4,666	5,117	55	50	105
2000-01	288	655	989	1,667	549	914	1,550	4,810	5,641	60	221	281
2001-02	894	1,047	947	1,892	644	1,407	1,647	4,997	6,387	34	74	108
2002-03	838	1,122	944	1,538	621	1,138	1,702	5,058	6,988	49	0	49
2003-04	845	1,133	880	1,714	588	983	1,636	4,976	6,412	56	63	119
2004-05	838	1,122	936	1,612	657	1,003	1,826	5,197	6,791	58	56	115

Among the cross breed cows jerssy and other cross breeds are more popular than HF. Among the indigenous cows kankaraj dominates. The buffalos of local Banni variety are most popular among the cattle reaer. Among the goat, the local species of Kutchi goat and sheeps form almost 99% of the population. The Graph below shows taluka wise livestock population in the villages covered under the present study. The graph shows that the study villages have 20.79% animals (3.35 lakh out of 17.00 lakh). The largest population of animals is found in villages Abdasa taluka and lowest in villages of Rapar taluka. Among the cattle, Mundra with more than 28,000 cattle (cows and buffalos) and Bhachau (22000 Nos.) are two talukas with highest density of animal population.

Graph : 4 Livestock population in coastal talukas of Kutch district.



	ABDASA	ANJAR	BHACHAU	LAKHPAT	MANDVI	MUNDRA	RAPAR
1.Cow	15486	12369	11177	7213	13602	17472	2802
2.Buffalo	3811	6135	10858	2785	3894	11243	2236
3.Bullock	1895	832	406	884	1501	1741	1114
4.Goat	41186	10751	17141	8913	17632	19096	3267
5.Sheep	32796	11294	25598	6957	11616	5261	8202
6.Camel	70	163	310	1435	245	224	26
7.Poultry	787	575		250	176	148	2

As shown in table-15 below, the coastal villages in Kutch district has the highest animals' population as compare to other coastal districts covered under the present study. However, the numbers of villages having buffalos are less than 50% of the villages covered under the study. Similarly, the population of Bullocks is also less as compare to other coastal districts.

Table- 15 Average number of animals in study village in Kutch and other coastal district

		Amreli	Junagadh	Porbandar	Jamnagar	Rajkot	Kutch
Cow-milch	Nos.	79	179	114	129	37	165
	Village	92	294	60	246	47	252
Cow-non milch	Nos.	56	93	88	57	43	157
	Village	89	284	60	230	46	237
Buffalo	Nos.	143	222	319	185	45	107
	Village	92	294	60	248	47	246
Buffalo-non milch	Nos.	62	89	204	88	37	66
	Village	88	283	60	236	47	229
Bullock	Nos.	194	256	321	242	39	36
	Village	91	293	60	249	46	235
Goat	Nos.	328	175	254	340	115	496
	Village	78	240	52	206	45	238
Sheep	Nos.	487	165	692	478	155	576
	Village	65	145	44	32	42	192
Camel	Nos.	00	4.3	08	27	06	13
	Village	00	65	05	60	16	116
Poultry	Nos.	160	271	48	487	199	44
	Village	11	107	02	32	18	50

(Animal census-2007)

11.3 Fisheries

The fishing is a major activity in Mundra, Mandvi and Abdasa taluka along with small fishermen population in Bhachau and Anjar. The Mundra and Jakhau are two main fishing centers in Kutch. district as well as in the state. Kutch district is one of the important marine fish production center. There are about 5837 person engaged in fishing and fish processing activity. The fishermen from the district go for fishing activity in other centers like Porbandar, Okha and Salaya for fishing. Majority of fishermen gets associated with the traders who own boats. The fishermen work with them on piece rate basis and hence bear risk to venture in deep sea in hard condition. The incidences of fishermen crossing international water boundaries and caught by Pakistan coast guards are increasing due to this.

Dry fish production is a major income generation activities done in villages of Mundra, Abdasa and Mandvi taluka village in Kutch district.

The sheep building activity is carried out in Mandvi town is one of the major fishing allied activity in the coastal Kutch.

12. Irrigation

The Kutch district has total geographical area of 4,565,200 ha, out of which 471,000 ha is cropped area. The district's irrigation facility cover 199200 hectare. The below graph shows that majority of the coastal villages have less than 20 % irrigated area. The irrigated areas in villages

in Mandvi and Mundra taluka have irrigation up to 40%. The Graph-2 shows the irrigation using surface water indicate that the surface irrigation is sporadic in nature and almost absent in large part of the coastal villages.

In coastal villages, major irrigation infrastructure belong to private sector i.e. farmers. The main source of irrigation is ground water wells which are owned mostly by the individual farmers. The recent recharge efforts focused by the state government through various departmental schemes such as SIPC, Sardar Jal Sanchay Yojana and NGO are well received by the farmers which have resulted in construction of Bandhara, check dams and farm ponds.

Table-16 Type of irrigation source and its numbers available in villages in each taluka is given in below

Type	Abdasa	Anjar	Bhachau	Lakhpat	Mundra	Rapar	Total
River	2	5		4	29	15	55
Irrigation Pond	1				17	25	43
Village Pond	14	19	4	11	28	7	83
Farm Pond	19	6		2	227	60	314
Canal				1	14		15
Check Dam	3	20		5	86	22	136
Bandhara	2			2			4
Bore Well	977	66	247	3	1,061	2	2,356
Well	93	262		17	297	57	726

12.1 Use of water saving devices

The Kutch district is one of the most water poor coastal district in the coastal Gujarat, however, looking at the adaptation of the water saving device indicate that the use of water saving devices is negligible considering its geographical area. As per state report, 2003, there were 405 sprinklers and 385 drip irrigation sets in the Kutch district which were forming only 1.83% and 5.99 % of total in the coastal districts. The large land holding may be one of the major reasons for fast adaptation of the water saving device. (Refer table-17 below). The recent initiative for promoting water saving devise by GGRC has improved the situation in the district towards using it. According to the published data of GGRC for 2007, the Kutch district has recorded 1035 ha. land under water saving devices along with additional 1700 ha. to be commissioned soon.

Table- 17 District wise availability of water saving devices

District	Sprinkler set	Drip Set	Sprinkler set	Drip Set
	Nos.	Nos.	% of total in coastal dist.	% of total in coastal dist.
Kutch	405	385	1.83	5.99
Rajkot	5,092	2,600	23.04	40.47
Jamnagar	2,073	1,273	9.38	19.82
Porbandar	2,894	284	13.10	4.42
Junagadh	7,020	1,193	31.76	18.57
Amreli	4,616	689	20.89	10.73
Coastal dist	22,100	6,424	100.00	100.00

Table-18 Application status under GGRC in year 2007

District	Application received		Work order issued		Work completed	
	No.	Hectare	No.	Hectare	No.	Hectare
Bhavnagar	943	1,200	788	940	821	1,042
Junagadh	3,524	4,603	3,255	4,056	3,100	3,752
Jamnagar	727	1,003	652	903	588	846
Amreli	897	1,447	510	675	419	567
Kutch	266	895	256	839	413	1,035
Total	6,357	9,148	5,461	7,413	5,341	7,242

13. Drinking water situation

The ground water is a major source for drinking in entire taluka till arrival of water from Narmda based water supply reached in the district. At present the drinking water supply in the coastal talukas is fulfilled through group, individual and other (RO, Hand pump etc.) based schemes. The new technological solution of RO is established in villages of Abdasa and Mundra taluka by the industrial establishment as a part of their CSR projects.

Out of 563 villages in coastal talukas, 502 villages are covered under various water supply schemes. Almost all villages (502) are covered under 492 group water supply schemes based on the ground water and surface water source. The scattered nature of settlement in Vandh area hamper the access to drinking water for all in the coastal areas of Mundra, Lakhpat and Abdasa taluka, which demand a model of decentralized and local resources, based water supply management. As a part of this option NGOs and WASMO is promoting RRWH and development of local water resources for the benefit of the families living in remote area. Since majority of water supply schemes are based on ground water source, the drinking water supply is facing problem of quality and quantitative supply.

Table -19 Present status of drinking water supply schemes in coastal talukas

Taluka	Total villages	Villages without population	No. of villages covered under			
			Group scheme	Individual scheme	Other (Hand pump + well+ RO)	Total
Lakhpat	100	14	86	0	0	86
Abdasa	166	16	150	0		150
Bhachau	71	2	69	0	0	79
Anjar	67	3	64	0	0	64
Mundra	60	2	58	0	0	58
Mandvi	91	1	57	0	0	57
Gandhidham	8	0	8	0	0	8
Total	**563**	**38**	**492**	**0**	**0**	**502**

The present study has identified that the coastal villages are dependent on more than one source of drinking water. Though piped water is available in 80% villages, the people are still dependent on the local ground water sources for the drinking water. The emerging industrial water demand also result in reduction in water availability in coastal villages having industrial set up.

Table-20 Showing number of villages using various drinking water sources.

Source	Number of villages						
	Abdasa	Anjar	Bhachau	Lakhpat	Mundra	Rapar	Total
Rivers		20	9	10	17	12	68
Pond	41	52	30	7	34	29	193
Open Well	36	47	54	13	72	7	229
Tube Well	26	2	4		135		167
Hand pump	1	25	1		1		28
Pipeline	34	27	27	17	72	7	184
RRWH	23	7	4	15	11	2	62
Tanker	3		1	1	5		10

The state Government under WASMO project has identified 20 villages having no alternative source to cover under reverse osmosis (RO) plants.

Table-21 Village identified for RO plants of Kutch district.

Sr. No	Taluka	Villages Name	No. of villages
1	Abdasa	Chothada, Kanakpur, Naliya, Paraju, Bhahavpur	05
2	Lakhpat	Ektanagar, Dolatpar, Nara,	03
3	Anjar	Tuna, Shinaya, Antarjal	03
4	Mandvi	Nagrecha, Maska, Mokada, Palodiya	04
5	Mundra	Bhadreshwar, Pragpar	02
6	Bhachau	Changamner, Sardarnagar, Dholavera	03
		Total	**20**

14. Village Institutions

The 2001 earthquake has brought a drastic change in development of village institutions which were meant for earthquake rehabilitation program. This process has boosted the village institution base in entire Kutch region. Apart from this recent development the villages in Kutch has history of religious base village institutions. The study area has recorded more than 1,000 village level organisation across the study villages. These institutions are meant for various purposes like natural resource management, festival celebration and voluntary services. The village institutions like irrigation co-operative, watershed development and water committees are formed under government program are the most useful for addressing salinity problem in the region. The table below shows taluka wise numbers of village institutions according to their type.

Table-22 Taluka wise Village Institutions (Numbers and Types)

Organisation type	Abdasa	Anjar	Bhachau	Lakhpat	Mandvi	Mundra	Rapar	Grand Total
SHG	15	24	6	23	24	63	14	169
CBO	5	5	1	1	4	17	1	34
Irrigation Cooperative	8	3	2		2	19		34
Water Committee	55	24	18	37	41	60	10	245
Watershed Groups	2	3	1		11	2	4	23
Voluntary Org.	28	7	15	6	4	30	6	96
Satsang Mandal	12	16	20		11	40	1	100
Yuvak Mandal	24	20	24		33	49	6	156
Caste Mandal	51	12	23	1	53	60		200
Total	**200**	**114**	**110**	**1**	**183**	**340**	**27**	**1,057**

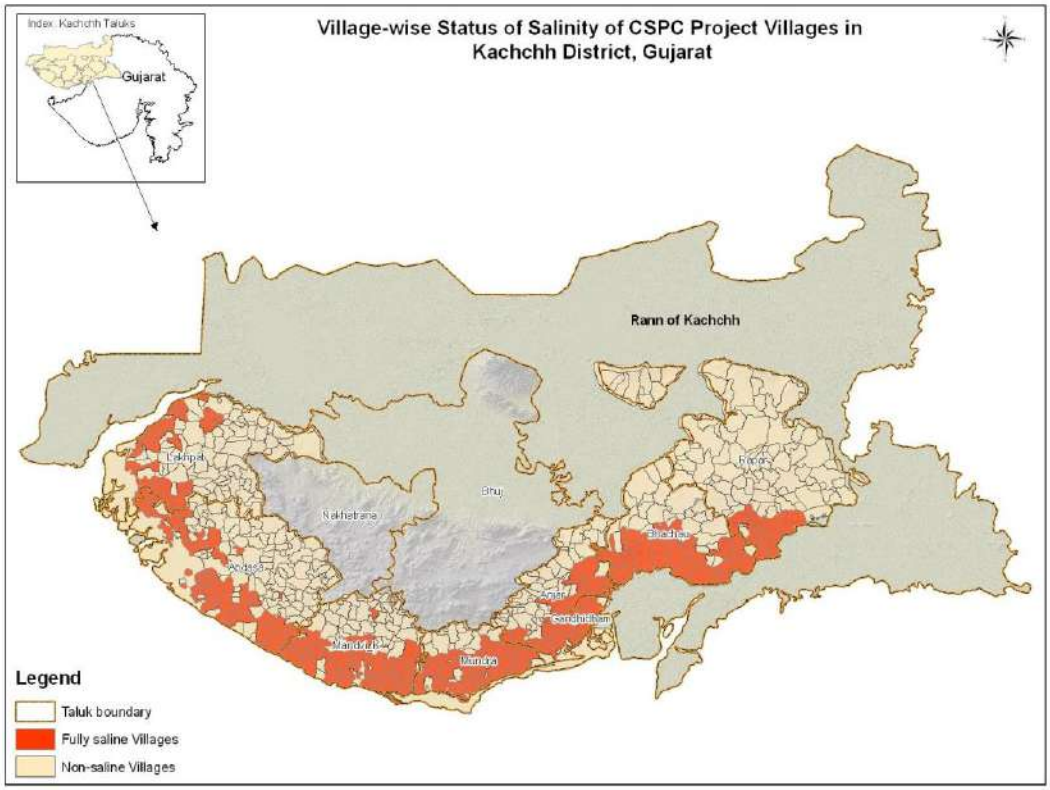
15. Salinity problem

The present study has covered 255 coastal villages 215 villages have problem of salinity ingress. The villagers in remaining 40 villages feel that the salinity problem does not exist in their villages. The maximum Number of villages facing salinity ingress problem are from Abdasa taluka followed by Mandvi taluka. The salinity is found in soil as well as in the water.

Table- 23 Extent of salinity

Taluka	Salinity existence				Total study villages
	Yes		No		
	No. of village	% of total	No. of village	% of total	
Mundra	35	79.5	9	20.5	44
Mandvi	42	89.4	5	10.6	47
Abdasa	47	90.4	5	9.6	52
Rapar	16	100.0	0	0.0	16
Bhachau	15	46.9	17	53.1	32
Gandhidham	26	89.7	3	10.3	29
Lakhapat	34	97.1	1	2.9	35
Total	**215**		**40**		**255**

The map below shows the geographical distribution of the salinity affected villages in Kutch district. The map indicates that the salinity ingress is felt in deeper area in Abdasa and Bhachau taluka.



The survey analysis of 255 villages shows that the villagers from 137 villages feel that their village is facing salinity problem since more than 10 years. The highest numbers of such villages are found in Abdasa followed by Lakhpat and Mundra taluka. The salinity has increase more during last five to ten years in Mandvi taluka. The salinity is most recent phenomenon i.e. showing impact during last five years in villages of Lakhpat and Mandvi taluka. Since the Lakhpat taluka is having inherent salinity, the salinity in Mandvi, Mundra and Bhachau is due to human induced reasons, which is increasing gradually. (refer table-24 below)

Table-24 Number of villages having first experience of salinity.

Taluka	Total village	Period of first experience of salinity			
		Inherent	< 5 yr	5 to 10	> 10 yr.
Abdasa	51	36	6	5	2
Anjar	28	15	11	0	1
Bhachau	30	9	8	0	0
Lakhpat	34	24	11	6	0
Mandvi	53	17	22	16	0
Mundra	43	21	13	4	2
Rapar	16	15	1	0	0
Total	**255**	**137**	**72**	**31**	**5**

16. Impact of salinity

The impact of salinity is felt in soil, water and drinking water. As shown in table-25 below, the villages located at a distance less than 5 Km from the coastline are facing impact of salinity ingress in both soil as well as water. The villages located in this area also reported soil salinity.

But the highest area facing salinity problem is located between 5 to 10 Km from the sea coast amounting to 117,717 ha. In villages located at distance beyond 10Km. from the coastline, the impact is restricted to 81 villages covering an area of 41,220 ha.

Table-25 Impact of salinity on soil and water

Distance from coastline	In Soil	In All
Upto5K.M	4,652.00	7,909.00
1 to10K.M	0.00	117,717.00
Above10K.M	8,990.00	41,220.00
Total	**13,642.00**	**166,846.00**

17. Reasons for salinity ingress

The salinity in coastal Kutch is increasing due to natural as well as human activities. The natural factors such as saline winds and flat topography are major reason. Apart from this the rest of the reasons contributing to the salinity increase are human induced. The major contribution is made by ground water exploitation in areas where the ground water was available for use. In recent years, the salinity impact in the villages already facing salinity has increased due to cutting of prosopis and mangrove forest which were acting as a buffer zone between sea wave/winds and coastal land. The fast developing industries are also contributing towards salinity ingress by means of deforestation, pollution and exploitation of precious ground water. Taluka wise reasons identified for increasing salinity is given in table-26 below.

Table-26 Taluka wise major reasons for increasing salinity

Sr. No.	Taluka	Natural salinity	Saline winds	Ground water exploitation	Reduction in River flow	Mining	Reduction in wind breakers	Mangrove depletion	Industrial pollution
1	Rapar	√	√				√		
2	Bhachau	√	√	√			√		√
3	Anjar		√	√			√		√
4	Mundra		√	√			√	√	√
5	Mandvi		√	√	√	√			
6	Abdasa	√				√		√	√
7	Lakhpat	√				√			

18. Sectoral Impact of salinity

The Kutch district share 360 Km long coastline of total 1600 Km long Gujarat coast. Since last 25-30 years, the salinity in the region is moving ahead at rate of 0.5 Km per year affecting the water based occupation like agriculture, animal husbandry. This is also creating constraints of availability of drinking water as well as creating health problems like skin diseases, stone in Kidney and Florosis among coastal communities.

The survey has identified number of villages facing impact of salinity on various income generation activities as well as on the drinking water supply in each taluka. The analysis showed that in all 216 villages are facing one or more than one problem due to salinity problem. The highest number of villages (147) reported impact on agriculture followed by drinking water and animal husbandry activity. Twelve villages have indicated impact on fisheries.

At taluka level, the highest Number of villages facing problem due to salinity fall in Mandvi taluka followed by Abdasa and Mundra taluka. The least impacted villages are found in Bhachau taluka having only 13 villages reporting any impact of salinity on livelihood activity.

The drinking water condition of the villages in Abdasa, Mandvi, Mundra, Lakhpat and Rapar is worst, where more than 50% villages surveyed have reported that the salinity problem has created drinking water problem. Similar trends are identified for impact of salinity on animal husbandry.

In case of fisheries 12 villages are affected by increasing salinity. Out of which five are in Abdasa and 3 in Mundra taluka.

Table-27 Taluka wise number of villages facing impact of salinity problem on economic activities and drinking water.

Impact on	Abdasa	Anjar	Bhachau	Lakhpat	Mandvi	Mundra	Rapar	Total
No. of affected villages	46	26	13	32	47	36	16	216
Drinking Water	34	5	1	20	25	33	14	132
Agriculture	41	5	1	25	26	34	15	147
Animal Husbandry	32	2	0	15	22	28	12	111
Fisheries	5	0	0	2	2	3	0	12
Cottage Industry	0	0	0	2	0	1	4	7
Industries	0	1	0	2	0	2	1	6

18.1 Social Impact of salinity

The salinity in coastal Kutch district is affecting nearly 3.3 lakh people living in 65,000 household. Majority of families affected belong to Koli, Ahir, Muslims, Rajput belong to OBC category. The major social impact is felt in terms of

- The wage employment from agriculture sector has reduced forcing large number of families to opt for non-agriculture livelihood.
- Reduction in interest in agriculture and animal husbandry due to industrial pressure on natural resources.
- Though migration is a regular phenomenon, the amount of distress migration has become a regular feature particularly from coastal talukas of Abdasa, Rapar and Bhachau.
- Health problem- Kidney stone, Florosis in some villages of Rapar, Abdasa, Lakhpat and Mandvi.
- The growth of industries and reduced income from agriculture is resulting in sales of agriculture land among small and marginal land holders in Mundra taluka.
- There is a reduction in family level income among the marginal families, which is posing pressure on youth for earning. The education is seen as an investment, but the families living in coastal villages do not have capacity to bear the expenditure to educate their children beyond education facility available in the village or in close vicinity.

The study has identified detail impact of salinity on five major sectors influencing the life of the coastal communities living in coastal villages of Kutch district. The analysis was done for three main occupations i.e. agriculture, animal husbandry and fisheries. The two basic amenities of drinking water and health were also covered under the Sectoral analysis. The details are discussed below.

18.2 Impact on agriculture

The salinity ingress has major impact on agriculture sector. The increase in level of salinity in water and soil has resulted in change the cropping pattern drastically. The area under horticulture is reducing gradually, no new plantation of mango and coconut is carried out by the farmers. The farmers having mango orchid are facing major challenge to their plantation since irrigating mango orchid using saline water affect the production in terms of quality as well as quantity.

The cropped area of pulses has reduced in coastal areas. The ground nut one of the major crop is replace by cotton which is known for its salt tolerance capacity.

The increase in salinity has impacted agriculture by

1. Reduction in crop productivity.
2. Increase in input cost and agriculture operation cost.
3. Affect quality of the agriculture produce.
4. Reduce area under horticulture, pulses and ground nut crop.
5. Use of saline water has turned soil saline.
6. Shortage of fodder impact animal husbandry.

In absence of fresh water, farmers growing cotton, castor and wheat use saline water for irrigation which increase salinity in soil as a result the farmers require higher inputs for growing crop during next season.

The salinity is one of the major reasons for change in cropping pattern in the coastal villages. The change in cropping pattern observed through survey findings is given in below table-28. The finding indicates that crop change due to salinity is taking place in 46 villages out of 255 villages covered in Kutch district. These villages are equally spread across all distance categories from the coastline. The food and cash crop change is occurring in 47 and 18 villages respectively. In case of horticulture and forestry no change is recorded. However, field observations indicate that there is interchange in species in horticulture.

Table -28 Changes in cropping recorded in villages covered under study in Kutch

Details	Distance from coastline			
	> 5 Km	5 To10K.M	< 10 Km	Total
No. of villages	17	11	18	46
Area of village	68251	119085	68286	255622
Village Nos.- change food crop	11	12	24	47
Village Nos.- change cash crop	8	6	4	18
Village No.- change horticulture	0	0	0	0
Village No.- change forestry	0	0	0	0

In case of food crops, the farmers have reported shift from pulses, wheat, Bajara and Tal to Jowar, cotton and castor crops. On other hand, the cash crop of ground nut is reducing and replaced by cotton and castor crops. The horticulture plantation of Mango, Kharek and Coconut has reduced drastically in Mandvi, Mundra and Bhachau taluka.

Increase in input cost

The salinity is not only forcing the farmers to change their crops but also posing question of continuing the agriculture activity due to increase in put cost and progressive reduction in productivity. The field observation suggest that majority of the small and marginal land holders in areas having industrial presence have stopped cultivation due to these problems.

Reduction in interest in agriculture

The state policy of promoting industries in coastal Kutch along with salinity problem is killing the interest in farming among all farming community class. The increasing raids of Nilgai due to invasion of prosopis developing on uncultivated agriculture land has also contributed to the difficulties faced by the farmers for doing farming. The farmers particularly in belt of Mundra, Bhachau and Rapar taluka observing huge industrial development coming up in near future have stopped cultivation and are awaiting for selling land to industrial houses.

Reduction in productivity

The salinity has major impacted on productivity of the crops. The comparison of standard production rates and average production rates of the major crops grown in the study villages is given in table-29 below.

Table-29 Productivity comparison between standards and in coastal villages

Crop	Unit	Standard-production	Production in coastal Kutch
Groundnut-Veldi	Kg/ha	1800-2200	2750
Wheat	Kg/ha	4000-5000	2400-5000
Cotton	Kg/ha	2500-4000	2400-3700
Castor	Kg/ha	2500-4000	1500-2100
Bajari	Kg/ha	2000-2500	300-1700
Jowar	Kg/ha	1500-2000	600-700
Til	Kg/ha	400-800	675
Jiru	Kg/ha	700-800	
Guwar	Kg/ha	1500-2000	1200-1700
Moong	Kg/ha	850-1400	400-900
Kharek	Kg/ha		8000-10000
Coconut	No./ha	10000-12000	4500
Mango	No./ha	8000-10000	400-1000
Chickoo	Kg/ha	12000-15000	7000-10000

The table-29 indicates that except ground nut and cotton all other crops have productivity lower than the standards. In many villages the productivity of the crops has gone down below lower production standards for e.g. Jowar. The major impact is felt on horticulture plants where the productivity rates of crops are not able to achieve the minimum of the standard productivity rates.

18.3. Impact on animal Husbandry

Over a period of last two decades, the animal husbandry has reduced in the coastal villages. The most dependent indicator is reduction in number of *Maldhari* families and number of animals kept by them. The reduction in guachar land and mangroves which were main sources of fodder for Maldharis has reduced the viability of livestock rearing in coastal Kutch.

As mentioned earlier, the objective of livestock rearing in Kutch is mainly for selling the animals and hence the most productive animals are not found in Kutch area. The major population of cattle are those which do not have market value. Due to this practice the animal owner engaged in animal rearing for sells have reduced No. of animals.

Among the farmers who are rearing animals for milk production have not able to generate adequate fodder to feed animals. The milch animal per family has reduced from 10-12 animals 20 year back to 2-3 animals. The milk production capacity of the animals reduces due to reduction in availability of green fodder from the agriculture. The animal health is a major concern that animal rearer face due to saline climate. The saline fodder and water weaken the digestive system of milch animals. The farmers told that animal yielding 15-20 liter milk in north Gujarat produce less than 10 liter milk per day in coastal villages. In many cases animals brought from out side die within three to five years in coastal area. The table-30 shows season wise change in milk production.

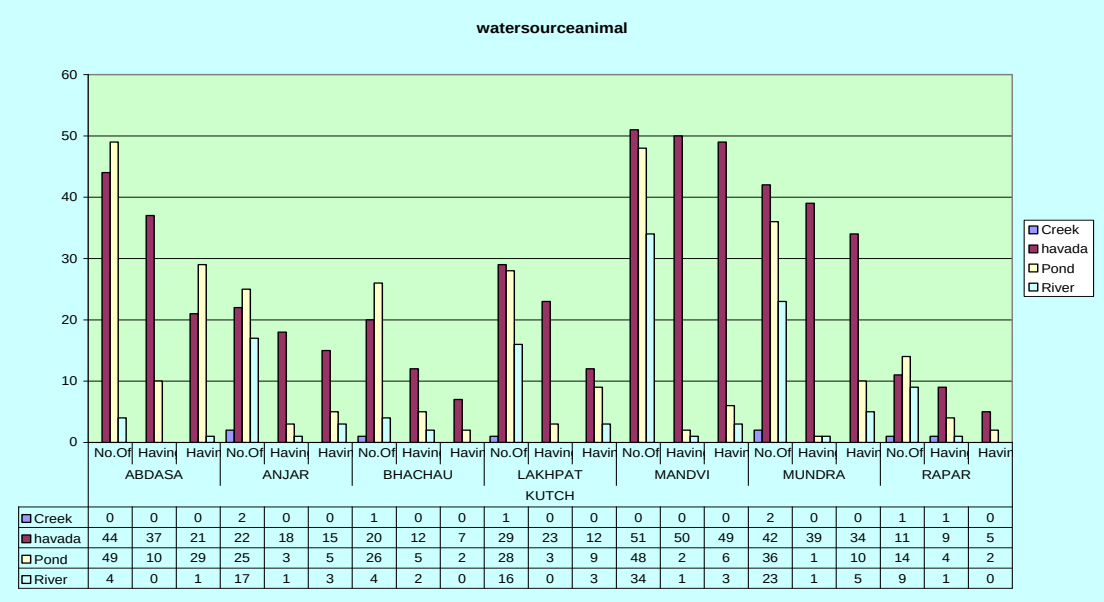
Table-30 Milk production in study villages

Block	Daily milk production in liter			% change in milk production		
	Winter	Summer	Monsoon	Winter	Summer	Monsoon
Abdasa	17,777	12,720	21,911	81.10	58.10	100
Anjar	30,185	26,880	34,596	87.20	77.70	100
Bhachau	53,279	49,118	53,834	99.00	91.20	100
Lakhpat	7,996	5,804	10,953	73.00	53.00	100
Mandvi	43,280	33,513	50,670	85.40	66.10	100
Mundra	50,501	43,276	81,636	61.90	53.00	100
Rapar	6,995	3,280	11,095	63.00	29.60	100
Total	**210,013**	**174,591**	**264,695**	**79.30**	**66.00**	**100**

Non-availability of water for cattle

The major availability of quality drinking water is one of the main impact of salinity on the livestock rearing. Though all villages have infrastructure like havada for provides water to the animals, the availability of water is a major constraint faced by the livestock rearers. In such situation the animals are fed using various sources like ponds, creeks and rivers. Since water in these sources is available during limited period, the water for animal remains a major problem in coastal villages. The graph below shows taluka wise no. of villages using different sources for cattle water needs and its seasonality.

Graph : 5 Showing taluka wise number of villages using various water source for animal water needs



	ABDASA			ANJAR			BHACHAU			LAKHPAT			MANDVI			MUNDRA			RAPAR		
Creek	0	0	0	2	0	0	1	0	0	1	0	0	0	0	0	2	0	0	1	1	0
havada	44	37	21	22	18	15	20	12	7	29	23	12	51	50	49	42	39	34	11	9	5
Pond	49	10	29	25	3	5	26	5	2	28	3	9	48	2	6	36	1	10	14	4	2
River	4	0	1	17	1	3	4	2	0	16	0	3	34	1	3	23	1	5	9	1	0

The graph-5 shows that the majority of villages in coastal region have facility of Havada to fulfill the water needs of the animals. Out of 321 Havadas available in the area 143 havadas are providing water round the years. It is observed that apart from Havadas ponds are also used as a major source for feeding animals. However, majority of ponds do not able to provide water round the year. Creek is used for feeding animals in villages of Mandvi, Anjar, Lakhpat and Mundra.

18.4 Impact on Fisheries

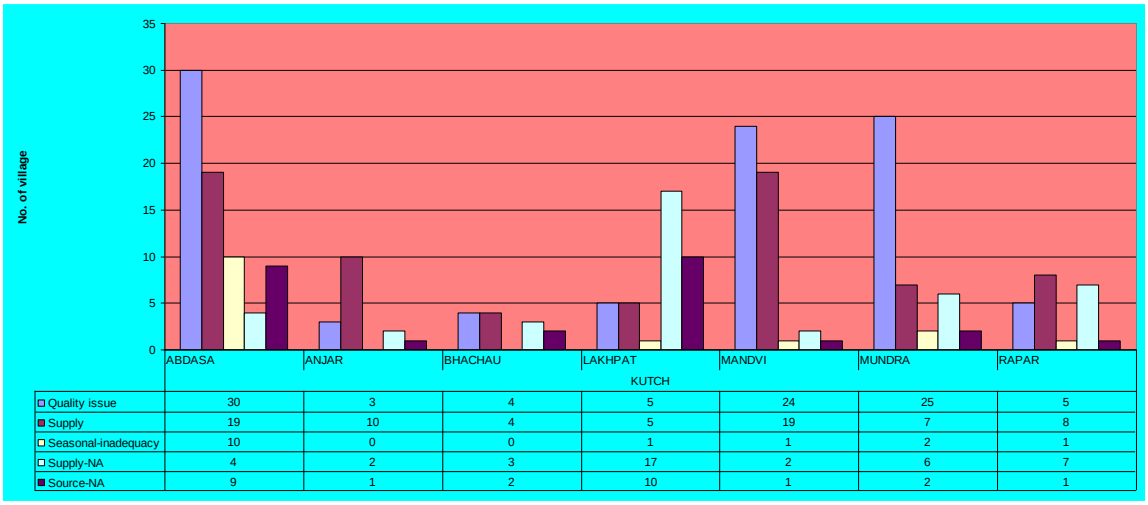
Around 5600 families involved in fishing live in villages around Jakhau, Mundra, Mandvi, Gandhidham, Lakhpat town. Most of the families illiterate Muslims families traditionally engaged in "Pagadia" fishing. The fishing activity is indirectly affected by industrial development which has resulted in cutting of mangrove forest, increase in shipping activity on the ports. The resultant affect is increase in salinity in the region. The change in natural condition on the coastal area has reduced the fish catch by the "Pagadia" fishermen. The extent of the impact of industrial invasion is so strong in areas of Mundra port that it has threaten livelihood of nearly 3200 fishermen families.

The indirect impact of salinity is reflected in constraint of drinking water at the Bandar site around Bhadreshwar, Tuna, Jakhao Bandar where more than 3000 families stay during fishing season.

18.5 Impact of Drinking water

The drinking water availability is a chronic problem for the entire coastal area in the Kutch and is being address by state as well as by NGOs working in Kutch. The major efforts are made by the state government for providing pipe water supply based on Narmada and other surface water sources. The NGOs are promoting people centric management solutions for the drinking water purpose. Though these efforts have changed the drudgery for accessing drinking water, the issues of equity, adequacy and quality of drinking have remained unsolved in many villages. The graph below shows that drinking water quality and supply are two major issues in the coastal area in Kutch. Many villages are getting adequate supply is facing seasonal in adequacy of the water supply particularly during month of March to May. Among the talukas covered in the study Lakhpat taluka has recoded highest number those villages which are covered under piped supply but are not receiving supply. There are villages which do not have any suitable local source for drinking water.

Graph : 6 Taluka wise number of villages facing water problems.



	ABDASA	ANJAR	BHACHAU	LAKHPAT	MANDVI	MUNDRA	RAPAR
Quality issue	30	3	4	5	24	25	5
Supply	19	10	4	5	19	7	8
Seasonal-inadequacy	10	0	0	1	1	2	1
Supply-NA	4	2	3	17	2	6	7
Source-NA	9	1	2	10	1	2	1

The survey analysis shows that out of 255 villages 151 villages are facing one or another problem related to drinking water. The problematic villages are more in Mandvi, Bhachau and Mundra taluka. Refer table-31.

Table-31 No. of villages facing water problem

Block	Not applicable	Yes	No	Can't say	Total
Abdasa	5	18	25	3	51
Anjar	4	15	4	5	28
Bhachau	3	25	2		30
Lakhpat	1	17	14	2	34
Mandavi	2	39	8	4	53
Mundra	2	29	5	7	43
Rapar		8	2	6	16
Total	17	151	60	27	**255**

The survey analysis indicates that out of 255 villages covered 64 villages are facing problem of drinking water adequacy. Nearly 1/3rd of the total villages are found in Abdasa taluka.

Table- 32 Adequacy of water supply

Count	Abdasa	Anjar	Bhachau	Lakhpat	Mandavi	Mundra	Rapar	Total
Yes	22	18	26	19	40	33	10	168
No	26	7	4	11	8	5	3	64
Can't say	3	3		3	5	5	3	16

As mentioned almost all villages are getting drinking water supply from the pipeline. In absence of supply from the pipeline the villagers have to manage water from distance varying from 2 to 10 Km. Nearly 20 villages has no potable source within 10 Km. from the village. Other 44 villages have source within distance of 5 to 10 Km. The villages in Mundra taluka are facing the most difficult time in situation of lack of drinking water supply through pipeline. (refer table-33)

Table-33 Nearest source of drinking water

Distance	Abdasa	Anjar	Bhachau	Lakhpat	Mandvi	Mundra	Rapar	Total
less than equal to 2 Km	43	19	18	26	26	20	8	160
2 to 5 Km	4	2	1	2	16	6		31
5 to 10 Km	4	5	6	3	8	10	8	44
More than 10 Km		2	5	3	3	7		20
Total	51	28	30	34	53	43	16	255

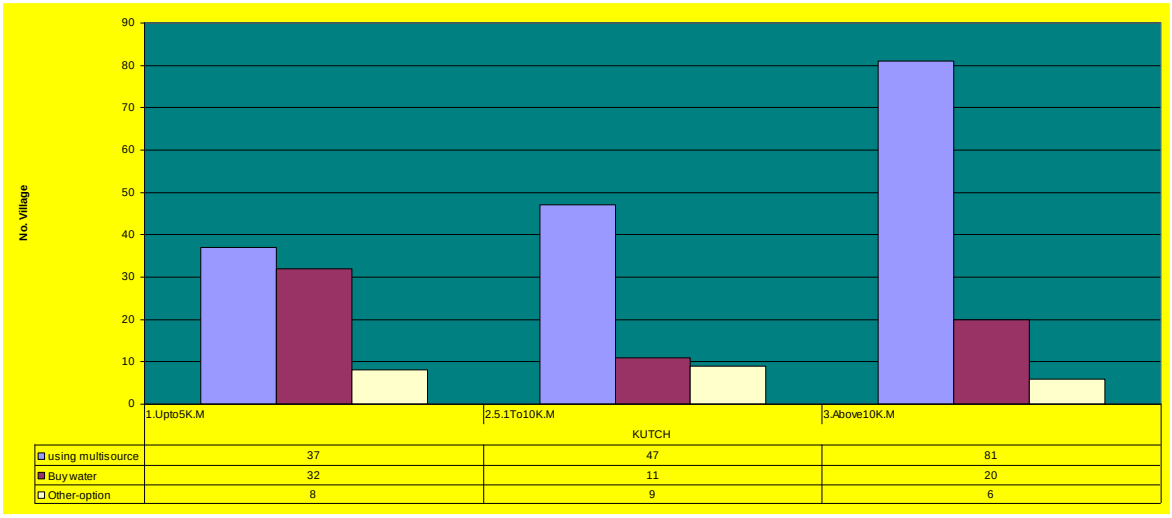
The salinity has affected the local drinking water resources. The survey has indicated that 133 villages do not have local drinking water sources as alternative sources. Highest number of villages is found in Mandvi and Bhachau taluka.

Table – 34 Number of villages having adequate drinking water sources

Block	Yes	No	Total
Abdasa	35	15	51
Anjar	14	13	28
Bhachau	4	25	30
Lakhpat	16	14	34
Mandavi	11	38	53
Mundra	15	23	43
Rapar	3	5	16
Grand Total	**98**	**133**	**255**

In situation of in adequate water supply the villages are managing the drinking water by using more than one source and buying water. The analysis of the survey based on distance from the coast line indicates that the problem of inadequacy exists across all distances. There are 183 villages which are dependent on more than one source for drinking water, while 63 villages are buying water. The option of buying water is found more in villages located at a distance of less than 5 Km. (refer-graph below)

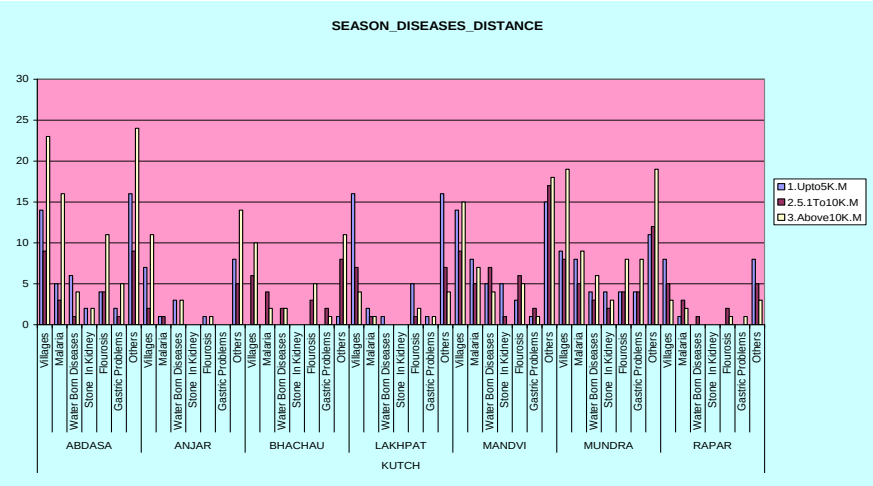
Graph : 7 Drinking water status in villages located at various distance from the coastline.



18.6 Impact on Health

The coastal communities suffer from various health problems as a result of poor quality of drinking water and use of saline water. The diseases like stone in kidney, Flurosis, skin and gastric diseases are common in coastal villages. These diseases are found across all the villages covered under the study. Among them water born diseases, Florosis and gastric problems dominates across all villages. The village survey analysis shows that problem of health in villages of Mandvi, Mundra and Rapar is more severe. The survey has identified 33 villages where the communities are facing health problem due to stone in Kidney. Majority of them are in Mandvi and Mundra taluka. There are 82 villages which are having problem of Florosis. This includes 40 villages from Mandvi taluka. The graph 8 below shows Taluka wise number of villages facing health problem and its types.

Graph : 8 Distance wise variation in seasonal diseases



18.7 Impact on economy of the region

The impact of salinity can be gauged through the banking sector business in the study area. the survey analysis shows that there are more than 2000 bank defaulters in the study area. only 3600 families are in position to get access to bank loan for income generation activity which is less than 5% of the total families in the coastal area. The salinity problem along with industrial development is making farming non viable options. The farmers having saline land given an opportunity are finding selling lands a better option than continuing farming. The survey has recoded that 2281 farmers have sold their land in last three years.

The salinity is also resulting in migration of the families. However, in case of Kutch having history of migration both seasonal as well as permanent, it is very difficult to assign migration as salinity impact. The survey has identified 2,886 families doing seasonal migration. The table-35 below shows the present status of banking, land selling and migration in the study villages.

Table : 35 Present status of banking, land selling and migration in the study villages

Description	Abdasa	Anjar	Bhachau	Lakhpat	Mandvi	Mundra	Rapar	Grand Total
Bank creditor	342	137	42	25	434	749	766	2,495
Bank defaulters	459	110	31	14	380	785	275	2,054
Bank-Depositor	505	118	35	10	629	2,281	41	3,619
Agri. Loan	1,177	110	115	16	571	525	301	2,815
Animal Loan	115	108	80	5	92	272	101	773
Fisheries Loan	2		2		2	120	4	130
Seasonal Migration	352	206	21	69	179	1,001	1,058	2,886
Land Selling Farmers	762	112	63	34	176	855	279	2,281

19. Major initiatives

The salinity problem in coastal area in Kutch is perennial problem, however its intensity has increased during last 10 years and hence the communities, NGOs, state department and corporate are focusing the issue of salinity and trying to solve the problem. Some of the important initiatives taken up to address salinity are described below.

19.1 By Government department

The state government recognized the salinity problem and initiated the Salinity Ingress Prevention Cell within irrigation department to prevent salinity in the region based on recommendations given by the high level committee (HLC-I). The cell activity focus on

1. Management which includes addressing change in cropping and agriculture practices.
2. Change in ground water use practices
3. Recharge techniques
4. Salinity control techniques
5. Coastal land reclamation techniques.

Out of five identified activities, the cell is mainly promoting Recharge and salinity control techniques in Junagadh district. The cell has constructed Tidal regulators.

The details of work done by SIPC in Kutch region is given in table-36 below.

Table : 36 Status of work done by Salinity Ingress Prevention Cell (SIPC) in Kutch district.

Type of work	Location	Nos.	Area covered-ha	Expenditure (in Lakh)
Check dams		110	3,196	662.00
Reclamation bund	Lakdavandh	1	1,732	375.91
Bandhara	Sanghad, Belavandh	2	686	557.00
Tidel regulator	Mandvi	1	48	260.38
Total			**5,662**	**1,855.29**

(Source : SIPC, Kutch circle)

- By irrigation department (SIPC)-preventive structures
- By WASMO-drinking water pipeline & local resource enhancement
- Watershed projects in all talukas by DRDA.
- The forest department is promoting plantation of medicinal plants.
- Promotion of Water saving device by GGRC
- Subsidies procurement schemes for fishermen.
- NDDB is promoting milk marketing services.

19.2 By Non-Government department

- Awareness about industrial impact on natural resources.
- Vivekanand Research and Training Institute, Mandvi is implementing Kharash Vistarotthan Yojana in 47 salinity affected villages. The KVY project. The major initiative of water harvesting micro planning and promotion of drip irrigation was taken up by VRTI with emphasis on creating structures for storing Narmada water if it is received in near future.
- The crop change program is another ambitious intervention done by VRTI in Mandvi taluka. Under this program pilot testing of the crops which can be grown in saline conditions is taken up. Under this program sugarbit plantation done by VRTI shown good results. Similarly, VRTI is also promoting the organic cotton cultivation technology in the coastal Kutch.
- Drinking water source enhancement through planning decentralized people oriented water management model. The Arid Communities Technology (ACT) is doing advocacy for such model through developing a taluka level perspective plan for drinking water.
- The Sanghi cement company is providing drinking water to the villages in surrounding in Abdasa taluka.
- Many corporate houses like Ashapura and Suzalon have adopted villages in vicinity of their project site for integrated infrastructure development.
- An innovative practice for livelihood of fishing community in Mundra is taken up with advocacy on their rights on natural resources by Ujjas Mahila Manch.
- Promotion of Saurashtra Kutch Dairy project in Kutch.
- Demonstrations of people oriented technologies
- Promotion of organic farming & drip systems.
- Water harvesting, promotion of alternative cropping

- Agro cell a division of excel industries is helping the farmers in organic cotton production, certification and marketing . Also providing support for crop and pest management
- The Kutch has unique set up of *Panjara pole* meant for providing support for animals during drought years. These *Panjara Poles* are supported by the Jain Mahajans settled in various part of globe.

19.3 By individual (farmers)

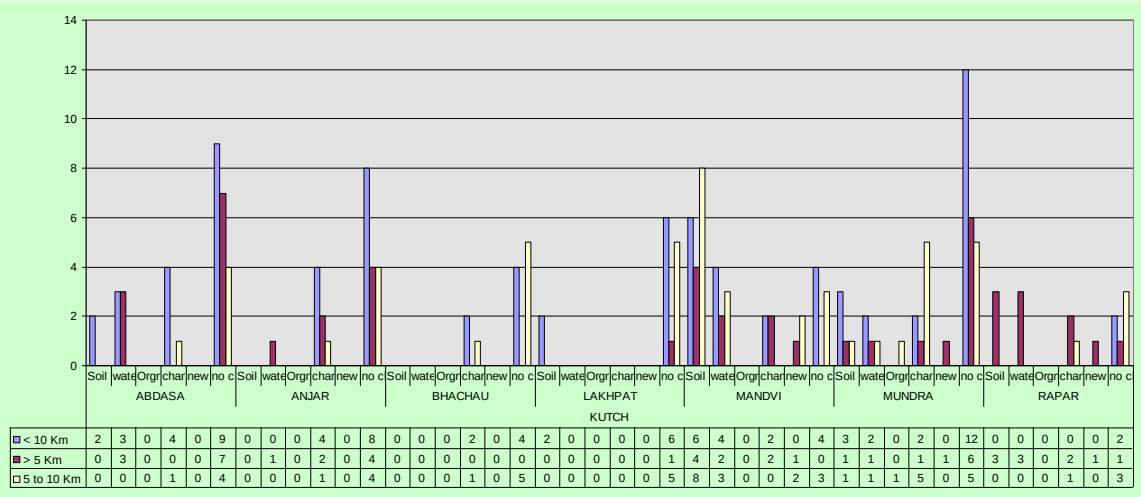
- Adoption of less water intensive cropping
- Rain water harvesting-well recharge, RRWH
- Farm Bunds
- Use of gypsum
- Use of drip irrigation
- Use of magnetic technology called "Sada Hara" to reduce impact of saline irrigation water on soil in village Jarapara, in Mundra taluka.
- Promoting organic farming in food grain and cash crops.
- The farmers living in the salinity affected regions are changing the crops which are impacted by the salinity. As shown in table below, the farmers are adopting new crops in place of the crops like wheat, pulses, ground nut and til. The farmers have slowly switched to salinity tolerant crops like cotton, castor, Jowar. In horticulture crop the farmers are growing Dadam and Chickoo. Many farmers are switching to medicinal plantation e.g. aloevera and Mindhiaval plantation in Mandvi and Rapar respectively.

Table- 37 Crop affected by salinity and farmers choice for farming under saline condition

Crop type	Present major crops	Impacted by salinity	New crops adopted	Popular crops
Food	Wheat, Bajara	Wheat	Jowar	Jowar
Cash	Pulses, Cotton, Jeru, Raydo, Guvar	Pulses, Cummins	Cotton, Raydo	Cotton
Oil seeds	G.nut, Til, Castor	G.nut, Til	Castor, sunflower	Castor
Horticulture	Mango, Kharek, Chickoo, Dadam,	Mango	Dadam, Chickoo, Cashew nut	Dadam, Kharek
Vegetable	All types	All types	Sugarbit	

The farmers from the affected villages are also taking proactive initiative for conserving the land and water resources as well as making use of new techniques. Such activities are found in surveyed villages of Mandvi and Mundra taluka. The farmers in villages of remaining talukas lack in awareness as well as access to information about the solutions for solving salinity problem. The farmers are trying out soil and water management, change of crop and change of seeds as major intervention to reduce impact of salinity on agriculture.

Graph- 9 Solution adopted for reducing impact of salinity on - agriculture



Solutions tried by livestock rearers

Since the Kutch district is having largest animal population among the coastal districts, It is important to know the efforts made by the livestock reaers to reduce the impact of salinity. Among the possible options, the animal rearers in the salinity affected villages are opting for change in animal breed and fodder management. However, the survey analysis shows that the livestock reaers in Bhachau and Rapar have not adopting any change in the animal husbandry practices to reduce impact of salinity.

20. Opportunities and Scope for Future work

The coastal Kutch region is at the cross road of its development. During last five years the area has started receiving huge industrial investment. This has brought opportunities as well as threats to the livelihood of the local communities. The proposed industrial development may change the future scenario of traditional income generation activities in the region.In such situation the livelihood activities such as agriculture and animals husbandry are loosing ground. At the same time, for the small and marginal families facing impact of salinity as well as industrial invasion are facing major challenges for sustaining or finding alternatives. In this situation, there is a fear that salinity issue may not be relevant except for drinking water availability. However, many initiatives are providing opportunities for addressing salinity impact on people and their livelihoods. The following opportunities which are identified are discussed.

20.1.Saurashtra-Kutch Dairy project (SKDP)

The co-operative model promoted by national dairy development board (NDDB) failed in Saurashtra & Kutch mainly due to cultural ethos where people are more tune to individual enterprises rather than co-operative business. In 2005, NDDB launched campaign to revive the dairy activity in Saurashtra and Kutch through establishment of Milk Producers Institutions (MPIs) under producer companies law at village level. The support system provide services for Breeding, feeding & animal health and management through representative chosen by MPI members.

Since its inception on November, 2005, the project has developed 832 MPIs having 55600 milk producers covering 832 villages in six coastal districts of Saurashtra and Kutch. The project is planning to reach 1432 villages by March, 2008. The project has brought remarkable change in coastal villages of Junagadh and Porbandar district. The SKDP has initiated its activities in Kutch district since 2007. The project is planning to expand its presence from 27 villages to 150 villages in coming year. This can be a platform to address the salinity issue linked with animal rearing.

The dairy has plan to focus on productivity initiatives during 2008-09 through

- ✓ Supply of Cattle feed & mineral mixture MPIs on request
- ✓ NDDB has a tie up with BAIF for initiating breeding activities
- ✓ Development of cattle feed Plant in Rajkot to ensure regular supply of cattle feed
- ✓ Ration balancing programme is being initiated in Junagadh district

20.2 Fodder Bank

The reducing fodder security in coastal areas is being addressed by NGOs working with dairy project in Mundra. Ujas Mahila Manch working in Mundra, Vivekanand Research and Training Institute (VRTI), Mandvi have taken up work for promotion of fodder banks in coastal areas. Looking at the expansion of the dairy net work, this initiative can help in building institutions for dairy development. There is large scope of development of fodder banks in Kutch.

20. 3. Promotion of medicinal plants

The arid areas like Kutch have potential for development of medicinal plants. The horticulture development center of forest department at Bhachau is instrumental in promotion of medicinal plantation like alovera, Mindhivad in Kutch region. Though it does not directly address salinity. The promotion of medicinal plantation has provided alternatives for the farmer who cannot cultivate field crops.

20. 4. Use of Ajola culture

Ajola is a fast growing and salt tolerant plant species. If the Ajola seeds are spread over the stagnant water, the biogenic process can increase the Ph level of water. When the land get dried this will add lakhs of tonns of organic matter to the soil, which will help in improving the physical characteristics of the soil over a period. Such treatment can be useful for villages in Rapar and Lakhpat taluka.

20. 5. Solar Ponds

The soils in Ghed and area close to Gulf of Kutch in Jodiya, Maliya and Okhamandal taluka have inherent salt in the soil. When the stagnant water dries up, the salt leach and settle as a layer each year since low permeability do not allow the dissolved salts to percolate down. Hence the amount of salt in this land remains constant. These areas are also characterized by large amount of saline wasteland which can be used for creating *solar ponds*. By constructing *solar ponds* the salt accumulated in the land will get washed during monsoon and get collected in the ponds. Over a period, the salt from the catchment area will get accumulated in the center of the pond and the remaining land will slowly become suitable for farming. A cropping pattern as shown in table can be planned.

Table :39 Proposed cropping pattern in area reclaimed under solar pond

Location	Crop type
Center of pond	Shrubs like selicornia
1st ring (close to center of solar pond)	Cotton, Rajko, Castor
Second Ring	Food crops-
Third ring (Away from the center of solar pond)	Pulses

20.6 Tapping philanthropist and CSR project

The coastal area has many philanthropist who are living out the native villages but have concern about development of their native villages. These types of people are available in Kutch. There is need to make efforts to sensitize them with the salinity issues.

The large industrial development taking place is a big resource for the people in the region. The industrial development shows impact on infrastructure development in the areas. According to Government guideline the corporate have to conduct CSR activities. Majority of corporate have funds allocation for CSR activities which is used for creation of infrastructures like vehicles or construction for school and collages. This CSR fund provides opportunities to address salinity issues in the project area.

20. 7. Provision of Drinking water

The drinking water is the priority demand of coastal communities. The existing government schemes of WASMO and reduction in cost of reverse osmosis plants can be big opportunities for development of decentralized drinking water system. The corporate giants can be involved in management of RO plants as they would also require drinking water. The sanghi cement company in Abdasa has shown good example of CSR through drinking water provision using RO plant. The survey has identified 225 villages with pani samitis which are at different level of awareness about its role in water management. These pani samiti awareness building can prove useful in addressing drinking water problem in coastal Kutch.

In villages of Abdasa, Lakhpat and Bhachau many families prefer to live in hamlets located away from the main village. Majority of such population is found in Abdasa and Lakhpat taluka of Kutch, where people live in "Wandh" located in outskirts. These families do not benefit the improvement in village drinking water resources. This population can be covered by RRWH. In villages of Abdasa and Lakhpat area, the sandy topography can be utilized for development of Nadi and Tanka with agor which have been a used for drinking purpose in desert areas of western Rajasthan since ages.

20.8. Promotion of animal husbandry

The promotion of animal husbandry can help in reversing the impact of salinity on agriculture- the most impacted livelihood activity in coastal region. The observation shows that coastal area has adequate potential for resurgent of livestock rearing activity in the coastal areas. As compare to agriculture, addressing promotion of livestock rearing would require lesser efforts. The two major requirements are facility for

- ✓ Fulfilling Drinking water needs of animals
- ✓ Development of fodder through agriculture and wasteland

Both of these requirements can be fulfilled through decentralized development model. The resources required for these activities are available in the form of local ponds and wasteland.

Fortunately, the areas with higher animal population have food crops as a main crop, which can generate fodder from agriculture.

The large number of families in Kutch are engaged traditionally in small animal rearing provides an opportunity for strengthening livelihood through promotion of gottary and sheep rearing. It is observed that the small animals have higher resistance power to drought as well as salinity, which can be utilized for ensuring livelihood income. The development of gottary can also facilitate promotion of salt resistant plantation like Neem, Amla which can help farmers adopt it. The Kutch region having large number of Neem trees and growth of *prosopis* is ideal for promotion of gottary.

A model of management of wasteland with combination of *Prosopis Juliflora*, Neem and other fodder providing tress has huge potential for promotion of livestock rearing.

20.9. Working with Panjara poles

The Kutch area having largest animal population has more than 500 panjara-pole run by Jain social groups. During droughts, these Panjara poles feed animals and help people save their animals. Many panjara poles have large amount of land which can be used for fodder production. These panjara poles can be a platform for addressing animal welfare/development program.

The establishment of Saurashtra Kutch dairy project can be a great success if it has appropriate infrastructure like fodder plots and drinking water arrangement for animals. The dairy expertise can be useful in animal husbandry development.

20.10. Involvement of APMC and Private player

The agriculture in salinity affected areas demand promotion of technologies which can enable the farmers to maintain their income. Each coastal taluka has Agro Product Market Committee (APMC), which is a strong link between the farming community and markets. The APMC network and infrastructure is also well spread in coastal areas. The region has APMC in all talukas. A model to work with APMC will not only help in solving market related problem but also provide a specialized platform to cater the needs of the farming community. Working with APMC can be helpful in promotion of technologies on a broad scale.

20.11. Activities for Physical intervention

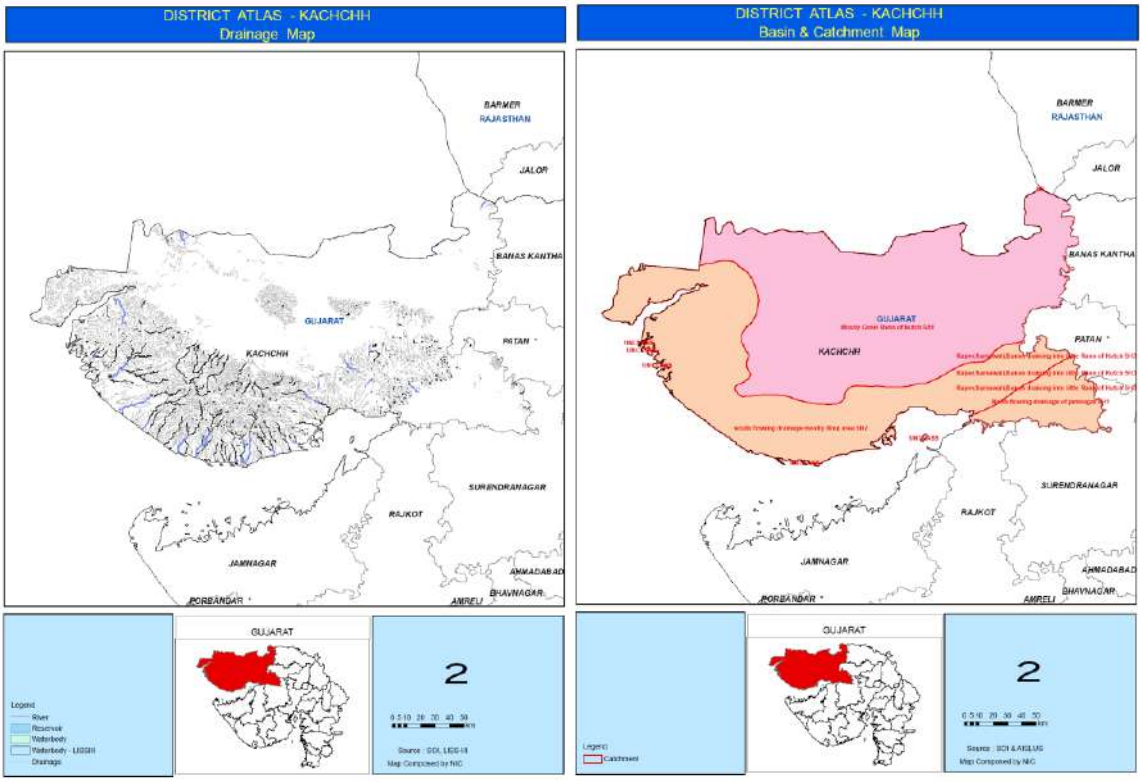
During taluka workshops people have expressed need for various physical interventions for curtailing the salinity in their talukas. The proposed physical treatment identified by the people for respective taluka is given in table below.

Table-40 Physical treatment proposed by the people in taluka workshop

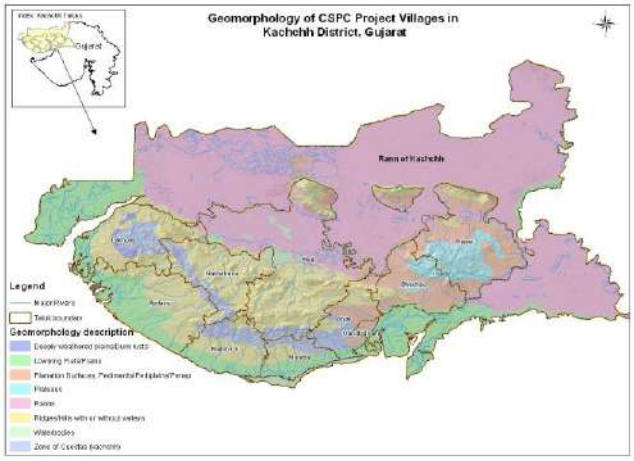
Sr. No.	Taluka	Mine recharge	Wind breakers	River linking	Watershed development	Field Bunds	Mangrove Plantation	Farm ponds
1	Rapar							√
2	Bhachau			√	√			
3	Anjar			√				
4	Mundra			√	√		√	
5	Mandvi		√	√	√		√	
6	Abdasa	√	√	√	√		√	√
7	Lakhpat	√	√	√	√		√	√

Maps

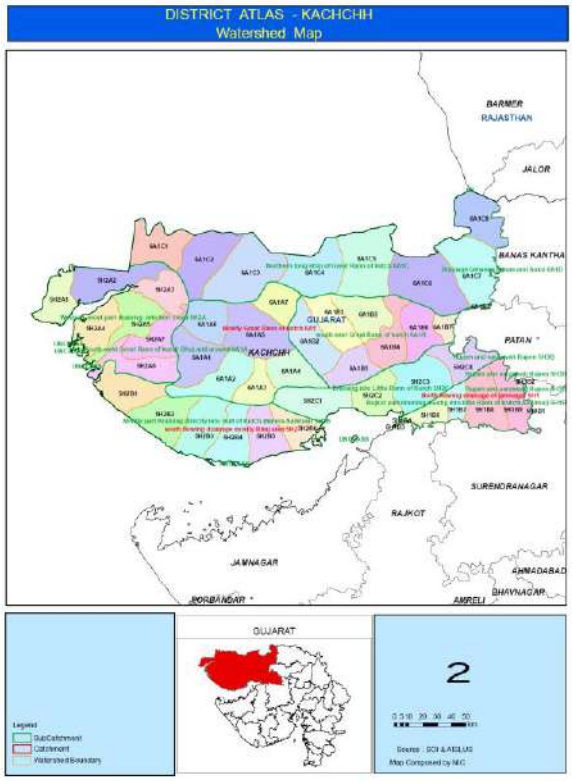
Map – 1 & 2 Maps showing basin & catchment and drainage of Kutch District



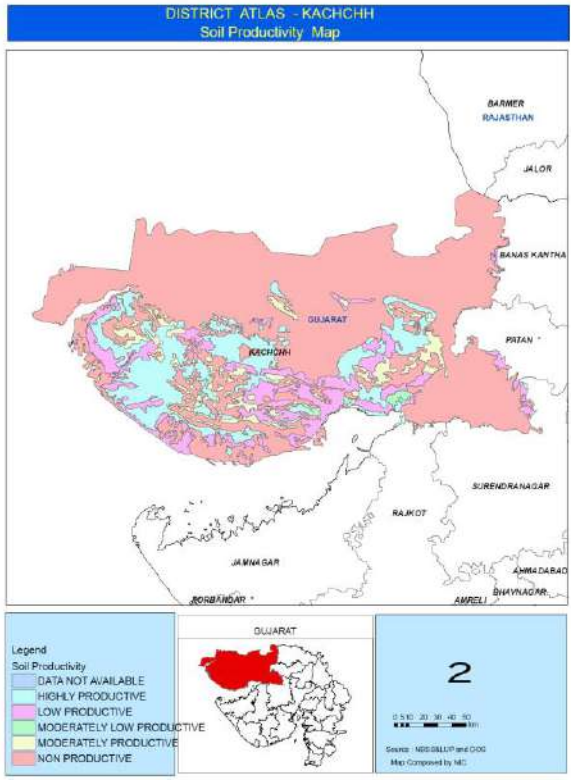
Map-3 showing Geomorphology of Kutch district



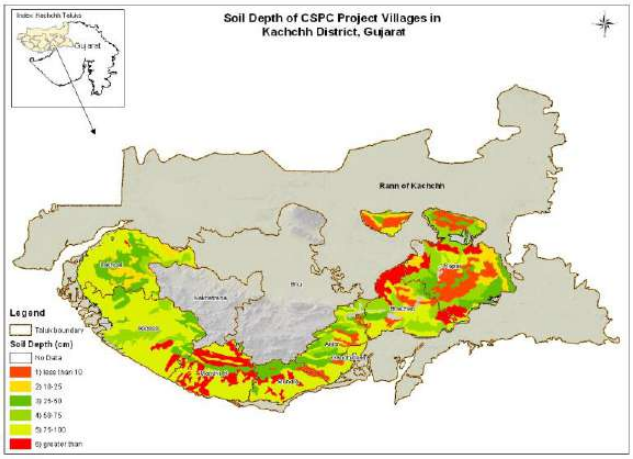
Map-4 Watershed map of Kutch district.



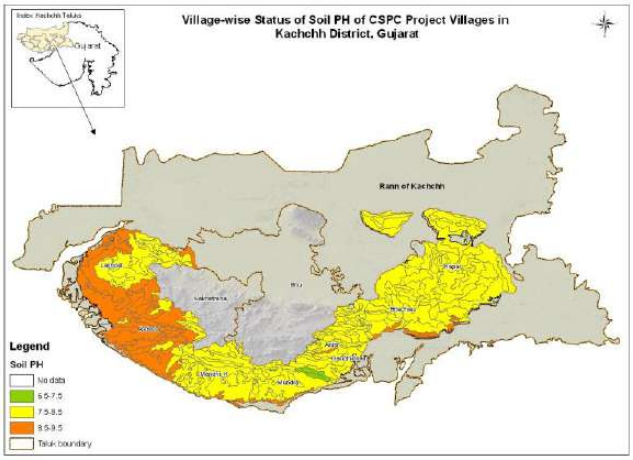
Maps – 5 Map showing soil productivity in Kutch District



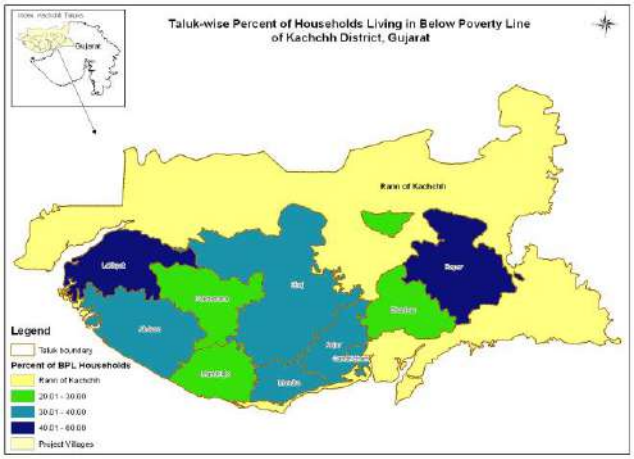
Map – 6 Map showing soil depth of CSPC Project Villages in Kutch district



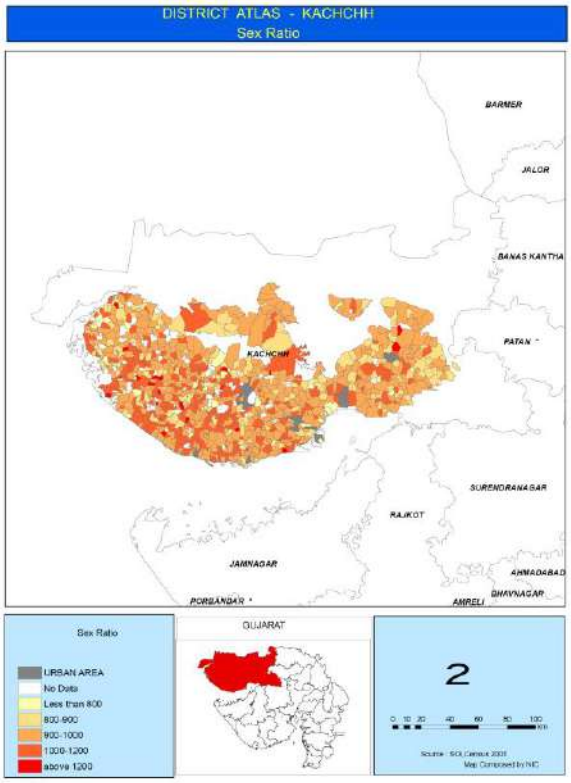
Map – 7 Map showing status of soil PH of CSPC Project villages in Kutch district



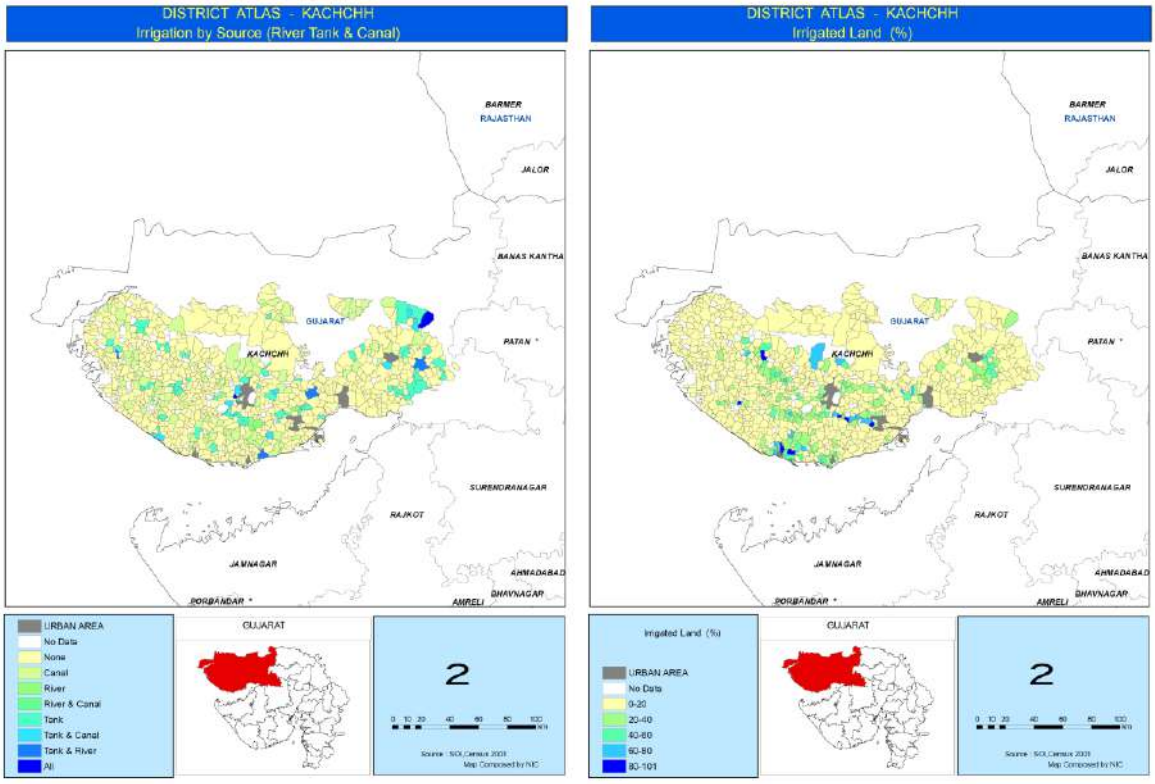
Map – 8 Map showing taluka-wise percent of Households living in below poverty line of Kutch district



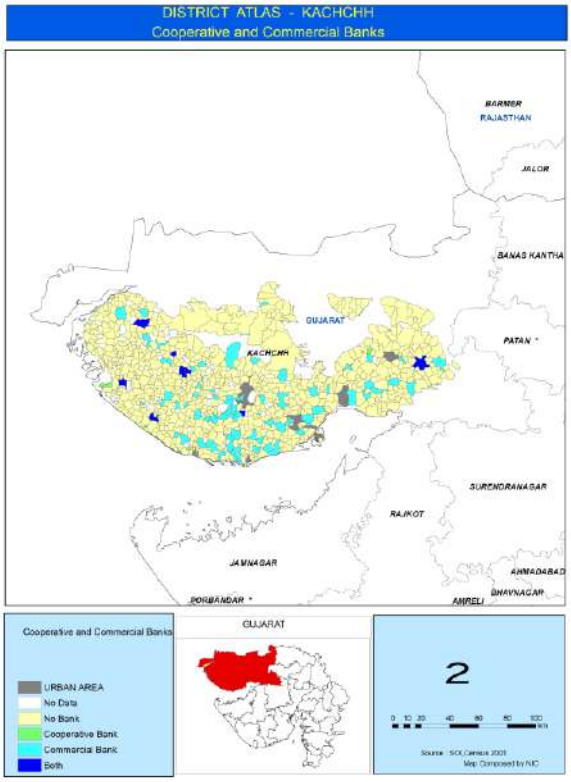
Map – 9 Map showing villagewise sex ratio in Kutch District



Map–10 & 11 Maps showing village wise source of irrigation and irrigated land of Kutch District



Map–12 Maps showing village wise Co-operatives and Commercial banks Kutch District



Map–13 Maps showing village wise Credit Societies in Kutch District